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Report of the 2018 NSSME+

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Additional Information

More details and products from the 2018 NSSME+, as well as previous iterations of the study, can be found at: http://horizon-research.com/NSSME/

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Introduction

In 2018, the National Science Foundation supported the sixth in a series of surveys through a grant to Horizon Research, Inc. (HRI). The first survey was conducted in 1977 as part of a major assessment of science and mathematics education and consisted of a comprehensive review of the literature; case studies of 11 districts throughout the United States; and a national survey of teachers, principals, and district and state personnel. A second survey of teachers and principals was conducted in 1985–86 to identify trends since 1977. A third survey was conducted in 1993, a fourth in 2000, and a fifth in 2012. This series of studies has been known as the National Survey of Science and Mathematics Education (NSSME+).

The 2018 iteration of the study included an emphasis on computer science, particularly at the high school level, which is increasingly prominent in discussions about K–12 STEM education and college and career readiness. The 2018 NSSME+ (the plus symbol reflecting the additional focus) 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. The research questions addressed by the study are:

1. To what extent do computer science, mathematics, and science instruction reflect what is known about effective teaching?

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

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

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

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

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

Data for the study come from six instruments:

School-level questionnaires

1. School Coordinator Questionnaire;
2. Mathematics Program Questionnaire;
3. Science Program Questionnaire;

Teacher-level questionnaires

4. High School Computer Science Teacher Questionnaire;[1]
5. Mathematics Teacher Questionnaire; and
6. Science Teacher Questionnaire.

The design and implementation of the 2018 NSSME+ involved developing a sampling strategy and selecting samples of schools and teachers, developing and piloting survey instruments, collecting data from sample members, and preparing data files and analyzing the data. These activities are described in the following sections. The final section of this chapter outlines the contents of the remainder of the report.

Sample Design and Sampling Error Considerations

The 2018 NSSME+ is based on a national probability sample of schools and science, mathematics, and computer science teachers in grades K–12 in the 50 states and the District of Columbia. The sample was designed to yield national estimates of course offerings and enrollment, teacher background preparation, textbook usage, instructional techniques, and availability and use of facilities and equipment. Every eligible school and teacher in the target population had a known, positive probability of being sampled.

The sample design involved clustering and stratification prior to sample selection. The first stage units consisted of elementary and secondary schools. Science, mathematics, and computer science teachers constituted the second stage units. The target sample sizes were designed to be large enough to allow sub-domain estimates, such as for particular regions or types of community.

The sampling frame for the school sample was constructed from the Common Core of Data and Private School Survey databases—programs of the U.S. Department of Education's National Center for Education Statistics—which include school name and address and information about the school needed for stratification and sample selection. The sampling frame for the teacher sample was constructed from lists provided by sample schools, identifying current teachers and the specific science, mathematics, and computer science subjects they were teaching.

Because biology is by far the most common science course at the high school level, selecting a random sample of science teachers would result in a much larger number of biology teachers than chemistry or physics teachers. Similarly, random selection of mathematics teachers might result in a smaller than desired sample of teachers of advanced mathematics courses. In order to ensure that the sample would include a sufficient number of advanced science and mathematics teachers for separate analysis, information on teaching assignments was used to create separate domains (e.g., for teachers of chemistry and physics), and sampling rates were adjusted by domain. In addition, because the number of computer science teachers in high schools is small compared to the number of science and mathematics teachers, all high school teachers who taught computer science were sampled for that subject.

[1] Based on the recommendation of the project's Advisory Board, high school computer science was defined for this study as courses that teach programming or have programming as a prerequisite.

The study design included obtaining in-depth information from each teacher about curriculum and instruction in a single, randomly selected class. Most elementary teachers were reported to teach in self-contained classrooms; i.e., they were responsible for teaching all academic subjects to a single group of students. Each such sampled teacher was randomly assigned to 1 of 2 groups—science or mathematics—and received a questionnaire specific to that subject. Most secondary teachers in the sample taught several classes of a single subject. Some secondary teachers taught multiple subjects addressed by the study. If such a teacher taught high school computer science, s/he was selected to respond to the computer science questionnaire; if s/he taught science and mathematics, s/he was randomly assigned to receive the science or mathematics teacher questionnaire. In addition, for all teachers responsible for more than one class in their designated subject area, one class was randomly selected.

Whenever a sample is anything other than a simple random sample of a population, the results must be weighted to take the sample design into account. In the 2018 NSSME+, the weight for each respondent was calculated as the inverse of the probability of selecting the individual into the sample multiplied by a non-response adjustment factor.[2] In the case of data about a randomly selected class, the teacher weight was adjusted to reflect the number of classes taught in that subject, and therefore, the probability of a particular class being selected. Detailed information about the sample design, weighting procedures, and non-response adjustments used in the 2018 NSSME+ is included in Appendix A.

The results of any survey based on a sample of a population (rather than on the entire population) are subject to sampling variability. The sampling error (or standard error) provides a measure of the range within which a sample estimate can be expected to fall a certain proportion of the time. For example, it may be estimated that 7 percent of all elementary mathematics lessons involve the use of computers. If it is determined that the sampling error for this estimate was 1 percent, then according to the Central Limit Theorem, 95 percent of all possible samples of that same size selected in the same way would yield computer usage estimates between 5 percent and 9 percent (that is, 7 percent ± 2 standard error units).

In survey research, the decision to obtain information from a sample rather than from the entire population is made in the interest of reducing costs, in terms of both money and the burden on the population to be surveyed. The particular sample design chosen is the one that is expected to yield the most accurate information for the least cost. It is important to realize that, other things being equal, estimates based on small sample sizes are subject to larger standard errors than those based on large samples. Also, for the same sample design and sample size, the closer a percentage is to zero or 100, the smaller the standard error. The standard errors for the estimates presented in this report are included in parentheses in the tables. The narrative sections of the report generally point out only those differences that are substantial as well as statistically

[2] The aim of non-response adjustments is to reduce possible bias by distributing the non-respondent weights among the respondents expected to be most similar to these non-respondents. In this study, adjustment was made by region, school metro status, grade level, type (public, catholic, other private), and student body race/ethnicity.

significant at the 0.05 level.[3] All population estimates presented in this report were computed using weighted data.

Instrument Development

Because one purpose of the 2018 NSSME+ was to identify trends in science and mathematics education, the process of developing survey instruments began with the questionnaires that were used in the 2012 NSSME. The project's Advisory Board, composed of experienced researchers in computer science, science, and mathematics education, reviewed the 2012 questionnaires and made recommendations about retaining or deleting particular items. Additional items that were needed to provide important information about the current status of computer science, science, and mathematics education were also considered.

Preliminary drafts of the questionnaires were sent to the professional organizations that endorsed the study for review (listed in Appendix B); these included the American Federation of Teachers, the Computer Science Teachers Association, the National Council of Teachers of Mathematics, the National Education Association, and the National Science Teachers Association.

The survey instruments were revised based on feedback from the various reviewers, field tested, and revised again. The instrument development process was lengthy, constantly compromising between information needs and data collection constraints. There were several iterations, including rounds of cognitive interviews with teachers and revisions to help ensure that individual items were clear and unambiguous and that the survey as a whole would provide the necessary information with the least possible burden on participants. Lastly, because of the large number of questions stakeholders (e.g., advisors, endorsers) wanted to include in the study, all teachers sampled for science or mathematics teacher responded to a core set of items plus 1 of 3 sets of items randomly assigned to respondents. The relatively small sample size of high school computer science teachers would not support random assignment of items, thus these teachers were presented only with core items. Copies of the questionnaires are included in Appendix C.

Data Collection

HRI secured permission for the study from education officials at various levels. First, notification letters were mailed to the Chief State School Officers. Similar letters were subsequently mailed to superintendents of districts including sampled public schools and diocesan offices of sampled Catholic schools, identifying the schools in the district that had been selected for the survey. (Information about this pre-survey mail-out is included in Appendix B.) Copies of the survey instruments and additional information about the study were provided when requested.

Principals received a mailing asking them to log on to the study website and designate a school contact person or "school coordinator." The school coordinator designation page was designed to confirm the principal's contact information, as well as to obtain the name, title, phone number, and email address of the coordinator. (The mailing also included a printed copy of the form and postage-paid return envelope.) Of the 2,000 target slots, 1,273 schools were successfully

[3] 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.

recruited; 41 slots were ineligible (e.g., the school had closed, should have been excluded from the sampling frame, merged with another school already in the sample). Thus, 65 percent of eligible slots were filled.

An incentive system was developed to encourage school and teacher participation in the survey. School coordinators were offered an honorarium of up to $200 ($100 for completing a teacher list and school questionnaire, $15 for completing each program questionnaire (optional), and $10 for each completed teacher questionnaire). Teachers were offered a $25 honorarium for completing the teacher questionnaire.

Survey invitation letters were mailed to teachers beginning in February 2018. In addition to the incentives described, phone calls and emails to school coordinators were used to encourage non-respondents to complete the questionnaires. In May 2018, a final questionnaire invitation mailing was sent to teachers who had not yet completed their questionnaires. The teacher response rate was 78 percent. The response rate for the school-level questionnaires was 86 percent. A detailed description of the data collection procedures is included in Appendix B.

Outline of This Report

This report of the 2018 NSSME+ is organized into major topical areas. In most cases, results are presented for by grade level—elementary, middle, and high.[4,5] Factor analysis was used to create several composite variables related to key constructs measured on the questionnaires. Composite variables, which are more reliable than individual survey items, were computed to have a minimum possible value of 0 and a maximum possible value of 100. The definitions of these and other reporting variables used in this report are included in Appendix D.

Chapter Two focuses on teacher backgrounds and beliefs. Basic demographic data are presented along with information about course background, perceptions of preparedness, and pedagogical beliefs. Chapter Three examines data on the professional status of teachers, including their opportunities for continued professional development.

Chapter Four presents information about the time spent on science and mathematics instruction in the elementary grades and about course offerings at the secondary level. Chapter Five examines the instructional objectives and the activities used to achieve these objectives, followed by a discussion of the availability and use of various types of instructional resources in Chapter Six. Finally, Chapter Seven presents data about a number of factors that are likely to affect science, mathematics, and computer science instruction, including school-wide programs, practices, and problems.

In addition, each chapter contains a set of analyses that examine the distribution of key outcomes across schools and classes of different demographic characteristics. For these analyses, data from the school-level questionnaires are examined by four factors:

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[4] The computer science teacher questionnaire was administered only to high school teachers; thus, results from this survey are shown only for high school. In addition, because it was not possible to matrix sample items on this questionnaire, some questions asked of science and mathematics teachers could not be asked of computer science teachers in order to keep response burden reasonable.

[5] Results by grade range for all applicable items can be found in Craven, L. M., Bruce, A. D., and Plumley, C. L. (2019). *The 2018 NSSME+ compendium of tables.* Chapel Hill, NC: Horizon Research, Inc.

1. Percentage of students in the school eligible for free/reduced-price lunch,
2. School size,
3. Community type, and
4. Region.

Data from the teacher questionnaires are examined by an additional two factors based on the randomly selected class:

1. Prior achievement level of students, and
2. Percentage of students in the class from race/ethnicity groups historically underrepresented in STEM fields.[6]

Additional information about these factors is included in Appendix D. Although the specific equity factors displayed in the body of the report vary by outcome, tables showing each examined outcome by all relevant equity factors are included in Appendix E.

[6] It is important to note that high school computer science classes tend to have many fewer students from these groups than science and mathematics classes. Consequently, the highest quartile of this variable for high school computer science is defined as the class having more than 39 percent of its students from a race/ethnicity group historically underrepresented in STEM compared to more than 76.9 and 76.2 percent in science and mathematics, respectively.

Teacher Background and Beliefs

Overview

A well-prepared teaching force is essential for an effective education system. This chapter provides data about the nation's science, mathematics, and computer science teachers, including their age, gender, race/ethnicity, teaching experience, course backgrounds, beliefs about teaching and learning, and perceptions of preparedness.

Teacher Characteristics

As can be seen in Table 2.1, the vast majority of science teachers at the elementary level are female. The proportion of science teachers who are female decreases as grade level increases, to about 60 percent at the high school level. Science teachers' experience teaching any subject at the K–12 level is similar across grade ranges, though middle school science teachers tend to be less experienced teaching science and more likely to be new to their school. In addition, the majority of the science teaching force is older than 40, with roughly 25 percent of science teachers in each grade range being older than 50. Fewer than 20 percent are age 30 or younger.

Black, Hispanic, and Asian teachers continue to be underrepresented in the science teaching force. At a time when only about half the K–12 student enrollment is White and non-Hispanic, the vast majority of science teachers in each grade range characterize themselves that way.

Table 2.1
Characteristics of the Science Teaching Force, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Sex			
Female	94 (0.7)	71 (1.8)	57 (1.9)
Male	6 (0.7)	28 (1.8)	43 (1.9)
Other	0 (0.1)	0 (0.2)	0 (0.0)
Hispanic or Latino			
Yes	9 (1.6)	7 (1.2)	6 (0.8)
No	91 (1.6)	93 (1.2)	94 (0.8)
Race			
White	88 (1.5)	91 (1.5)	91 (1.2)
Black or African American	8 (1.2)	8 (1.5)	5 (0.9)
Asian	2 (0.6)	2 (0.5)	5 (0.9)
American Indian or Alaskan Native	1 (0.6)	2 (0.6)	2 (0.5)
Native Hawaiian or Other Pacific Islander	1 (0.4)	0 (0.2)	0 (0.1)
Age			
≤ 30	19 (1.6)	17 (2.1)	14 (0.9)
31–40	28 (1.6)	29 (2.5)	31 (1.5)
41–50	29 (1.8)	26 (1.9)	28 (1.3)
51–60	20 (1.4)	20 (2.0)	20 (1.1)
61 +	5 (0.8)	8 (1.4)	8 (0.9)
Experience Teaching any Subject at the K–12 Level			
0–2 years	12 (1.3)	15 (1.9)	12 (1.1)
3–5 years	16 (1.4)	13 (1.9)	14 (1.3)
6–10 years	18 (1.6)	18 (1.7)	17 (1.4)
11–20 years	34 (2.1)	35 (2.4)	37 (2.1)
≥ 21 years	20 (1.3)	19 (2.4)	20 (1.2)
Experience Teaching Science at the K–12 Level			
0–2 years	15 (1.3)	21 (2.0)	15 (1.1)
3–5 years	19 (1.4)	15 (1.7)	13 (0.9)
6–10 years	19 (1.6)	18 (1.3)	17 (1.4)
11–20 years	31 (2.0)	34 (2.2)	35 (1.9)
≥ 21 years	16 (1.2)	12 (1.5)	20 (1.2)
Experience Teaching at Their School, any Subject			
0–2 years	24 (1.7)	34 (2.4)	25 (1.4)
3–5 years	24 (1.7)	18 (1.8)	21 (1.6)
6–10 years	18 (1.3)	20 (2.1)	18 (1.3)
11–20 years	24 (1.7)	21 (1.6)	25 (1.8)
≥ 21 years	9 (1.2)	8 (1.2)	8 (0.8)

Table 2.2 shows characteristics of the mathematics teaching force, which overall, are quite similar to those of the science teaching force. For example, elementary mathematics teachers are also predominantly female, and the proportion who are female decreases as grade level increases. Mathematics teacher experience data are also strikingly similar to those of science teachers. As

is the case in science, the typical mathematics teacher in each grade range is White, non-Hispanic, and older than 40.

Table 2.2
Characteristics of the Mathematics Teaching Force, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Sex			
Female	94 (1.0)	70 (2.2)	60 (1.5)
Male	6 (1.0)	30 (2.2)	40 (1.5)
Other	0 (0.1)	0 ---†	0 (0.1)
Hispanic or Latino			
Yes	10 (1.4)	8 (1.5)	7 (1.1)
No	90 (1.4)	92 (1.5)	93 (1.1)
Race			
White	89 (1.3)	89 (1.4)	91 (1.0)
Black or African American	7 (1.0)	8 (1.2)	5 (0.8)
Asian	3 (0.7)	3 (0.8)	4 (0.6)
American Indian or Alaskan Native	1 (0.5)	1 (0.5)	2 (0.3)
Native Hawaiian or Other Pacific Islander	0 (0.3)	1 (0.8)	1 (0.3)
Age			
≤ 30	20 (1.6)	17 (1.7)	20 (1.5)
31–40	27 (1.8)	31 (2.2)	27 (1.3)
41–50	29 (2.1)	29 (2.4)	28 (1.5)
51–60	18 (1.3)	18 (1.7)	19 (1.2)
61 +	5 (0.7)	4 (0.8)	6 (0.7)
Experience Teaching any Subject at the K–12 Level			
0–2 years	12 (1.2)	13 (2.1)	10 (1.1)
3–5 years	17 (1.5)	17 (2.0)	19 (1.7)
6–10 years	17 (1.3)	20 (2.1)	17 (1.1)
11–20 years	35 (1.8)	35 (2.5)	33 (1.6)
≥ 21 years	20 (1.9)	15 (1.6)	21 (1.4)
Experience Teaching Mathematics at the K–12 Level			
0–2 years	14 (1.4)	18 (2.2)	11 (1.0)
3–5 years	17 (1.4)	19 (2.1)	18 (1.6)
6–10 years	18 (1.4)	20 (1.9)	17 (1.2)
11–20 years	33 (1.8)	32 (2.3)	34 (1.6)
≥ 21 years	17 (1.7)	11 (1.1)	20 (1.3)
Experience Teaching at Their School, any Subject			
0–2 years	27 (1.8)	37 (2.5)	30 (1.7)
3–5 years	22 (1.5)	19 (2.0)	22 (1.9)
6–10 years	19 (1.4)	19 (2.1)	19 (1.3)
11–20 years	26 (1.5)	19 (1.8)	22 (1.7)
≥ 21 years	6 (0.9)	6 (0.9)	8 (0.8)

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

The characteristics of high school computer science teachers, shown in Table 2.3, are similar to those of high school science and mathematics teachers in some areas and markedly different in others. Similar to science and mathematics teachers, nearly all high school computer science teachers characterize themselves as White, and most are older than 40. In contrast, the majority are male. In addition, although nearly half have more than 10 years of experience teaching at the K–12 level, many are novice teachers of computer science, with 35 percent having 0–2 years of experience teaching the subject.

Table 2.3
Characteristics of the High School Computer Science Teaching Force

	PERCENT OF TEACHERS
Sex	
Female	40 (3.6)
Male	60 (3.6)
Other	0 ---†
Hispanic or Latino	
Yes	8 (2.2)
No	92 (2.2)
Race	
White	94 (1.7)
Asian	4 (1.4)
Black or African American	3 (1.3)
American Indian or Alaskan Native	2 (0.5)
Native Hawaiian or Other Pacific Islander	1 (0.6)
Age	
≤ 30	12 (2.9)
31–40	31 (3.8)
41–50	25 (3.3)
51–60	21 (2.8)
61 +	11 (2.8)
Experience Teaching any Subject at the K–12 Level	
0–2 years	10 (2.2)
3–5 years	19 (3.2)
6–10 years	23 (3.0)
11–20 years	32 (3.4)
≥ 21 years	15 (2.6)
Experience Teaching Computer Science at the K–12 Level	
0–2 years	35 (3.8)
3–5 years	28 (2.8)
6–10 years	16 (2.7)
11–20 years	18 (2.6)
≥ 21 years	3 (1.2)
Experience Teaching at Their School, any Subject	
0–2 years	28 (3.4)
3–5 years	18 (3.1)
6–10 years	25 (3.2)
11–20 years	21 (3.0)
≥ 21 years	8 (1.9)

† No high school computer science teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Analyses were conducted to examine how teachers are distributed among schools—for example, whether teachers with the least experience are concentrated in high-poverty schools (i.e., schools with high proportions of students eligible for free/reduced-price lunch). As can be seen in Table 2.4, science classes in high-poverty schools are more likely than those in low-poverty schools to be taught by teachers with five or fewer years of experience. In addition, a majority of computer science classes in high-poverty schools are taught by those with only 0–2 years of experience teaching the subject.

Table 2.4
Equity Analyses of Classes Taught by Teachers With Varying Experience Teaching Subject, by Proportion of Students Eligible for Free/Reduced-Price Lunch

	PERCENT OF CLASSES			
	LOWEST QUARTILE	SECOND QUARTILE	THIRD QUARTILE	HIGHEST QUARTILE
Experience Teaching Science				
0–2 years	11 (1.4)	13 (1.3)	22 (2.4)	19 (2.2)
3–5 years	16 (1.9)	13 (1.6)	20 (3.0)	19 (1.9)
6–10 years	18 (2.1)	22 (2.2)	16 (1.9)	21 (2.1)
11–20 years	40 (2.3)	33 (2.6)	27 (2.3)	27 (2.3)
≥ 21 years	15 (1.4)	19 (2.0)	16 (2.0)	13 (2.1)
Experience Teaching Mathematics				
0–2 years	12 (1.8)	11 (1.4)	17 (1.7)	15 (2.1)
3–5 years	17 (2.0)	18 (1.9)	14 (1.9)	18 (2.0)
6–10 years	19 (1.8)	18 (1.8)	18 (1.5)	19 (1.8)
11–20 years	34 (2.2)	36 (2.2)	33 (2.7)	32 (2.7)
≥ 21 years	18 (1.5)	17 (1.6)	17 (2.0)	15 (2.0)
Experience Teaching Computer Science				
0–2 years	28 (5.0)	31 (8.3)	23 (8.2)	56 (9.8)
3–5 years	30 (5.3)	29 (7.1)	36 (12.1)	12 (6.7)
6–10 years	16 (3.6)	17 (5.9)	8 (3.5)	21 (5.3)
11–20 years	24 (4.9)	22 (6.5)	33 (11.4)	3 (2.8)
≥ 21 years	2 (1.4)	2 (1.9)	1 (0.7)	8 (4.9)

Table 2.5 shows the percentage of classes taught by teachers from race/ethnicity groups historically underrepresented in STEM by the proportion of students from these groups in the class. Note that across all three subjects, classes in the highest quartile in terms of students from these groups are more likely than those in the lowest quartile to be taught by teachers from these groups.

Table 2.5
Equity Analysis of Classes Taught by Teachers From Race/Ethnicity Groups Historically Underrepresented in STEM, by Subject

	PERCENT OF CLASSES		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	2 (0.7)	3 (0.7)	5 (3.0)
Second Quartile	6 (1.1)	5 (0.9)	7 (3.6)
Third Quartile	13 (1.4)	12 (1.4)	3 (2.3)
Highest Quartile	42 (4.1)	45 (3.4)	47 (11.1)

Teacher Preparation

In order to help students learn, teachers must themselves have a firm grasp of important ideas in the discipline they are teaching. Because direct measures of teachers' content knowledge were not feasible in this study, the survey used a number of proxy measures, including teachers' major areas of study and courses completed.

As can be seen in Table 2.6, very few elementary teachers have college or graduate degrees in science or mathematics. The percentage of teachers with one or more degrees in science or mathematics increases with increasing grade range, with 79 percent of high school science teachers and 55 percent of high school mathematics teachers having a major in their discipline. If the definition of degree in discipline is expanded to include degrees in science/mathematics education, these figures increase to 91 percent of high school science teachers and 79 percent of high school mathematics teachers. Only about 1 in 4 computer science teachers have a degree in computer engineering, computer science, or information science, and very few have a degree in computer science education.

Table 2.6
Teacher Degrees, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science Teachers			
Science/Engineering	3 (0.5)	42 (2.2)	79 (1.4)
Science Education	1 (0.3)	36 (2.8)	57 (2.1)
Science/Engineering or Science Education	3 (0.7)	54 (2.9)	91 (1.1)
Mathematics Teachers			
Mathematics	1 (0.4)	26 (2.0)	55 (1.6)
Mathematics Education	2 (0.7)	28 (2.4)	53 (2.0)
Mathematics or Mathematics Education	3 (0.9)	45 (2.7)	79 (1.7)
Computer Science Teachers			
Computer Engineering, Computer Science, or Information Science	n/a	n/a	24 (3.3)
Computer Science Education	n/a	n/a	4 (2.1)
Computer Engineering, Computer Science, Information Science, or Computer Science Education	n/a	n/a	25 (3.2)

Table 2.7 shows the percentage of science teachers in each grade range with at least one college course in each of a number of science disciplines. Note that the vast majority of science teachers at each level have had coursework in the life sciences, and 59–72 percent have had coursework in Earth/space science. In contrast, in chemistry and physics, the percentage of teachers with at least one college course in the discipline increases substantially with increasing grade range. Few teachers at any grade level have had coursework in engineering.

Table 2.7
Science Teachers With College Coursework in Various Disciplines, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Chemistry	45 (1.8)	80 (2.2)	95 (0.6)
Biology/Life Science	89 (1.2)	91 (1.5)	93 (0.7)
Physics	31 (1.7)	69 (2.4)	85 (1.4)
Earth/Space Science	66 (1.5)	72 (2.4)	59 (1.6)
Environmental Science	40 (1.8)	58 (2.3)	53 (1.3)
Engineering	3 (0.5)	10 (1.7)	13 (1.1)

Tables 2.8–2.12 provide additional information about secondary science teacher coursework in biology, chemistry, physics, Earth/space science, and environmental science, respectively, in each case showing the percentage of middle and high school teachers who have had one or more courses beyond the introductory level, as well as the percentage who have completed each of a number of individual courses. Typically, high school teachers are substantially more likely than their middle grades counterparts to have taken coursework beyond the introductory level in a given discipline. Teachers were also asked whether they have had one or more teaching methods courses in a given discipline. About half of teachers at each level have had a methods course focused on biology/life science. Far fewer (14–22 percent of middle school teachers and 7–23 percent of high school teachers) have had methods courses in the other disciplines.

Table 2.8
Secondary Science Teachers Completing Various Biology/Life Science Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Introductory Biology/Life Science	**88 (2.0)**	**92 (0.8)**
One or More Biology/Life Science Courses Beyond the Introductory Level	**65 (2.3)**	**79 (1.5)**
Genetics	33 (2.2)	56 (1.7)
Anatomy/physiology	37 (2.1)	51 (1.8)
Cell biology	34 (2.3)	50 (1.7)
Ecology	34 (2.6)	50 (1.8)
Microbiology	28 (1.7)	48 (1.7)
Biochemistry	22 (2.0)	43 (1.9)
Botany	27 (2.1)	40 (1.7)
Zoology	24 (1.9)	37 (1.6)
Evolution	21 (2.1)	32 (1.8)
Other biology/life science beyond the general/introductory level	33 (2.3)	45 (1.9)
Biology/Life Science Teaching Methods Course	**52 (2.2)**	**52 (1.7)**

Table 2.9
Secondary Science Teachers Completing Various Chemistry Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Introductory Chemistry	**79 (2.2)**	**95 (0.6)**
One or More Chemistry Courses Beyond the Introductory Level	**41 (2.3)**	**72 (1.7)**
Organic chemistry	32 (2.1)	64 (1.7)
Inorganic chemistry	18 (1.7)	42 (1.8)
Biochemistry	20 (2.0)	40 (1.7)
Physical chemistry	12 (1.4)	26 (1.3)
Analytic chemistry	7 (1.2)	25 (1.2)
Quantum chemistry	2 (0.4)	7 (0.6)
Other chemistry beyond the general/introductory level	8 (1.0)	17 (1.5)
Chemistry Teaching Methods Course	**15 (1.9)**	**23 (1.3)**

Table 2.10
Secondary Science Teachers Completing Various Physics Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Introductory Physics	**67 (2.4)**	**84 (1.4)**
One or More Physics Courses Beyond the Introductory Level	**19 (1.8)**	**31 (1.6)**
Mechanics	6 (1.3)	19 (1.3)
Electricity and magnetism	6 (1.0)	17 (1.1)
Heat and thermodynamics	6 (1.3)	14 (1.2)
Astronomy/astrophysics	10 (1.4)	13 (1.1)
Modern or quantum physics	3 (0.7)	13 (1.0)
Optics	2 (0.7)	9 (1.2)
Nuclear physics	1 (0.3)	6 (0.7)
Other physics beyond the general/introductory level	8 (0.9)	13 (1.2)
Physics Teaching Methods Course	**16 (1.9)**	**15 (1.3)**

Table 2.11
Secondary Science Teachers Completing Various Earth/Space Science Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Introductory Earth/Space Science	**68 (2.6)**	**58 (1.6)**
One or More Earth/Space Science Courses Beyond the Introductory Level	**29 (2.1)**	**24 (1.4)**
Geology	22 (1.8)	19 (1.3)
Astronomy/astrophysics	15 (1.7)	13 (1.2)
Physical geography	13 (1.6)	9 (1.0)
Meteorology	9 (1.4)	9 (1.0)
Oceanography	8 (0.9)	8 (0.9)
Other Earth/space science beyond the general/introductory level	11 (1.3)	11 (1.1)
Earth/Space Science Teaching Methods Course	**22 (1.8)**	**11 (1.1)**

Table 2.12
Secondary Science Teachers Completing Various Environmental Science Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Introductory Environmental Science	**55 (2.4)**	**52 (1.2)**
One or More Environmental Science Courses Beyond the Introductory Level	**19 (1.7)**	**26 (1.4)**
Ecology	15 (1.4)	22 (1.3)
Conservation biology	8 (1.2)	11 (0.9)
Oceanography	5 (0.6)	8 (1.0)
Forestry	4 (1.3)	5 (1.0)
Hydrology	3 (0.6)	4 (0.6)
Toxicology	2 (0.4)	3 (0.5)
Other environmental science beyond the general/introductory level	8 (1.2)	13 (1.1)
Environmental Science Teaching Methods Course	**14 (1.9)**	**7 (0.6)**

Teachers of science in the elementary grades are typically responsible for instruction across science disciplines. Accordingly, the National Science Teachers Association (NSTA) has recommended that rather than studying a single science discipline in depth, elementary science teachers be prepared to teach life science, Earth science, and physical science.[7] As a proxy for the competencies outlined by NSTA in these different areas, teachers were asked about their coursework in each. As can be seen in Table 2.13, 34 percent of elementary science teachers have had courses in all three of those areas, and another 36 percent have had coursework in 2 of the 3 areas. At the other end of the spectrum, 7 percent of elementary science teachers have not had any college science courses in these areas.

[7] National Science Teachers Association. (2012). NSTA science content analysis form: Elementary science specialists or middle school science teachers. Arlington, VA: NSTA.

Table 2.13
Elementary Science Teachers' Coursework Related to NSTA Preparation Standards

	PERCENT OF TEACHERS
Courses in Earth, life, and physical science†	34 (1.5)
Courses in 2 of the 3 areas	36 (1.6)
Course in 1 of the 3 areas	23 (1.5)
Courses in 0 of the 3 areas	7 (1.0)

† Physical science is defined as a course in either chemistry or physics.

Forty-nine percent of middle grades teachers of general or integrated science have had at least one college course in chemistry, Earth science, life science, and physics. An additional 29 percent have had coursework in 3 of the 4 areas (see Table 2.14).

Table 2.14
Middle School Teachers of General/Integrated Science Coursework Related to NSTA Preparation Standards

	PERCENT OF TEACHERS
Courses in chemistry, Earth science, life science, and physics	49 (2.8)
Courses in 3 of the 4 areas	29 (3.0)
Courses in 2 of the 4 areas	12 (1.9)
Course in 1 of the 4 areas	4 (0.9)
Courses in 0 of the 4 areas	6 (2.3)

Many secondary science classes, especially at the high school level, focus on a single area of science, such as biology or chemistry. Table 2.15 provides information about the course background of those teaching these courses. Middle school life science/biology teachers are far more likely to have a degree in their discipline (40 percent) than those teaching Earth science (5 percent) or physical science (7 percent). In addition, a majority of middle school Earth science and physical science teachers have had either no coursework in the field or only an introductory course. High school biology teachers also tend to have particularly strong backgrounds in their discipline, with 63 percent having a degree in biology, and another 25 percent with at least three college courses beyond introductory biology. In contrast, about one-third of high school environmental science teachers and roughly one-quarter of Earth science teachers in each grade range have not had any college coursework in their field.

Table 2.15
Secondary Science Teachers With Varying Levels of Background in Subject†

	PERCENT OF TEACHERS				
	DEGREE IN FIELD	NO DEGREE IN FIELD BUT 3+ COURSES BEYOND INTRODUCTORY	NO DEGREE IN FIELD BUT 1–2 COURSES BEYOND INTRODUCTORY	NO DEGREE IN FIELD OR COURSES BEYOND INTRODUCTORY	NO COURSEWORK IN FIELD
Middle					
Life science/biology	40 (4.5)	26 (3.9)	10 (2.3)	18 (3.1)	6 (2.0)
Physical science	7 (3.3)	10 (3.3)	9 (3.3)	64 (5.4)	9 (2.2)
Earth science	5 (1.3)	22 (6.0)	17 (4.0)	31 (5.5)	26 (5.3)
High					
Life science/biology	63 (2.5)	25 (2.6)	6 (1.1)	5 (1.4)	1 (0.5)
Chemistry	42 (2.7)	28 (2.2)	20 (2.1)	9 (1.9)	1 (0.6)
Physics	24 (2.6)	27 (3.1)	15 (2.6)	30 (3.7)	4 (1.2)
Earth science	15 (2.9)	18 (3.4)	11 (2.6)	31 (5.0)	26 (5.7)
Environmental science	11 (3.4)	21 (3.0)	17 (2.9)	20 (5.3)	31 (4.4)

† Teachers assigned to teach classes in more than one subject area are included in each category.

Additional analyses were conducted to examine the extent to which teachers with the strongest background in their field are equitably distributed; results are shown in Table 2.16. Secondary science classes with different proportions of students from race/ethnicity groups historically underrepresented in STEM are about equally likely to be taught by teachers who have had at least three courses in the subject beyond the introductory level. In contrast, classes composed of high-achieving students are significantly more likely to be taught by teachers with strong content background than those with low levels of prior achievement. In addition, classes in schools with the highest proportion of students eligible for free/reduced-price lunch are less likely to be taught by teachers with substantial background in the subject than classes in schools in the lowest quartile. There also appear to be regional differences, as classes in the Northeast and Midwest are more likely to be taught by teachers who have a degree or at least three advanced courses in the subject.

Table 2.16
Equity Analyses of Secondary Science Classes With Teachers With Substantial Background† in Subject of Selected Class

	PERCENT OF CLASSES
Prior Achievement Level of Class	
Mostly High	72 (2.5)
Average/Mixed	61 (2.2)
Mostly Low	43 (5.1)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	63 (3.0)
Second Quartile	67 (3.1)
Third Quartile	57 (2.9)
Highest Quartile	56 (5.0)
Percent of Students in School Eligible for FRL	
Lowest Quartile	66 (2.7)
Second Quartile	64 (3.1)
Third Quartile	62 (3.6)
Highest Quartile	52 (4.2)
Region	
Midwest	69 (2.9)
Northeast	71 (4.0)
South	58 (2.7)
West	50 (4.3)

† Defined as having either a degree or at least three advanced courses in the subject of their selected class.

Turning to elementary grades mathematics, as can be seen in Table 2.17, nearly all teachers have completed college coursework in mathematics for elementary school teachers. Roughly half of elementary mathematics teachers have had college courses in each of a number of areas of mathematics, including algebra and statistics. About 1 in 4 elementary mathematics teachers have had a course in computer science, though very few have taken a course in engineering.

Table 2.17
Elementary Mathematics Teachers Completing Various College Courses

	PERCENT OF TEACHERS
Mathematics	
Mathematics content for elementary school teachers	92 (1.1)
College algebra/trigonometry/functions	49 (2.1)
Statistics	47 (1.9)
Integrated mathematics	34 (1.6)
College geometry	32 (2.1)
Probability	25 (1.6)
Calculus	18 (1.4)
Discrete mathematics	6 (0.8)
Other upper division mathematics	14 (1.3)
Other	
Computer science	27 (1.7)
Engineering	2 (0.5)

The National Council of Teachers of Mathematics (NCTM) has recommended that elementary mathematics teachers take college coursework in a number of different areas, including number and operations (for which "mathematics content for elementary teachers" can serve as a proxy), algebra, geometry, probability, and statistics.[8] As can be seen in Table 2.18, only 7 percent of elementary mathematics teachers have had courses in each of these areas; the typical elementary teacher has had coursework in only 1 or 2 of these 5 areas.

Table 2.18
Elementary Mathematics Teachers' Coursework Related to NCTM Preparation Standards

	PERCENT OF TEACHERS
Courses in algebra, geometry, number and operations, probability, and statistics	7 (0.9)
Courses in 3–4 of the 5 areas	39 (1.9)
Courses in 1–2 of the 5 areas	53 (2.0)
Courses in 0 of the 5 areas	2 (0.5)

Table 2.19 shows the percentage of middle and high school mathematics teachers with coursework in each of a number of areas. Nearly all high school mathematics teachers have completed a calculus course, and 85 percent have taken a course in advanced calculus. Similar proportions have had college coursework in linear algebra and in statistics. Other college courses completed by a majority of high school mathematics teachers include abstract algebra, differential equations, axiomatic geometry, analytic geometry, probability, number theory, and discrete mathematics. Substantially fewer teachers at the middle grades have had college coursework in each of these areas though about three-quarters have had a course in statistics and two-thirds in calculus.

[8] National Council of Teachers of Mathematics. (2012). NCTM CAEP mathematics content for elementary mathematics specialist. Reston, VA: NCTM.

Table 2.19
Secondary Mathematics Teachers
Completing Various College Courses, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
Mathematics		
Calculus	65 (2.3)	92 (1.4)
Statistics	74 (1.9)	89 (1.1)
Advanced calculus	47 (2.0)	85 (1.4)
Linear algebra (e.g., vectors, matrices, eigenvalues)	42 (2.0)	84 (1.5)
Probability	52 (2.5)	75 (1.3)
Abstract algebra (e.g., groups, rings, ideals, fields)	31 (1.7)	73 (1.5)
Mathematics content for middle/high school teachers	62 (2.6)	69 (1.9)
Differential equations	36 (1.9)	68 (1.6)
Analytic/coordinate geometry (e.g., transformations or isometries, conic sections)	33 (2.0)	66 (1.8)
Discrete mathematics (e.g., combinatorics, graph theory, game theory)	31 (2.4)	61 (1.6)
Axiomatic geometry (Euclidean or non-Euclidean)	24 (1.9)	59 (1.9)
Number theory (e.g., divisibility theorems, properties of prime numbers)	41 (2.4)	58 (1.7)
Real analysis	19 (1.7)	49 (1.6)
Integrated mathematics	50 (2.5)	47 (1.8)
Other upper division mathematics	28 (2.2)	58 (1.9)
Other		
Computer science	42 (2.2)	62 (1.7)
Engineering	9 (1.1)	18 (1.3)

At the middle grades level, NCTM recommends that teachers have more extensive college coursework, including courses in number theory (for which "mathematics for middle school teachers" can serve as a proxy), algebra, geometry, probability, statistics, and calculus.[9] As can be seen in Table 2.20, more than half of middle grades mathematics teachers have had college courses in all or nearly all of these areas, having completed at least 4 of the 6 recommended courses.

Table 2.20
Middle School Mathematics Teachers'
Coursework Related to NCTM Preparation Standards

	PERCENT OF TEACHERS
Courses in algebra, calculus, geometry, number theory, probability, and statistics	21 (2.0)
Courses in 4–5 of the 6 areas	37 (2.4)
Courses in 2–3 of the 6 areas	27 (1.9)
Course in 1 of the 6 areas	9 (1.3)
Courses in 0 of the 6 areas	6 (1.6)

Table 2.21 provides analogous data for high school mathematics teachers, in this case based on a total of seven courses, including number theory and discrete mathematics and omitting

[9] National Council of Teachers of Mathematics. (2012). NCTM CAEP mathematics content for middle grades. Reston, VA: NCTM.

mathematics coursework specifically aimed at teachers.[10] Approximately three-quarters of high school teachers meet or come close to having taken courses in all seven areas, completing at least five.

Table 2.21
High School Mathematics Teachers' Coursework Related to NCTM Preparation Standards

	PERCENT OF TEACHERS
Courses in algebra, calculus, discrete mathematics, geometry, number theory, probability, and statistics	36 (1.6)
Courses in 5–6 of the 7 areas	40 (1.6)
Courses in 3–4 of the 7 areas	16 (1.7)
Courses in 1–2 of the 7 areas	6 (0.9)
Courses in 0 of the 7 areas	1 (0.5)

Table 2.22 shows the percentage of high school computer science teachers with coursework in each of a number of areas. A large majority of computer science teachers have taken an introduction to programming or an introduction to computer science course. Substantially fewer have taken other, more specific, courses related to computer science such as algorithms, computer networks, or artificial intelligence. However, a large majority of computer science teachers also have taken mathematics coursework often used in computer science, either in statistics or linear algebra.

[10] National Council of Teachers of Mathematics. (2012). NCTM CAEP mathematics content for secondary. Reston, VA: NCTM.

Table 2.22
High School Computer Science Teachers Completing Various College Courses

	PERCENT OF TEACHERS
Computer Science/Engineering	
Introduction to computer science/programming	84 (2.5)
Algorithms (e.g., sorting; search trees, heaps, and hashing; divide-and-conquer)	50 (3.8)
Operating systems/computer systems	45 (3.5)
Database systems (e.g., the relational model, relational algebra, SQL)	38 (3.7)
Software design/engineering	35 (3.1)
Computer networks (e.g., application layer protocols, Internet protocols, network interfaces)	32 (3.7)
Computer graphics (e.g., ray tracing, the graphics pipeline, transformations, texture mapping)	22 (3.6)
Computer engineering	19 (2.9)
Electrical/electronics engineering	19 (3.3)
Human-computer interaction (e.g., human information processing subsystems; libraries of standard graphical user interface objects; methodologies to measure the usability of software)	17 (3.2)
Artificial intelligence (e.g., machine learning, robotics, computer vision)	14 (2.7)
Other upper division computer science	39 (3.9)
Other types of engineering courses	23 (3.6)
Mathematics	
Statistics	84 (2.7)
Linear algebra	72 (3.0)
Probability	59 (3.3)
Discrete mathematics (e.g., combinatorics, graph theory, game theory)	44 (4.1)
Number theory (e.g., divisibility theorems, properties of prime numbers)	44 (3.6)

The Computer Science Teachers Association (CSTA) has published recommendations for computer science teacher certification,[11] and the International Society for Technology in Education (ISTE) has published standards for computer science educators.[12] Although there is not perfect agreement between these lists from CSTA and ISTE, they are reasonably consistent. Taken together, they suggest computer science teachers have coursework in the following four areas: programming, algorithms, data structures, and some element of computer systems or networks. As can be seen in Table 2.23, 1 in 4 computer science teachers have taken courses in all four recommended areas. Including those with coursework in at least 3 of the 4 recommended areas increases the percentage of teachers to nearly half.

[11] Ericson, B., Armoni, M., Gal-Ezer, J., Seehorn, D., Stephenson, C., & Trees, F. (2008). Ensuring exemplary teaching in an essential discipline. Addressing the crisis in computer science teacher certification. *Final Report of the CSTA Teacher Certification Task Force. ACM.*

[12] International Society for Technology in Education. (2011). *Standards for computer science educators.* Retrieved from https://www.iste.org/standards.

Table 2.23
High School Computer Science Teachers' Coursework Related to CSTA/ISTE Course-Background Standards

	PERCENT OF TEACHERS
Courses in algorithms, computer systems/networks, data structures, and programming	25 (3.3)
Courses in 3 of the 4 areas	21 (3.2)
Courses in 2 of the 4 areas	20 (2.7)
Course in 1 of the 4 areas	21 (2.6)
Courses in 0 of the 4 areas	13 (2.1)

Teachers were also asked about their path to certification. As can be seen in Table 2.24, elementary science teachers are more likely than those at the high school level to have had an undergraduate program leading to a bachelor's degree and a teaching credential, and high school science teachers are more likely than their elementary school counterparts to have completed a post-baccalaureate credentialing program that did not include a master's degree. Similar patterns are seen among mathematics teachers' paths to certification across grade ranges, though the differences are not as striking. Seven percent of high school mathematics teachers and the same proportion of high school science teachers have not earned a teaching credential. Thirty-eight percent of high school computer science teachers have earned a teaching credential through an undergraduate program leading to a bachelor's degree, and 24 percent through a post-baccalaureate credentialing program that did not include a master's degree. Sixteen percent of computer science teachers have not earned a teaching credential.

Table 2.24
Teachers' Paths to Certification, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science			
An undergraduate program leading to a bachelor's degree and a teaching credential	65 (1.9)	53 (2.8)	40 (1.9)
A post-baccalaureate credentialing program (no master's degree awarded)	11 (1.5)	20 (2.3)	25 (1.7)
A master's program that also led to a teaching credential	22 (1.8)	24 (2.7)	28 (2.2)
Has not earned a teaching credential	1 (0.5)	4 (1.3)	7 (1.0)
Mathematics			
An undergraduate program leading to a bachelor's degree and a teaching credential	65 (2.2)	61 (2.6)	57 (2.3)
A post-baccalaureate credentialing program (no master's degree awarded)	10 (1.5)	14 (1.9)	16 (1.2)
A master's program that also led to a teaching credential	23 (2.1)	20 (1.6)	21 (1.6)
Has not earned a teaching credential	2 (0.6)	4 (1.1)	7 (1.5)
Computer Science			
An undergraduate program leading to a bachelor's degree and a teaching credential	n/a	n/a	38 (3.7)
A post-baccalaureate credentialing program (no master's degree awarded)	n/a	n/a	24 (3.2)
A master's program that also led to a teaching credential	n/a	n/a	22 (2.8)
Has not earned a teaching credential	n/a	n/a	16 (2.7)

Table 2.25 shows the content areas high school science teachers are certified to teach (i.e., have a credential, endorsement, or license in that area). Nearly all are certified in at least one science

area, with the most common areas being biology/life science (71 percent) and chemistry (51 percent). About one-third are certified to teach Earth/space science, physics, or ecology/ environmental science. About 1 in 6 are certified to teach all science content areas.

Table 2.25
High School Science Teachers' Areas of Certification

	PERCENT OF TEACHERS
Certified in One or More Science Areas	**91 (1.1)**
Biology/life science	71 (1.6)
Chemistry	51 (2.2)
Earth/space science	37 (2.1)
Physics	33 (1.6)
Ecology/environmental science	32 (2.0)
Certified in All Science Areas	**18 (1.4)**
Not Certified in Any Science Area	**9 (1.1)**

High school computer science teachers were asked a similar item about their areas of certification (see Table 2.26). Forty-four percent have a certification in computer science, and 34 percent are certified to teach mathematics. About one-quarter are certified to teach business.

Table 2.26
High School Computer Science Teachers' Areas of Certification

	PERCENT OF TEACHERS
Certified in One or More Areas	**84 (2.7)**
Computer Science	44 (3.6)
Mathematics	34 (3.4)
Business	28 (2.4)
Engineering	10 (2.4)
Science	9 (2.3)
Not Certified	**16 (2.7)**

Recognizing that teaching is not always an individual's first career, the survey also included an item asking whether teachers had a full-time job in their designated field after completing their undergraduate degree and prior to teaching. Science teachers were asked whether they had full-time job experience in a science- or engineering-related field. Mathematics and computer science teachers were asked about experience in a mathematics-related field (e.g., accounting, engineering, computer programming) and computer programming or computer/software engineering, respectively. As can be seen in Table 2.27, the likelihood of science and mathematics teachers having prior career experience in their field substantially increases with increasing grade range. In addition, high school science and computer science teachers are more likely than their mathematics colleagues to have prior job experience in their respective fields (about one-third vs. one-fifth).

Table 2.27
Teachers With Full-Time Job Experience in Their Designated Field Prior to Teaching, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science	3 (0.7)	23 (2.8)	36 (2.1)
Mathematics	7 (1.1)	12 (1.4)	19 (1.4)
Computer Science	n/a	n/a	35 (4.3)

Teacher Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning. Table 2.28 shows the percentage of science teachers in each grade range agreeing with each of the statements; data for mathematics teachers and computer science teachers are shown in Table 2.30 and Table 2.32, respectively.

It is interesting to note that elementary, middle, and high school science teachers have similar views about a number of elements of science instruction. At least 90 percent of teachers in each grade range agree that: (1) teachers should ask students to support their conclusions about a science concept with evidence; (2) students learn best when instruction is connected to their everyday lives; (3) students should learn science by doing science; and (4) most class periods should provide opportunities for students to apply scientific ideas to real-world contexts. A similarly large proportion of science teachers in each grade range believe that most class periods should provide opportunities for students to share their thinking and reasoning. In contrast, teacher opinions about ability grouping vary considerably by grade range, with 60 percent of high school science teachers, 48 percent of those in the middle grades, and 25 percent at the elementary level believing that students learn science best in classes with students of similar abilities.

There are also inconsistent views in relation to a number of elements of effective science instruction, with teachers agreeing with statements associated with both traditional and reform-oriented beliefs. Approximately three-fourths of teachers at each grade range agree that it is better to focus on ideas in depth, even if it means covering fewer topics, one of the central tenets of calls for reform in science instruction. At the same time, despite research on learning that suggests otherwise,[13] roughly one-third of science teachers at each grade level agree that teachers should explain an idea to students before having them consider evidence for that idea, and more than half that laboratory activities should be used primarily to reinforce ideas that the students have already learned. And despite recommendations that students develop understanding of concepts first and learn the scientific language later, 66–77 percent of science teachers at the various grade ranges think that students should be given definitions for new vocabulary at the beginning of instruction on a science idea.

[13] National Research Council. (2005). *How students learn: History, mathematics, and science in the classroom.* M. S. Donovan & J. D. Bransford, (Eds.) Washington, DC: National Academy Press.

Table 2.28
Science Teachers Agreeing† With Various Statements About Teaching and Learning, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Reform-Oriented Beliefs			
Teachers should ask students to support their conclusions about a science concept with evidence.	95 (1.1)	97 (0.9)	99 (0.3)
Students learn best when instruction is connected to their everyday lives.	95 (1.0)	97 (0.7)	96 (0.7)
Students should learn science by doing science (e.g., developing scientific questions; designing and conducting investigations; analyzing data; developing models, explanations, and scientific arguments).	95 (1.0)	93 (1.7)	93 (1.2)
Most class periods should provide opportunities for students to apply scientific ideas to real-world contexts.	93 (1.2)	90 (2.0)	91 (1.4)
Most class periods should provide opportunities for students to share their thinking and reasoning.	96 (0.9)	92 (1.9)	89 (1.4)
It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics.	75 (2.1)	74 (2.9)	77 (2.0)
Traditional Beliefs			
At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.	77 (2.1)	72 (2.3)	66 (2.1)
Students learn science best in classes with students of similar abilities.	25 (1.9)	48 (3.6)	60 (1.7)
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned.	56 (2.4)	57 (2.6)	52 (2.0)
Teachers should explain an idea to students before having them consider evidence that relates to the idea.	33 (2.1)	30 (2.6)	37 (2.3)

† Includes teachers indicating “strongly agree” or “agree” on a five-point scale ranging from 1 “strongly disagree” to 5 “strongly agree.”

These items (and the analogous items for mathematics and computer science) were combined into two composite variables: Traditional Teaching Beliefs and Reform-Oriented Teaching Beliefs. The composite scores shown in Table 2.29 suggest that elementary, middle, and high school science teachers have relatively strong reform-oriented beliefs. However, traditional beliefs are also fairly prevalent across all grades.

Table 2.29
Mean Scores for Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Elementary	55 (0.9)	86 (0.6)
Middle	57 (1.1)	87 (0.7)
High	59 (0.7)	85 (0.5)

As can be seen in Table 2.30, mathematics teachers share many of the reform-oriented beliefs of science teachers, with at least 85 percent of teachers in each grade range agreeing that (1) teachers should ask students to justify their mathematical thinking, (2) students should learn mathematics by doing mathematics, (3) most class periods should provide students opportunities to share their thinking and reasoning, and (4) students learn best when instruction is connected to their everyday lives. At the same time, 49 percent of elementary mathematics teachers, increasing to 66 percent in the middle grades and 70 percent at the high school level, believe that students learn mathematics best in classes with students of similar abilities.

As is the case in science, most mathematics teachers agree with the notion of covering fewer ideas in greater depth, but sizeable proportions do not agree with other recommendations for improving mathematics teaching and learning. For example, 43–53 percent of mathematics teachers, depending on grade range, believe that hands-on activities/manipulatives should be used primarily to reinforce ideas the students have already learned, despite recommendations that these be used to help students develop their initial understanding of key concepts. And even larger proportions of mathematics teachers, from 78 percent at the high school level to 82 percent at the elementary level, believe that students should be given definitions of new vocabulary at the beginning of instruction on a mathematical idea.

Table 2.30
Mathematics Teachers Agreeing† With Various Statements About Teaching and Learning, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Reform-Oriented Beliefs			
Teachers should ask students to justify their mathematical thinking.	97 (0.6)	99 (0.4)	98 (0.6)
Students should learn mathematics by doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models).	97 (0.7)	97 (0.6)	96 (0.8)
Most class periods should provide opportunities for students to share their thinking and reasoning.	96 (0.9)	95 (0.7)	94 (0.9)
Students learn best when instruction is connected to their everyday lives.	97 (0.6)	93 (1.8)	85 (1.7)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	77 (2.0)	89 (1.5)	83 (1.7)
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	93 (1.1)	92 (1.1)	78 (1.6)
Traditional Beliefs			
At the beginning of instruction on a mathematical idea, students should be provided with definitions for new mathematics vocabulary that will be used.	82 (1.6)	78 (3.1)	78 (1.8)
Students learn mathematics best in classes with students of similar abilities.	49 (2.3)	66 (2.7)	70 (1.8)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.	53 (2.5)	43 (2.7)	44 (2.1)
Teachers should explain an idea to students before having them investigate the idea.	34 (2.1)	31 (2.9)	32 (2.3)

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

Similar to science teachers, mathematics teachers also have relatively strong reform-oriented beliefs (see Table 2.31). Traditional beliefs are also fairly common among mathematics teachers at all grade levels.

Table 2.31
Mean Scores for Mathematics Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Elementary	59 (0.9)	84 (0.6)
Middle	60 (1.1)	84 (0.8)
High	61 (0.9)	79 (0.5)

Computer science teachers' views also echo those of science and mathematics teachers, as at least 90 percent agree that students should learn computer science by doing computer science and learn best when instruction is connected to their everyday lives, that teachers should ask students to justify their solutions, and that most class periods should provide opportunities for students to share their thinking and reasoning (see Table 2.32).

Although most computer science teachers agree with statements characteristic of reform-oriented instruction, a majority still hold beliefs aligned with more traditional instruction. For example, 71 percent agree that hands-on/manipulatives/programming activities should be used primarily to reinforce a computer science idea that the students have already learned. Similar to their mathematics counterparts, 3 out of 4 high school computer science teachers agree that at the beginning of instruction on a computer science idea, students should be provided with definitions for new vocabulary that will be used.

Table 2.32
High School Computer Science Teachers Agreeing† With Various Statements About Teaching and Learning

	PERCENT OF TEACHERS
Reform-Oriented Beliefs	
Students should learn computer science by doing computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts).	97 (1.2)
Teachers should ask students to justify their solutions to a computational problem.	92 (1.6)
Most class periods should provide opportunities for students to share their thinking and reasoning.	91 (2.5)
Students learn best when instruction is connected to their everyday lives.	90 (2.0)
Most class periods should provide opportunities for students to apply computer science ideas to real-world contexts.	79 (3.1)
It is better for computer science instruction to focus on ideas in depth, even if that means covering fewer topics.	58 (3.9)
Traditional Beliefs	
At the beginning of instruction on a computer science idea, students should be provided with definitions for new vocabulary that will be used.	75 (2.7)
Hands-on/manipulatives/programming activities should be used primarily to reinforce a computer science idea that the students have already learned.	71 (3.5)
Students learn computer science best in classes with students of similar abilities.	51 (3.3)

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

As can be seen in Table 2.33, high school computer science teachers have relatively strong reform-oriented beliefs. In addition, computer science teachers hold relatively strong traditional beliefs about instruction, even more so than their science and mathematics counterparts.

Table 2.33
Mean Scores for High School Computer Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE
Reform-Oriented Beliefs	82 (0.9)
Traditional Beliefs	67 (1.4)

Because beliefs are important mediators of behaviors, it is worth examining whether teachers' beliefs vary by the context in which they teach or the students they serve. Tables 2.34–2.36 display class mean scores for the teacher belief composites by a number of equity factors.

Table 2.34 presents composite scores for science teachers' beliefs about teaching and learning by two equity factors: the prior achievement level of the class and the proportion of students in the school who are eligible for free/reduced-price lunch. Teachers of classes composed of students characterized as mostly low prior achievers are somewhat more likely to hold traditional beliefs and slightly less likely to hold reform-oriented beliefs about science instruction. Science classes in schools with the highest proportions of students eligible for free/reduced-price lunch are more likely to be taught by teachers with more traditional beliefs than those in low-poverty schools, though the difference is small.

Table 2.34
Equity Analyses of Class Mean Scores for Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Prior Achievement Level of Class		
Mostly High	57 (1.4)	88 (0.5)
Average/Mixed	55 (0.8)	87 (0.5)
Mostly Low	61 (1.5)	84 (1.1)
Percent of Students in School Eligible for FRL		
Lowest Quartile	54 (1.1)	87 (0.7)
Second Quartile	56 (1.1)	86 (0.8)
Third Quartile	56 (2.4)	87 (0.7)
Highest Quartile	60 (0.9)	86 (0.7)

Data in Table 2.35 suggest weak relationships between mathematics teachers' beliefs and the proportion of students in the class from race/ethnicity groups historically underrepresented in STEM and the proportion of students in the school who are eligible for free/reduced-price lunch. Interestingly, the two factors share the same pattern, with traditional beliefs and reform-oriented beliefs being strongest among teachers of classes with the greatest percentage of students from race/ethnicity groups historically underrepresented in STEM and students eligible for free/reduced-price lunch.

Table 2.35
Equity Analyses of Class Mean Scores for Mathematics Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	58 (0.9)	81 (0.7)
Second Quartile	60 (1.1)	82 (0.8)
Third Quartile	59 (1.3)	84 (0.6)
Highest Quartile	63 (1.0)	85 (0.7)
Percent of Students in School Eligible for FRL		
Lowest Quartile	57 (0.9)	82 (0.7)
Second Quartile	59 (1.2)	82 (0.7)
Third Quartile	61 (1.1)	84 (0.7)
Highest Quartile	63 (1.0)	85 (0.7)

As can be seen in Table 2.36, there does not appear to be a relationship between computer science teachers' beliefs and the proportion of students in the class from race/ethnicity groups historically underrepresented in STEM. Classes in schools with the highest proportions of students eligible for free/reduced-price lunch are somewhat more likely to be taught by teachers with stronger reform-oriented beliefs than those in low-poverty schools.

Table 2.36
Equity Analyses of Class Mean Scores for High School Computer Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	65 (2.1)	80 (1.7)
Second Quartile	72 (4.1)	82 (2.5)
Third Quartile	61 (1.8)	85 (1.8)
Highest Quartile	66 (4.5)	84 (1.8)
Percent of Students in School Eligible for FRL		
Lowest Quartile	65 (1.7)	80 (1.4)
Second Quartile	67 (3.5)	82 (1.6)
Third Quartile	69 (5.2)	86 (2.4)
Highest Quartile	61 (2.8)	85 (2.3)

Teachers' Perceptions of Preparedness

Elementary teachers are typically assigned to teach multiple subjects to a single group of students, including not only science and mathematics, but other areas as well. However, as can be seen in Table 2.37, these teachers do not feel equally well prepared to teach the various subjects. Although 73 percent of elementary teachers of self-contained classes feel very well prepared to teach mathematics—slightly lower than the 77 percent for reading/language arts—only 31 percent feel very well prepared to teach science, and only 6 percent feel very well prepared to teach computer science or programming.

Table 2.37
Elementary Teachers' Perceptions of Their Preparedness to Teach Each Subject

	PERCENT OF TEACHERS†			
	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
Reading/Language arts	0 (0.1)	3 (0.5)	19 (1.0)	77 (1.2)
Mathematics	0 (0.1)	4 (0.7)	23 (1.6)	73 (1.6)
Social studies	3 (0.5)	15 (1.0)	39 (1.4)	42 (1.3)
Science	4 (0.8)	23 (1.8)	42 (1.9)	31 (1.9)
Computer science/programming	45 (1.8)	35 (1.5)	14 (1.1)	6 (0.7)

† Includes only teachers assigned to teach multiple subjects to a single class of students in grades K–6.

As noted earlier, teachers of self-contained classes were randomly assigned to respond to either the science or mathematics teacher questionnaire. Those who received the science questionnaire were asked about their preparedness to teach each of the major science disciplines to that class, and those receiving the mathematics questionnaire were asked about a number of mathematics areas.

As can be seen in Table 2.38, elementary teachers are more likely to feel very well prepared to teach life science and Earth science than they are to teach physical science. Engineering stands out as the area where elementary teachers feel least prepared, with only 3 percent feeling very well prepared to teach it at their grade level, and 51 percent noting that they are not adequately prepared.

Table 2.38
Elementary Teachers' Perceptions of Their Preparedness to Teach Various Science Disciplines

	PERCENT OF TEACHERS			
	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
Life science	3 (0.7)	24 (1.8)	49 (1.8)	24 (1.5)
Earth/Space science	6 (0.8)	27 (1.5)	47 (1.7)	20 (1.5)
Physical science	11 (1.3)	35 (1.6)	41 (2.1)	13 (1.1)
Engineering	51 (2.2)	33 (1.8)	14 (1.2)	3 (0.6)

Table 2.39 provides data on elementary teachers' perceptions of their preparedness to teach each of a number of mathematics topics at their assigned grade level. Interestingly, 74 percent of elementary teachers feel very well prepared to teach number and operations, which is about the same proportion that feel very well prepared to teach mathematics in general. The fact that markedly fewer teachers feel very well prepared to teach measurement and data representation, geometry, and early algebra suggests that elementary teachers equate teaching mathematics with teaching number and operations.

Table 2.39
Elementary Teachers' Perceptions of Their Preparedness to Teach Various Mathematics Topics

	PERCENT OF TEACHERS			
	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
Number and operations	0 (0.1)	2 (0.5)	23 (1.7)	74 (1.7)
Measurement and data representation	3 (0.5)	8 (1.1)	37 (1.8)	53 (1.8)
Geometry	4 (0.7)	12 (1.3)	35 (1.8)	49 (2.2)
Early algebra	6 (0.9)	17 (1.2)	36 (2.1)	41 (1.9)

As noted earlier, the teacher questionnaires included a series of items about a single, randomly selected class. Middle and high school science teachers were shown a list of topics based on the subject of that class and asked how well prepared they felt to teach each of those topics at the grade levels they teach. As can be seen in Table 2.40, high school science teachers are more likely than their middle grades counterparts to feel very well prepared to teach topics within each discipline. In addition, high school chemistry teachers are more likely to feel well prepared than teachers in any other subject/grade level group, with 76–89 percent considering themselves very well prepared to teach the various topics. It is interesting to note the variation among topics within physics, with only 19 percent of high school physics teachers feeling very well prepared to teach modern physics (e.g., relativity) compared to 45–79 percent for the other topics in the list.

Table 2.40
Secondary Science Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics, by Grade Range

	PERCENT OF TEACHERS†	
	MIDDLE	HIGH
Earth/Space Science		
Earth's features and physical processes	42 (2.2)	64 (7.0)
The solar system and the universe	32 (2.0)	60 (7.0)
Climate and weather	31 (2.3)	60 (7.0)
Biology/Life Science		
Cell biology	50 (2.6)	74 (2.6)
Structures and functions of organisms	55 (2.7)	70 (3.3)
Genetics	46 (3.0)	70 (3.2)
Ecology/ecosystems	52 (3.0)	65 (2.5)
Evolution	40 (2.8)	63 (2.5)
Chemistry		
The periodic table	47 (3.0)	89 (2.4)
States, classes, and properties of matter	55 (2.6)	88 (2.4)
Atomic structure	46 (3.2)	87 (2.9)
Elements, compounds, and mixtures	45 (2.6)	87 (3.0)
Chemical bonding, equations, nomenclature, and reactions	28 (2.6)	83 (3.3)
Properties of solutions	30 (2.2)	76 (3.1)
Physics		
Forces and motion	44 (3.5)	79 (4.2)
Energy transfers, transformations, and conservation	39 (3.0)	72 (4.6)
Properties and behaviors of waves	21 (2.1)	57 (4.8)
Electricity and magnetism	19 (2.0)	45 (4.4)
Modern physics	7 (1.3)	19 (2.7)
Environmental and Resource Issues (e.g., land and water use, energy resources and consumption, sources and impacts of pollution)	31 (2.8)	63 (6.7)

† Each secondary science teacher was asked about one set of science topics based on the discipline of his/her randomly selected class.

Table 2.41 displays mean scores for the composite variable Perceptions of Content Preparedness, which was defined based on the content of the targeted class. The mean scores indicate that elementary teachers generally do not feel well prepared to teach science. In addition, high school science teachers feel better prepared to teach science than their middle school counterparts.

Table 2.41
Mean Scores for Science Teachers' Perceptions of Content Preparedness Composite

	MEAN SCORE
Elementary	50 (0.8)
Middle	71 (0.8)
High	88 (0.6)

Secondary science teachers were also asked about their preparedness to teach engineering, regardless of the discipline of their designated class. As can be seen in Table 2.42, very few middle and high school science teachers feel very well prepared to teach engineering concepts, and sizeable proportions indicate being not adequately prepared. This finding is not surprising given that few teachers have had college coursework in engineering and engineering has not historically been part of the school curriculum. K–12 teachers will likely need both high-quality curriculum and substantive professional development to be successful at integrating engineering into their science teaching.

Table 2.42
Secondary Science Teachers' Perceptions of Their Preparedness to Teach Engineering

	PERCENT OF TEACHERS			
	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
Middle				
Developing possible solutions	28 (2.2)	32 (2.2)	26 (1.9)	14 (1.8)
Defining engineering problems	29 (2.1)	35 (2.3)	24 (2.0)	12 (1.6)
Optimizing a design solution	32 (2.2)	33 (2.2)	24 (1.9)	10 (1.6)
High				
Developing possible solutions	34 (1.9)	36 (1.9)	22 (1.4)	8 (0.8)
Defining engineering problems	38 (1.8)	38 (1.7)	18 (1.2)	7 (0.7)
Optimizing a design solution	42 (1.8)	36 (1.7)	16 (1.1)	6 (0.7)

The relatively low scores on the Perceptions of Preparedness to Teach Engineering composite, shown in Table 2.43, indicate that middle and high school science teachers do not feel adequately prepared to teach engineering. Interestingly, middle school science teachers feel significantly more prepared in this area than high school science teachers.

Table 2.43
Mean Scores for Secondary Science Teachers' Perceptions of Preparedness to Teach Engineering Composite

	MEAN SCORE
Middle	43 (1.4)
High	33 (1.0)

Table 2.44 provides data on secondary mathematics teachers' perceptions of preparedness to teach each of a number of mathematics topics. At each grade level, teachers are most likely to feel very well prepared to teach the number system and operations and algebraic thinking, and far less likely to feel that level of preparedness for discrete mathematics. High school mathematics teachers are substantially more likely than middle school teachers to feel very well prepared to teach many of the listed topics. However, in the case of statistics and probability, middle grades teachers are more likely than high school teachers to feel very well prepared. In addition, very few secondary mathematics teachers consider themselves very well prepared to teach computer science/programming ideas.

Table 2.44
Secondary Mathematics Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics, by Grade Range

	PERCENT OF TEACHERS	
	MIDDLE	HIGH
The number system and operations	85 (1.4)	89 (0.9)
Algebraic thinking	78 (1.7)	89 (0.9)
Functions	57 (2.0)	84 (1.4)
Measurement	61 (2.0)	74 (1.3)
Geometry	59 (2.3)	65 (1.4)
Modeling	46 (2.4)	59 (1.8)
Statistics and probability	40 (2.4)	31 (1.7)
Discrete mathematics	12 (1.4)	21 (1.3)
Computer science/programming	4 (0.7)	5 (0.8)

Table 2.45 shows mathematics teachers' scores on the Perceptions of Content Preparedness composite. Similar to science teachers, high school mathematics teachers feel better prepared than middle school mathematics teachers. Elementary teachers feel as prepared to teach mathematics as do middle school mathematics teachers, and substantively more prepared in mathematics than they do in science.

Table 2.45
Mean Scores for Mathematics Teachers' Perceptions of Content Preparedness Composite

	MEAN SCORE
Elementary	79 (0.7)
Middle	78 (0.7)
High	82 (0.6)

High school computer science teachers were also asked about their preparedness to teach each of a number of topics related to computing and programming. As can be seen in Table 2.46, fewer than half consider themselves very well prepared in any of the topics, though they are more likely to feel well prepared to teach about algorithms and programming than about networks and the Internet (47 vs. 23 percent, respectively).

Table 2.46
High School Computer Science Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics

	PERCENT OF TEACHERS
Algorithms and programming	47 (4.0)
Impacts of computing	35 (3.4)
Computing systems	31 (3.9)
Data and analysis	27 (4.1)
Networks and the Internet	23 (3.4)

These items were combined into a composite variable measuring high school computer science teachers' perceptions of content preparedness (see Table 2.47). Compared to high school science and mathematics teachers, high school computer science teachers perceive themselves to be far less prepared to teach their respective content.

Table 2.47
Mean Scores for High School Computer Science Teachers' Perceptions of Content Preparedness Composite

	MEAN SCORE
Overall	64 (1.5)

Two series of items focused on teacher preparedness for a number of tasks associated with instruction. First, teachers were asked how well prepared they feel to carry out a number of tasks in instruction, including developing students' understanding and abilities, encouraging participation of students, and differentiating their instruction to meet learners' needs. Second, teachers were asked about how well prepared they feel to monitor and address student understanding, focusing on a specific unit in the randomly selected class.

As can be seen in Table 2.48, science teacher preparedness tends to increase with increasing grade range. For example, only 23 percent of elementary teachers feel very well prepared to develop students' conceptual understanding of science ideas, compared to 42 percent of middle grades teachers and 58 percent of high school teachers. A majority of high school teachers also feel very well prepared to use formative assessment to monitor student learning; the proportion of teachers feeling very well prepared increases with increasing grade level. Fewer teachers at all grade levels feel very well prepared to provide science instruction that is based on students' ideas, develop students' awareness of STEM careers, and incorporate students' cultural backgrounds into science instruction.

Table 2.48
Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Develop students' conceptual understanding	23 (1.5)	42 (2.2)	58 (1.5)
Use formative assessment to monitor student learning	28 (1.7)	48 (2.2)	52 (1.6)
Develop students' abilities to do science (e.g., develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)	17 (1.5)	38 (1.9)	46 (1.6)
Encourage students' interest in science and/or engineering	26 (1.3)	42 (2.2)	44 (1.6)
Encourage participation of all students in science and/or engineering	31 (1.6)	44 (2.3)	43 (1.6)
Differentiate science instruction to meet the needs of diverse learners	19 (1.3)	33 (2.0)	35 (1.5)
Provide science instruction that is based on students' ideas	12 (1.1)	21 (1.8)	25 (1.4)
Develop students' awareness of STEM careers	9 (0.9)	21 (1.8)	21 (1.2)
Incorporate students' cultural backgrounds into science instruction	11 (1.1)	15 (1.3)	18 (1.4)

The items in Table 2.48 were combined into a composite variable to examine science teachers' overall perceptions of pedagogical preparedness. As can be seen in Table 2.49, secondary science teachers feel more prepared in this area than elementary science teachers.

Table 2.49
Mean Scores for Science Teachers' Perceptions of Pedagogical Preparedness Composite

	MEAN SCORE
Elementary	57 (0.8)
Middle	68 (0.9)
High	71 (0.6)

Table 2.50 shows the percentage of science classes at each grade level taught by teachers who feel very well prepared for each of a number of tasks related to instruction within a particular unit in a designated class. Two findings are notable. First, secondary teachers feel better prepared for these tasks than elementary teachers. Second, science teachers, regardless of grade level, tend to feel less well prepared for finding out what students already know or think about the key science ideas to be addressed, and anticipating what students might find difficult in the unit.

Table 2.50
Science Classes in Which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit in a Designated Class, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Assess student understanding at the conclusion of this unit	32 (1.8)	58 (2.0)	59 (1.8)
Monitor student understanding during this unit	33 (1.9)	51 (2.1)	53 (1.8)
Implement the instructional materials to be used during this unit	32 (2.0)	45 (2.4)	53 (1.6)
Anticipate difficulties that students may have with particular science ideas and procedures in this unit	22 (1.9)	37 (2.1)	45 (1.6)
Find out what students thought or already knew about the key science ideas	31 (2.2)	39 (2.1)	38 (1.6)

The items in Table 2.50 were combined to create a composite variable named Perceptions of Preparedness to Implement Instruction in Particular Unit. As can be seen in Table 2.51, feelings of preparedness increase with increasing grade range.

Table 2.51
Mean Scores for Science Teachers' Perceptions of Preparedness to Implement Instruction in Particular Unit Composite

	MEAN SCORE
Elementary	68 (0.9)
Middle	77 (0.9)
High	80 (0.5)

As can be seen in Table 2.52, mathematics teachers' feelings of pedagogical preparedness differ by grade range. High school teachers tend to feel more prepared than those at the elementary level to carry out tasks related to deepening students' understanding. For example, about two-thirds of high school mathematics teachers feel very well prepared to develop students' abilities to do mathematics and develop students' conceptual understanding, compared to 46 percent of elementary teachers. In contrast, elementary teachers are more likely than their secondary counterparts to feel very well prepared to encourage students' interest and participation in mathematics. As in science, few mathematics teachers at any grade level feel very well prepared to incorporate students' cultural backgrounds into instruction and develop students' awareness of STEM careers.

Table 2.52
Mathematics Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	46 (1.7)	55 (2.1)	66 (2.0)
Develop students' conceptual understanding	46 (1.6)	49 (2.2)	61 (1.8)
Use formative assessment to monitor student learning	53 (1.7)	57 (2.2)	57 (1.6)
Encourage participation of all students in mathematics	56 (1.6)	49 (2.1)	46 (1.8)
Encourage students' interest in mathematics	42 (1.9)	37 (2.0)	38 (1.5)
Differentiate mathematics instruction to meet the needs of diverse learners	41 (1.9)	36 (2.2)	33 (1.6)
Provide mathematics instruction that is based on students' ideas	19 (1.6)	23 (1.7)	26 (1.5)
Incorporate students' cultural backgrounds into mathematics instruction	15 (1.5)	13 (1.1)	17 (1.3)
Develop students' awareness of STEM careers	8 (1.0)	10 (0.9)	15 (1.1)

In contrast to the pattern in science teachers' perceptions of pedagogical preparedness, mathematics perceptions are fairly consistent across all grade bands (see Table 2.53). In addition, elementary mathematics teachers feel more pedagogically prepared than elementary science teachers, which is not surprising given that self-contained elementary teachers consider themselves far more prepared to teach mathematics than science. Middle and high school teachers' perceptions of pedagogical preparedness are very similar across the two subjects.

Table 2.53
Mean Scores for Mathematics Teachers' Perceptions of Pedagogical Preparedness Composite

	MEAN SCORE
Elementary	69 (0.7)
Middle	69 (0.8)
High	71 (0.5)

Table 2.54 shows the percentage of elementary, middle, and high school mathematics classes taught by teachers who feel very well prepared for each of a number of instructional tasks. As is the case in science, mathematics teachers tend to feel less well prepared to find out what students thought or already knew about the key ideas to be addressed in the unit.

Table 2.54
Mathematics Classes in Which Teachers Feel Very Well Prepared for Various Tasks in the Most Recent Unit, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Assess student understanding at the conclusion of this unit	64 (1.9)	62 (2.3)	68 (1.4)
Implement the instructional materials to be used during this unit	55 (1.8)	55 (2.0)	61 (1.6)
Monitor student understanding during this unit	60 (1.8)	57 (1.9)	60 (1.6)
Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit	43 (1.7)	50 (2.1)	59 (1.6)
Find out what students thought or already knew about the key mathematical ideas	42 (2.1)	38 (2.2)	47 (1.5)

As can be seen in Table 2.55, mathematics teachers feel relatively well prepared to implement instruction in a particular unit. Among the three grade bands, high school teachers feel slightly more prepared than elementary and middle grades teachers.

Table 2.55
Mean Scores for Mathematics Teachers' Perceptions of Preparedness to Implement Instruction in Particular Unit Composite

	MEAN SCORE
Elementary	81 (0.8)
Middle	80 (1.0)
High	83 (0.6)

In high school computer science, roughly half of teachers feel very well prepared to encourage students' interest in computer science, develop students' ability to do computer science, and encourage participation of all students in computer science (see Table 2.56). Fewer than one-quarter feel very well prepared to differentiate computer science instruction to meet the needs of diverse learners or to incorporate students' cultural backgrounds into computer science instruction.

Table 2.56
High School Computer Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	PERCENT OF TEACHERS
Encourage students' interest in computer science	49 (3.6)
Develop students' abilities to do computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	48 (3.7)
Encourage participation of all students in computer science	45 (3.8)
Develop students' conceptual understanding	42 (3.6)
Develop students' awareness of STEM careers	36 (4.2)
Use formative assessment to monitor student learning	35 (3.4)
Provide computer science instruction that is based on students' ideas	28 (3.9)
Differentiate computer science instruction to meet the needs of diverse learners	21 (3.3)
Incorporate students' cultural backgrounds into computer science instruction	16 (3.1)

Table 2.57 shows the mean composite score for high school computer science teachers' perceptions of pedagogical preparedness. The mean score of 68 is quite similar to the mean score for high school science and mathematics teachers.

Table 2.57
Mean Scores for High School Computer Science Teachers' Perceptions of Pedagogical Preparedness Composite

	MEAN SCORE
Overall	68 (1.7)

High school computer science teachers were also asked about their preparedness for unit-related tasks. As can be seen in Table 2.58, computer science teachers tend to feel less well prepared for (1) finding out what students thought or already knew about the key ideas to be addressed in the unit and (2) anticipating what difficulties students may have in the unit than they do for monitoring understanding during or assessing understanding at the end of the unit.

Table 2.58
High School Computer Science Classes in Which Teachers Feel Very Well Prepared for Various Tasks in the Most Recent Unit

	PERCENT OF CLASSES
Monitor student understanding during this unit	43 (4.6)
Assess student understanding at the conclusion of this unit	41 (4.0)
Implement the instructional materials to be used during this unit	41 (4.2)
Find out what students thought or already knew about the key computer science ideas	29 (4.6)
Anticipate difficulties that students may have with particular computer science ideas and procedures in this unit	26 (3.9)

High school computer science teachers' perceptions of preparedness to implement instruction in a particular unit are shown in Table 2.59. Their feelings of preparedness in this area are consistent with their perceptions of pedagogical preparedness more broadly (see Table 2.57).

Table 2.59
Mean Scores for High School Computer Science Teachers' Perceptions of Preparedness to Implement Instruction in Particular Unit Composite

	MEAN SCORE
Overall	71 (1.6)

Scores on the teacher perceptions of preparedness composites were analyzed by a number of equity variables. In science, the most striking differences are among classes of students with different levels of prior achievement (see Table 2.60). Compared to classes of mostly low prior achievers, teachers of classes with mostly high prior achievers are more likely to feel well prepared to teach science content, implement pedagogies (e.g., develop students' abilities to do science, encourage students' interest in science and/or engineering), and implement instruction in a particular unit. Although the same pattern appears in teachers' perceptions of preparedness to teach engineering, the difference between classes of mostly high prior achievers and mostly low prior achievers is not statistically significant. In addition, classes containing a higher proportion of students from race/ethnicity groups historically underrepresented in STEM and classes in higher-poverty schools are less likely to be taught by teachers who feel well prepared to teach science content and implement instruction in a particular unit.

Table 2.60
Equity Analyses of Class Mean Scores for Science Teacher Perceptions of Preparedness Composites

	MEAN SCORE			
	SCIENCE CONTENT PREPAREDNESS	PREPAREDNESS TO TEACH ENGINEERING†	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class				
Mostly High	81 (1.3)	38 (1.9)	72 (1.1)	82 (0.9)
Average/Mixed	62 (0.8)	38 (1.0)	63 (0.7)	73 (0.6)
Mostly Low	61 (1.7)	33 (2.6)	60 (1.3)	69 (1.4)
Percent of Historically Underrepresented Students in Class				
Lowest Quartile	67 (1.4)	38 (1.8)	64 (0.9)	75 (1.0)
Second Quartile	66 (1.3)	37 (1.7)	65 (1.0)	77 (0.9)
Third Quartile	63 (1.5)	39 (1.6)	64 (1.1)	74 (1.0)
Highest Quartile	62 (1.5)	35 (2.0)	62 (1.7)	70 (1.4)
Percent of Students in School Eligible for FRL				
Lowest Quartile	68 (1.6)	38 (1.5)	64 (1.0)	76 (0.9)
Second Quartile	65 (1.5)	39 (1.5)	65 (1.1)	75 (0.9)
Third Quartile	63 (1.5)	35 (1.6)	63 (1.3)	73 (1.1)
Highest Quartile	62 (1.5)	37 (2.2)	63 (1.4)	71 (1.4)

† The Perceptions of Preparedness to Teach Engineering composite was computed only for secondary science classes.

Table 2.61 shows the mean scores on each of the teacher preparedness composites for mathematics classes by the same three equity variables. As is the case in science, classes of mostly high prior achievers are significantly more likely than those that include mostly low prior achievers to be taught by teachers who feel well prepared in mathematics content and to implement instruction in a particular unit. Also similar to science, classes containing a higher proportion of students from race/ethnicity groups historically underrepresented in STEM and classes in higher poverty schools are somewhat less likely to be taught by teachers who feel well prepared to implement instruction in a particular unit.

Table 2.61
Equity Analyses of Class Mean Scores for Mathematics Teacher Perceptions of Preparedness Composites

	MEAN SCORE		
	CONTENT PREPAREDNESS	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class			
Mostly High	84 (0.8)	71 (0.9)	85 (0.8)
Average/Mixed	79 (0.5)	70 (0.6)	82 (0.6)
Mostly Low	78 (1.1)	69 (1.1)	79 (1.0)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	81 (0.7)	68 (0.7)	83 (0.7)
Second Quartile	80 (0.8)	70 (0.8)	83 (0.9)
Third Quartile	78 (0.7)	70 (1.0)	81 (1.1)
Highest Quartile	79 (0.9)	71 (0.8)	80 (0.7)
Percent of Students in School Eligible for FRL			
Lowest Quartile	82 (0.7)	71 (0.8)	84 (0.8)
Second Quartile	79 (0.8)	69 (0.8)	82 (1.0)
Third Quartile	79 (0.9)	68 (0.9)	80 (0.9)
Highest Quartile	79 (0.9)	71 (0.8)	80 (0.7)

When examining these composites by equity factors for high school computer science, the results differ from those in science and mathematics (see Table 2.62). Although there appear to be relationships between the composites and the equity factors, none of the differences are statistically significant.

Table 2.62
Equity Analyses of Class Mean Scores for High School Computer Science Teacher Perceptions of Preparedness Composites

	MEAN SCORE		
	CONTENT PREPAREDNESS	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class			
Mostly High	68 (2.3)	67 (2.2)	73 (3.1)
Average/Mixed	67 (2.1)	71 (2.3)	72 (2.3)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	64 (3.9)	65 (2.7)	70 (3.4)
Second Quartile	72 (3.5)	74 (3.8)	72 (3.1)
Third Quartile	65 (3.8)	68 (2.9)	75 (2.6)
Highest Quartile	69 (2.8)	73 (2.6)	73 (4.2)
Percent of Students in School Eligible for FRL			
Lowest Quartile	68 (1.9)	69 (2.4)	75 (2.1)
Second Quartile	66 (2.4)	68 (2.5)	70 (4.0)
Third Quartile	66 (5.1)	70 (4.6)	72 (2.5)
Highest Quartile	71 (4.8)	75 (3.9)	70 (5.8)

Teachers' Leadership Roles and Responsibilities

In addition to asking teachers about their educational background, beliefs, and preparedness, the survey asked teachers whether they have served in various leadership roles in the profession in the last three years. As can be seen in Table 2.63, elementary science teachers are far less likely than secondary teachers to have had many of these responsibilities. For example, 44–51 percent of secondary science teachers have: (1) served on a school- or district-wide committee specific to their subject or (2) observed another teachers' science lesson in order to provide feedback. Relatively few elementary science teachers have served in these roles. Elementary teachers may have fewer opportunities to serve on subject-specific committees or as an observer, as many are responsible for teaching all subjects in a self-contained setting on the same schedule as their colleagues. Secondary science teachers are also more likely than elementary teachers to have served as a formal mentor or coach for a science teacher. In contrast, elementary teachers are more likely to have supervised student teachers in the last three years.

Table 2.63
Science Teachers Having Various Leadership Responsibilities Within the Last Three Years, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Served on a school or district/diocese-wide science committee	22 (1.9)	44 (3.1)	51 (2.0)
Observed another teacher's science lesson for the purpose of giving him/her feedback	11 (1.6)	44 (3.1)	50 (2.3)
Taught a science lesson for other teachers in their school to observe	8 (1.1)	37 (2.9)	38 (2.1)
Served as a lead teacher or department chair in science	14 (1.6)	37 (2.7)	33 (2.0)
Led or co-led a workshop or professional learning community for other teachers focused on science or science teaching	8 (1.4)	22 (2.3)	28 (1.7)
Served as a formal mentor or coach for a science teacher	4 (0.7)	21 (2.1)	27 (1.8)
Supervised a student teacher in their classroom	30 (2.2)	22 (2.2)	22 (2.3)

Roles and responsibilities held by mathematics teachers within the past three years are quite similar to those held by science teachers and vary by grade range in similar ways (see Table 2.64). Secondary mathematics teachers, like secondary science teachers, are more likely than their elementary counterparts to have served as a formal mentor but less likely to have supervised student teachers. Elementary teachers are much more likely to have taught a mathematics lesson for other teachers in their school to observe than a science lesson.

Table 2.64
Mathematics Teachers Having Various Leadership Responsibilities Within the Last Three Years, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Observed another teacher's mathematics lesson for the purpose of giving him/her feedback	27 (1.9)	47 (3.0)	53 (2.0)
Served on a school or district/diocese-wide mathematics committee	21 (1.6)	45 (2.9)	49 (2.1)
Taught a mathematics lesson for other teachers in their school to observe	28 (1.7)	43 (2.9)	41 (2.4)
Served as a formal mentor or coach for a mathematics teacher	6 (1.2)	21 (1.9)	29 (2.0)
Served as a lead teacher or department chair in mathematics	14 (1.6)	31 (2.3)	28 (1.8)
Led or co-led a workshop or professional learning community for other teachers focused on mathematics or mathematics teaching	10 (1.2)	23 (2.2)	26 (1.8)
Supervised a student teacher in their classroom	27 (2.2)	21 (2.1)	20 (1.8)

Table 2.65 shows results in this area for high school computer science teachers. Over a third have (1) served on a school computer science committee, (2) been a lead teacher or department chair, and (3) taught a computer science lesson for other teachers to observe. Results in this area may be lower for computer science than the other subjects because, in high schools that offer computer science, many have only one computer science teacher.

Table 2.65
High School Computer Science Teachers Having Various Leadership Responsibilities Within the Last Three Years

	PERCENT OF TEACHERS
Served on a school or district/diocese-wide computer science committee	39 (4.0)
Served as a lead teacher or department chair	36 (3.6)
Taught a computer science lesson for other teachers to observe	36 (3.7)
Led or co-led a workshop or professional learning community for other teachers focused on computer science or computer science teaching	22 (3.1)
Observed another teacher's computer science lesson for the purpose of giving him/her feedback	17 (2.7)
Supervised a student teacher in their classroom	15 (2.6)
Served as a formal mentor or coach for a computer science teacher	10 (2.2)

Summary

Data in this chapter provide insight on teachers' preparation and indicate that science and mathematics teachers, especially in the elementary and middle grades, do not have strong content preparation in their respective subjects. Elementary teachers are typically assigned to teach science, mathematics, and other academic subjects to one group of students, but it is clear that they do not feel equally prepared in each area. About three-quarters of elementary teachers feel very well prepared to teach reading/language arts and mathematics, but fewer than half feel very well prepared to teach science.

In part, this result may be due to very few elementary science and mathematics teachers having undergraduate majors in these fields. Elementary teachers also have less extensive college coursework in science/mathematics than their middle grades counterparts, who in turn have had less science/mathematics coursework than their high school counterparts. High school computer science teachers have had little college coursework in their field, with only about one-quarter having a degree in the subject. Many teachers at all grade levels have less extensive backgrounds in the discipline they teach than is recommended by NSTA, NCTM, and CTSA/ ISTE. In addition, few science teachers, at any grade level, feel well prepared to teach engineering, a key element of the Next Generation Science Standards (NGSS).

Teachers' beliefs about effective instruction are, in some ways, in line with current recommendations from research and, in other ways, are not well aligned. A large majority of teachers in all subject/grade-range categories hold relatively strong reform-oriented beliefs (e.g., believing that it is better to cover fewer topics in depth). However, many continue to share beliefs characteristic of more traditional instruction, such as believing that students should be given definitions for new vocabulary at the beginning of instruction, that teachers should explain an idea to students before having them consider evidence for it, and that hands-on activities should be used primarily to reinforce ideas students have already learned.

The 2018 NSSME+ also found that well-prepared teachers are not necessarily equitably distributed. Classes in schools with high proportions of students eligible for free/reduced-price lunch are more likely than classes in schools with few such students to be taught by new teachers. In addition, science and mathematics classes categorized as consisting of "mostly high prior achievers" are more likely than those categorized as "mostly low prior achievers" to be taught by teachers who feel well prepared to implement instruction in a particular unit (e.g., implement the instructional materials, monitor student understanding). Unlike science and mathematics, there are no statistically significant differences by these factors for computer science classes.

About half or fewer science and mathematics teachers have held various leadership roles in the profession (e.g., serving on a science committee, supervising a student teacher, leading a workshop) in the last three years. In most cases, elementary science and mathematics teachers are the least likely to hold such roles, with the exception of supervising a student teacher, in which elementary teachers are more likely than their secondary counterparts. Fewer than 40 percent of high school computer science teachers have served in such capacities. These teachers may have limited opportunities to take on roles such as observing others' instruction, teaching a lesson for others to observe, or serving as a mentor, because in many high schools that offer computer science courses, there is only one computer science teacher.

CHAPTER 3

Science, Mathematics, and Computer Science Professional Development

Overview

Science, mathematics, and computer science teachers, like all professionals, need opportunities to keep up with advances in their field, including both disciplinary content and how to help their students learn important science/mathematics/computer science content. Staying up-to-date is particularly challenging for science and mathematics teachers at the elementary level, since they typically teach multiple subjects. The 2018 NSSME+ collected data on teachers' participation in in-service education and other professional activities, as well as data on study groups, one-on-one coaching, and teacher induction programs provided by schools and districts. These data are discussed in this chapter.

Teacher Professional Development

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 3.1, with the exception of elementary science teachers, roughly 80 percent or more of science, mathematics, and computer science teachers have participated in discipline-focused professional development (i.e., focused on science, mathematics, computer science content or the teaching of science, mathematics, computer science) within the last three years. Elementary science teachers stand out for the relative paucity of professional development in science or science teaching, with fewer than about 60 percent having participated in the last three years.

Table 3.1
Most Recent Participation in Professional Development, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science			
In the last 12 months	36 (2.2)	57 (2.5)	59 (1.8)
1–3 years ago	22 (1.7)	21 (2.2)	24 (1.5)
4–6 years ago	8 (1.2)	6 (1.4)	5 (0.8)
7–10 years ago	5 (0.7)	2 (0.8)	2 (0.4)
More than 10 years ago	6 (1.0)	3 (0.8)	2 (0.6)
Never	24 (1.5)	11 (1.6)	7 (0.9)
Mathematics			
In the last 12 months	59 (2.1)	71 (2.5)	68 (1.7)
1–3 years ago	24 (2.0)	19 (2.0)	21 (1.8)
4–6 years ago	7 (1.1)	5 (1.1)	5 (0.9)
7–10 years ago	1 (0.4)	2 (0.6)	1 (0.3)
More than 10 years ago	2 (0.5)	1 (0.3)	2 (0.7)
Never	5 (1.0)	4 (0.8)	3 (0.5)
Computer Science			
In the last 12 months	n/a	n/a	64 (3.8)
1–3 years ago	n/a	n/a	18 (2.7)
4–6 years ago	n/a	n/a	4 (1.2)
7–10 years ago	n/a	n/a	2 (1.4)
More than 10 years ago	n/a	n/a	1 (0.6)
Never	n/a	n/a	11 (2.7)

Although some involvement in professional development may be better than none, a brief exposure of a few hours over several years is not likely to be sufficient to enhance teachers' knowledge and skills in meaningful ways. Accordingly, teachers across all subject areas were asked about the total amount of time they have spent on discipline-focused professional development in the last three years. As can be seen in Table 3.2, about a quarter of middle school and about a third of high school science teachers have participated in 36 hours or more of science professional development in the last three years; very few elementary teachers have had this amount of professional development in science. A similar pattern exists in mathematics, with about 2 in 5 secondary teachers having participated in at least 36 hours of mathematics-focused professional development in the last three years compared to fewer than 1 in 6 elementary teachers. In contrast, over half of high school computer science teachers have participated in this amount of professional development related to computer science or computer science teaching. This finding most likely reflects the recent national emphasis on computer science in STEM education and the push to develop students' computational thinking skills.

Table 3.2
Time Spent on Professional Development in the Last Three Years, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science			
None	43 (2.2)	22 (2.2)	18 (1.3)
Less than 6 hours	20 (1.6)	8 (1.1)	8 (1.3)
6–15 hours	20 (1.5)	23 (2.4)	18 (1.6)
16–35 hours	12 (1.3)	21 (1.6)	22 (1.3)
36–80 hours	3 (0.7)	16 (1.5)	21 (1.4)
More than 80 hours	1 (0.4)	10 (1.2)	14 (1.0)
Mathematics			
None	16 (1.6)	11 (1.7)	11 (1.2)
Less than 6 hours	17 (1.4)	8 (1.6)	7 (0.9)
6–15 hours	31 (1.6)	20 (2.2)	19 (1.5)
16–35 hours	22 (1.6)	24 (1.7)	22 (1.2)
36–80 hours	10 (1.1)	22 (1.9)	24 (1.5)
More than 80 hours	4 (0.6)	15 (1.2)	16 (1.3)
Computer Science			
None	n/a	n/a	18 (2.9)
Less than 6 hours	n/a	n/a	3 (1.1)
6–15 hours	n/a	n/a	8 (2.0)
16–35 hours	n/a	n/a	17 (2.3)
36–80 hours	n/a	n/a	24 (3.2)
More than 80 hours	n/a	n/a	30 (3.0)

The data were also analyzed by a number of class and school equity factors. Table 3.3 suggests some interesting differences in the extent to which science and mathematics classes with different demographic characteristics have access to teachers who have had a substantial amount of professional development. In science, classes composed of mostly low prior achievers and classes with the highest proportion of students from race/ethnicity groups historically underrepresented in STEM are significantly less likely than classes of high prior achievers and few students from these race/ethnicity groups to be taught by teachers who have participated in more than 35 hours of professional development in the last three years. A similar disparity exists by school size. Only about half as many science classes in the smallest schools compared to classes in the largest schools have access to teachers who have participated in a substantial amount of professional development. In contrast, mathematics classes with the highest proportion of students from race/ethnicity groups historically underrepresented in STEM are more likely than their counterparts to be taught by teachers who have participated in more than 35 hours of professional development in the last three years.

Table 3.3
Equity Analyses of Classes Taught by Teachers With More Than 35 Hours of Professional Development in the Last Three Years, by Subject

	PERCENT OF CLASSES	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	36 (2.6)	36 (2.6)
Average/Mixed	15 (0.8)	24 (1.1)
Mostly Low	15 (2.1)	34 (2.5)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	20 (1.5)	25 (1.9)
Second Quartile	18 (1.7)	26 (2.0)
Third Quartile	19 (1.6)	25 (1.8)
Highest Quartile	15 (1.7)	33 (2.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	20 (1.6)	26 (2.1)
Second Quartile	20 (2.1)	29 (2.3)
Third Quartile	16 (1.7)	25 (2.1)
Highest Quartile	18 (1.8)	32 (2.2)
School Size		
Smallest Schools	9 (1.4)	26 (2.9)
Second Group	17 (2.2)	27 (2.8)
Third Group	18 (1.4)	29 (2.0)
Largest Schools	21 (1.6)	29 (1.7)

Teachers who had recently participated in professional development were asked about the nature of those activities. Data for science, mathematics, and computer science teachers are shown in Table 3.4. For each subject/grade-range combination, workshops are the most prevalent activity, with roughly 90 percent of teachers indicating they have attended a program/workshop related to their discipline. Participation in professional learning communities is the next most prevalent activity, especially for secondary teachers (ranging from 55–68 percent of teachers). Across grade ranges, mathematics teachers are more likely to have received assistance or feedback from a formally designated coach/mentor than their science and computer science colleagues. Also, computer science teachers are far more likely than high school science and mathematics teachers to have completed an online course/webinar.

Table 3.4
Teachers Participating in Various Professional Development Activities in Last Three Years, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Science			
Attended a professional development program/workshop	89 (2.0)	94 (1.2)	91 (1.5)
Participated in a professional learning community/lesson study/ teacher study group	42 (2.9)	61 (3.1)	55 (1.7)
Attended a national, state, or regional science teacher association meeting	12 (1.8)	37 (3.2)	40 (2.0)
Received assistance or feedback from a formally designated coach/mentor	28 (2.6)	33 (3.4)	35 (2.1)
Completed an online course/webinar	9 (1.5)	29 (3.0)	34 (2.2)
Took a formal course for college credit	5 (1.3)	9 (1.5)	16 (1.4)
Mathematics			
Attended a professional development program/workshop	94 (1.1)	93 (1.4)	91 (1.4)
Participated in a professional learning community/lesson study/ teacher study group	53 (2.6)	68 (3.1)	64 (2.1)
Attended a national, state, or regional mathematics teacher association meeting	13 (1.7)	26 (2.4)	34 (2.4)
Received assistance or feedback from a formally designated coach/mentor	47 (2.4)	56 (3.2)	44 (2.4)
Completed an online course/webinar	19 (1.5)	35 (2.9)	32 (2.0)
Took a formal course for college credit	5 (1.1)	15 (2.1)	19 (1.7)
Computer Science			
Attended a professional development program/workshop	n/a	n/a	88 (2.4)
Participated in a professional learning community/lesson study/ teacher study group	n/a	n/a	62 (3.8)
Attended a national, state, or regional computer science teacher association meeting	n/a	n/a	35 (3.9)
Received assistance or feedback from a formally designated coach/mentor	n/a	n/a	29 (3.7)
Completed an online course/webinar	n/a	n/a	59 (4.7)
Took a formal course for college credit	n/a	n/a	20 (3.1)

It is widely agreed upon 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 investigations, both to learn disciplinary content and to experience inquiry-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.[14]

[14] Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, *38*(3), 181–199.

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., and Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*(4), 915–945.

Accordingly, teachers who 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 3.5, 47–62 percent of science teachers, depending on grade range, have worked closely during the professional development with other science colleagues from their school or science teachers in their grade level and/or subject, whether or not they were from the same school. Other relatively common characteristics of their professional development are having opportunities to experience lessons as students would from the textbook/modules used in the classroom (43–45 percent) and engaging in science investigations/engineering design challenges (38–45 percent). Only about a quarter to a third of teachers, depending on grade range, have had substantial opportunities to rehearse instructional practices during professional development.

Table 3.5
Science Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent,† by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Worked closely with other teachers from their school	57 (3.3)	62 (3.5)	55 (2.3)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	47 (3.2)	53 (3.0)	54 (2.1)
Had opportunities to engage in science investigations/engineering design challenges	38 (3.0)	46 (3.5)	45 (2.4)
Had opportunities to experience lessons, as their students would, from the textbook/modules they use in their classroom	43 (3.1)	40 (3.0)	45 (2.4)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	30 (2.6)	40 (3.1)	43 (2.4)
Had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	31 (2.9)	38 (3.1)	39 (2.3)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect on those practices)	23 (2.6)	27 (2.6)	35 (2.3)

† Includes science teachers indicating 4 or 5 on a five-point scale ranging from 1 “not at all” to 5 “to a great extent.”

Similar to science, the most prevalent characteristic of mathematics-focused professional development is working closely with other mathematics teachers, whereas having opportunities to rehearse instructional practices during the professional development is a far less likely activity (see Table 3.6). Roughly 40–50 percent of mathematics teachers have had opportunities in their professional development to apply what they learned in their classroom and then come back and talk about it, examine classroom artifacts, engage in mathematics investigations, and experience lessons as their students would from the textbooks/units they use in their classroom.

Table 3.6
Mathematics Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent,† by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Worked closely with other teachers from their school	69 (2.5)	72 (2.8)	67 (2.2)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	56 (2.1)	58 (3.2)	57 (2.1)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	44 (2.4)	46 (3.3)	46 (2.2)
Had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	46 (2.6)	49 (3.2)	44 (2.0)
Had opportunities to engage in mathematics investigations	46 (2.6)	47 (2.8)	43 (1.9)
Had opportunities to experience lessons, as their students would, from the textbook/units they use in their classroom	48 (2.5)	45 (3.6)	42 (2.4)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect of those practices)	35 (2.2)	34 (3.1)	32 (2.0)

† Includes mathematics teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Table 3.7 shows the data for high school computer science teachers. About three-fourths have had opportunities to engage in activities to learn computer science in the last three years. Another common characteristic is experiencing lessons as students would from the textbooks/units used in the classroom (62 percent). Further, about half of computer science teachers have had substantial opportunities to work closely with other computer science teachers who taught the same grade and/or subject, whether or not they were from their school, and to examine classroom artifacts. As is the case with science and mathematics teachers, high school computer science teachers rarely have had substantial opportunities to rehearse instructional practices during professional development.

Table 3.7
High School Computer Science Teachers Whose Professional Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent†

	PERCENT OF TEACHERS
Had opportunities to engage in activities to learn computer science content	76 (3.6)
Had opportunities to experience lessons, as their students would, from the textbook/units they use in their classroom	62 (3.7)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	51 (4.0)
Had opportunities to examine classroom artifacts (e.g., student work samples, e-portfolios, videos of classroom instruction)	46 (3.9)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	39 (3.5)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect on those practices)	31 (3.8)
Worked closely with other teachers from their school	26 (3.9)

† Includes high school computer science teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Responses to these seven items describing the characteristics of professional development experiences were combined into a single composite variable called Extent Professional Development Aligns with Elements of Effective Professional Development. As can be seen in Table 3.8, the mean scores on this composite are similar across subject/grade-range categories, except for elementary science, where scores are lower than the other subject/grade-range combinations.

Table 3.8
Teacher Mean Scores for Extent Professional Development Aligns With Elements of Effective Professional Development Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	49 (1.4)	58 (1.1)	n/a
Middle	55 (1.4)	59 (1.3)	n/a
High	55 (1.1)	57 (0.9)	56 (1.6)

When looking at the composite scores by equity factors, a number of differences are apparent by both class and school factors (see Table 3.9). Science classes consisting mostly of high-achieving students are more likely than classes of mostly low-achieving students to be taught by teachers who attended high-quality professional development (mean scores of 57 and 48, respectively). A similar pattern exists in terms of school size. Science classes in the largest schools have an advantage over those in the smallest schools when it comes to having access to teachers with effective professional learning experiences (mean scores of 54 and 47, respectively).

In contrast, mathematics classes composed of mostly low-achieving students tend to be taught by teachers with more high-quality professional development experiences than classes with mostly high-achieving students (mean score 61 and 56, respectively). Also, high school computer science classes with the largest proportion of students from race/ethnicity groups historically underrepresented in STEM are more likely to be taught by teachers who have experienced aspects of effective professional development than classes with the smallest proportion of students from these groups (mean score of 64 and 51, respectively). However, it is important to note that for computer science, the highest quartile contains relatively few students from these groups.

Table 3.9
Equity Analyses of Class Mean Scores for Extent Professional Development Aligns With Elements of Effective Professional Development Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Prior Achievement Level of Class			
Mostly High	57 (1.3)	56 (1.4)	55 (1.8)
Average/Mixed	52 (0.8)	58 (0.7)	58 (2.4)
Mostly Low	48 (1.6)	61 (1.5)	n/a
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	52 (1.4)	58 (1.2)	51 (3.2)
Second Quartile	50 (1.5)	54 (1.4)	59 (3.8)
Third Quartile	55 (1.4)	60 (1.3)	56 (2.6)
Highest Quartile	52 (1.5)	61 (1.2)	64 (3.3)
Percent of Students in School Eligible for FRL			
Lowest Quartile	53 (1.4)	57 (1.5)	54 (1.8)
Second Quartile	52 (1.5)	56 (1.3)	56 (1.9)
Third Quartile	52 (1.4)	60 (1.3)	60 (4.3)
Highest Quartile	54 (1.5)	60 (1.4)	64 (4.6)
School Size			
Smallest Schools	47 (2.6)	55 (2.2)	55 (5.5)
Second Group	51 (1.6)	59 (1.8)	61 (5.0)
Third Group	53 (1.1)	58 (0.9)	58 (4.0)
Largest Schools	54 (1.1)	59 (0.9)	56 (1.6)

Another series of items asked about the focus of professional development opportunities teachers have had in the last three years. As can be seen in Table 3.10, roughly half of secondary science teachers' recent professional development heavily emphasized deepening understanding of how science is done; monitoring student understanding during science instruction; differentiating science instruction to meet the needs of diverse learners; and deepening science content knowledge. As elementary teachers tend to be less well prepared in science, it is somewhat surprising that they have been less likely to attend professional development that emphasizes deepening their science content knowledge and their understanding of how science is done.

Given the inclusion of engineering in the NGSS and many states' standards, as well as teachers' self-report of lack of preparation to teach engineering, it is somewhat surprising that fewer than a third of K–12 science teachers have attended professional development that focused heavily on deepening their understanding of how engineering is done. Further, only about a quarter of science teachers across the grade-range categories have attended professional development with a heavy emphasis on incorporating students' cultural backgrounds into science instruction despite the push for culturally responsive teaching.

Table 3.10
Science Teachers Reporting That Their Professional Development in the Last Three Years Gave Heavy Emphasis† to Various Areas, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Deepening their understanding of how science is done (e.g., developing scientific questions, developing and using models, engaging in argumentation)	39 (2.9)	59 (3.2)	51 (2.4)
Monitoring student understanding during science instruction	40 (3.3)	47 (3.7)	47 (2.0)
Differentiating science instruction to meet the needs of diverse learners	33 (2.9)	49 (2.8)	46 (2.0)
Deepening their own science content knowledge	39 (2.6)	51 (3.3)	45 (1.9)
Learning about difficulties that students may have with particular science ideas	26 (3.2)	35 (3.0)	40 (2.0)
Finding out what students think or already know prior to instruction on a topic	35 (3.0)	42 (3.7)	37 (2.0)
Learning how to provide science instruction that integrates engineering, mathematics, and/or computer science	36 (3.0)	49 (3.4)	34 (2.1)
Implementing the science textbook/modules to be used in their classroom	34 (2.9)	30 (3.1)	29 (1.9)
Deepening their understanding of how engineering is done (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	25 (2.8)	34 (3.5)	23 (1.8)
Incorporating students' cultural backgrounds into science instruction	19 (2.5)	27 (2.3)	23 (2.1)

† Includes science teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Data for mathematics teachers are shown in Table 3.11. Similar to science, about half of mathematics teachers across the grade ranges have had professional growth opportunities in the last three years that heavily emphasized deepening understanding of how mathematics is done (49–58 percent), monitoring student understanding during mathematics instruction (53–56 percent), and differentiating mathematics instruction to meet the needs of diverse learners (53–56 percent). Another area emphasized, was learning about difficulties students may have with particular mathematics ideas and procedures (46–51 percent). Learning how to use hands-on activities/manipulatives for mathematics instruction was also a common focus of professional development, though more so at the elementary level than the secondary level. Only about 20 percent of teachers' recent professional development emphasized learning how to provide mathematics instruction that integrates engineering, science, and/or computer science, and incorporating students' cultural backgrounds into mathematics instruction.

Table 3.11
Mathematics Teachers Reporting That Their Professional Development in the Last Three Years Gave Heavy Emphasis† to Various Areas, by Grade Range

	PERCENT OF TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
Differentiating mathematics instruction to meet the needs of diverse learners	56 (2.7)	55 (3.2)	53 (2.0)
Monitoring student understanding during mathematics instruction	56 (2.1)	55 (2.7)	53 (1.8)
Deepening their understanding of how mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	58 (2.4)	55 (3.1)	49 (2.4)
Learning about difficulties that students may have with particular mathematical ideas and procedures	47 (2.2)	51 (3.1)	46 (2.0)
Learning how to use hands-on activities/manipulatives for mathematics instruction	59 (2.5)	45 (3.4)	40 (2.2)
Deepening their own mathematics content knowledge	51 (2.5)	44 (3.4)	39 (2.1)
Finding out what students think or already know prior to instruction on a topic	46 (2.4)	39 (3.4)	38 (2.2)
Implementing the mathematics textbook to be used in their classroom	40 (2.6)	38 (3.1)	25 (2.1)
Incorporating students' cultural backgrounds into mathematics instruction	20 (1.9)	19 (3.0)	25 (2.3)
Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	22 (2.4)	20 (2.5)	21 (1.8)

† Includes mathematics teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

High school computer science teacher data are shown in Table 3.12. The most common emphases related to understanding and doing computer science: deepening their computer science content knowledge, including programming (70 percent); learning how to use programming activities that require a computer (64 percent); and deepening understanding of how computer science is done (63 percent). Half of computer science teachers' professional development has had a substantial focus on implementing the computer science textbook/online course to be used in their classroom. Only about a quarter have attended professional development that emphasized differentiating computer science instruction to meet the needs of diverse learners or incorporating students' cultural backgrounds into computer science instruction, two areas that likely will need greater emphasis to help ensure students from all backgrounds have opportunities in this field.

Table 3.12
High School Computer Science Teachers Reporting That Their Professional Development in the Last Three Years Gave Heavy Emphasis† to Various Areas

	PERCENT OF TEACHERS
Deepening their own computer science content knowledge, including programming	70 (3.6)
Learning how to use programming activities that require a computer	64 (4.1)
Deepening their understanding of how computer science is done (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	63 (3.6)
Implementing the computer science textbook/online course to be used in their classroom	50 (4.0)
Learning about difficulties that students may have with particular computer science ideas and/or practices	48 (4.2)
Monitoring student understanding during computer science instruction	40 (3.6)
Learning how to provide computer science instruction that integrates engineering, mathematics, and/or science	36 (3.7)
Differentiating computer science instruction to meet the needs of diverse learners	29 (3.4)
Incorporating students' cultural backgrounds into computer science instruction	25 (3.4)

† Includes high school computer science teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Several items related to a focus on student-centered instruction in recent teacher professional development were combined into a composite variable. As can be seen in Table 3.13, professional development for elementary mathematics is more likely than professional development for elementary science to support student-centered instruction (mean scores of 61 and 48, respectively). Interestingly, in science, professional development for middle and high school teachers gives more emphasis to student-centered instruction than elementary teachers, but in mathematics, professional development for elementary teachers is more likely to have this focus compared to what high school mathematics teachers experience. Lastly, the mean score for high school computer science teachers is significantly higher than the mean scores for both science and mathematics high school teachers.

Table 3.13
Teacher Mean Scores for Extent Professional Development Supports Student-Centered Instruction Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	48 (1.6)	61 (1.1)	n/a
Middle	55 (1.1)	58 (1.2)	n/a
High	52 (0.8)	54 (0.9)	58 (1.8)

Table 3.14 provides information about the extent to which science, mathematics, and computer science classes with different demographic characteristics have access to teachers who have had recent opportunities to learn about student-centered instruction. Science classes in suburban schools and those consisting of mostly high prior achievers are more likely to be taught by teachers with higher scores on this composite than classes in rural schools or those consisting of mostly low prior achievers. In mathematics, the opposite pattern is evident for prior achievement level of the class. The mean score for mathematics classes with mostly low-achieving students is 60, compared to 55 for classes with mostly high-achieving students. Surprisingly, disparities in science, mathematics, or computer science classes do not exist when the data are examined by school size, poverty level, and the percentage of students in the class from race/ethnicity groups historically underrepresented in STEM.

Table 3.14
Equity Analyses of Class Mean Scores for Extent Professional Development Supports Student-Centered Instruction Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Prior Achievement Level of Class			
Mostly High	54 (1.4)	55 (1.4)	56 (3.0)
Average/Mixed	51 (1.0)	59 (0.7)	59 (2.6)
Mostly Low	49 (1.8)	60 (1.6)	n/a
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	51 (1.4)	59 (1.1)	54 (3.5)
Second Quartile	50 (1.4)	53 (1.2)	62 (5.5)
Third Quartile	52 (1.5)	59 (1.1)	60 (3.4)
Highest Quartile	51 (1.9)	62 (1.5)	61 (4.2)
Percent of Students in School Eligible for FRL			
Lowest Quartile	51 (1.5)	58 (1.3)	54 (2.3)
Second Quartile	52 (1.3)	55 (1.1)	58 (3.5)
Third Quartile	50 (1.5)	59 (1.1)	63 (4.7)
Highest Quartile	53 (2.0)	62 (1.7)	62 (6.3)
School Size			
Smallest Schools	47 (2.9)	61 (1.8)	59 (8.2)
Second Group	51 (1.7)	60 (1.6)	65 (5.2)
Third Group	52 (1.4)	59 (1.1)	59 (4.9)
Largest Schools	52 (1.1)	57 (1.0)	56 (2.4)
Community Type			
Rural	48 (1.4)	58 (1.2)	65 (4.3)
Suburban	53 (1.0)	58 (1.0)	57 (2.1)
Urban	51 (1.5)	59 (1.4)	57 (4.8)

Professional Development Offerings at the School Level

The data presented in this chapter thus far are drawn from the teacher questionnaires. The 2018 NSSME+ also included School Program Questionnaires for science and mathematics and a School Coordinator Questionnaire for computer science,[15] each completed by a person knowledgeable about school programs, policies, and practices in the designated subject.

School representatives were asked whether professional development workshops in the respective discipline have been offered by their school and/or district, possibly in conjunction with other school systems, colleges or universities, museums, professional associations, or commercial vendors. As can be seen in Table 3.15, both elementary schools and middle schools are more likely to have locally offered workshops in mathematics than in science in the last three years. Schools across the grade levels are least likely to have local workshops in computer science.

[15] Unlike the Computer Science Teacher Questionnaire, which was administered only to high school teachers, the School Coordinator Questionnaire asked schools at all grade levels about computer science practices and programs in the school/district.

Table 3.15
Professional Development Workshops Offered Locally in the Last Three Years, by Subject

	PERCENT OF SCHOOLS		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	51 (2.8)	69 (2.7)	35 (2.5)
Middle	48 (2.6)	61 (3.3)	28 (2.4)
High	41 (2.9)	46 (3.1)	19 (1.9)

Science and mathematics program representatives who indicated that workshops have been offered locally in the last three years were asked about the extent to which that professional development emphasized each of a number of areas. In both science and mathematics, about 60 percent of schools indicated that locally offered workshops have emphasized deepening teachers' understanding of: (1) state standards, (2) how science/mathematics is done, and (3) science/mathematics concepts (see Table 3.16 and Table 3.17). Learning how to engage students in doing science/mathematics, how to use particular instructional materials, and how to use technology in instruction are also relatively common emphases (45–54 percent of schools depending on subject). Relatively few locally offered workshops have focused on how to develop students' confidence that they can successfully pursue careers in the discipline, how to connect instruction to career opportunities, and how to incorporate students' cultural backgrounds into instruction.

Table 3.16
Locally Offered Science Professional Development Workshops in the Last Three Years With a Substantial Emphasis† in Each of a Number of Areas

	PERCENT OF SCHOOLS
Deepening teachers' understanding of the state science/engineering standards	66 (2.9)
Deepening teachers' understanding of how science is done (e.g., developing scientific questions, developing and using models, engaging in argumentation)	58 (2.7)
Deepening teachers' understanding of science concepts	57 (3.1)
How to engage students in doing science (e.g., developing scientific questions, developing and using models, engaging in argumentation)	54 (2.8)
How to use technology in science/engineering instruction	48 (3.3)
Deepening teachers' understanding of how students think about various science ideas	46 (3.4)
How to use particular science/engineering instructional materials (e.g., textbooks or modules)	45 (3.2)
Deepening teachers' understanding of how engineering is done (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	44 (3.5)
How to monitor student understanding during science instruction	40 (3.1)
How to incorporate real-world issues (e.g., current events, community concerns) into science instruction	38 (2.6)
How to engage students in doing engineering (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	37 (2.9)
How to integrate science, engineering, mathematics, and/or computer science	36 (3.0)
How to adapt science instruction to address student misconceptions	35 (3.2)
How to connect instruction to science/engineering career opportunities	33 (2.9)
How to differentiate science instruction to meet the needs of diverse learners	28 (2.8)
How to develop students' confidence that they can successfully pursue careers in science/engineering	25 (2.7)
How to incorporate students' cultural backgrounds into science instruction	17 (2.1)

† Includes schools indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Table 3.17
Locally Offered Mathematics Professional Development Workshops in the Last Three Years With a Substantial Emphasis† in Each of a Number of Areas

	PERCENT OF SCHOOLS
Deepening teachers' understanding of the state mathematics standards	66 (2.7)
Deepening teachers' understanding of how mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	62 (2.8)
Deepening teachers' understanding of mathematics concepts	61 (2.6)
Deepening teachers' understanding of how students think about various mathematical ideas	57 (2.9)
How to engage students in doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	52 (2.8)
How to monitor student understanding during mathematics instruction	52 (2.9)
How to use particular mathematics instructional materials (e.g., textbooks)	50 (2.9)
How to use technology in mathematics instruction	49 (2.4)
How to differentiate mathematics instruction to meet the needs of diverse learners	44 (2.8)
How to adapt mathematics instruction to address student misconceptions	43 (2.7)
How to use investigation-oriented tasks in mathematics instruction	41 (2.7)
How to incorporate real-world issues (e.g., current events, community concerns) into mathematics instruction	31 (2.4)
How to integrate science, engineering, mathematics, and/or computer science	29 (2.7)
How to develop students' confidence that they can successfully pursue careers in mathematics	24 (2.3)
How to connect instruction to mathematics career opportunities	20 (2.3)
How to incorporate students' cultural backgrounds into mathematics instruction	13 (1.6)

† Includes schools indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

One concern about professional development workshops is that teachers may not be given adequate assistance in applying what they are learning to their own instruction. Teacher study groups (professional learning communities, lesson study, etc.) have the potential to help teachers focus on instruction. School science, mathematics, and computer science program representatives were asked whether their school has offered teacher study groups where teachers meet on a regular basis to discuss science, mathematics, or computer science teaching and learning in the last three years. As can be seen in Table 3.18, study groups are more likely to be offered in mathematics than in science or computer science. For example, 55 percent of elementary schools offer teacher study groups in mathematics compared to only 28 percent offering them in science.

Table 3.18
Teacher Study Groups Offered at Schools in the Last Three Years, by Subject

	PERCENT OF SCHOOLS		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	28 (2.4)	55 (3.2)	43 (3.1)
Middle	45 (2.8)	57 (3.3)	41 (3.3)
High	45 (3.1)	53 (2.8)	33 (2.9)

Tables 3.19–3.26 present additional information provided by school program representatives about school-based teacher study groups focused on science and mathematics. As can be seen in Table 3.19, study groups in these two subjects are relatively similar in terms of whether teachers have been required to participate (78 and 81 percent). If schools do have a specified duration for

the science and mathematics study groups, they tend to meet for the entire school year (55 and 72 percent, respectively), but there is considerable variation in the frequency of these study group meetings. About a quarter of schools have science and mathematics teacher study groups that meet more than twice a month.

Table 3.19
Participation, Duration, and Frequency of Teacher Study Groups, by Subject

	PERCENT OF SCHOOLS†	
	SCIENCE	MATHEMATICS
Participation Required		
Yes	78 (2.7)	81 (2.4)
No	22 (2.7)	19 (2.4)
Duration of Study Group		
No specified duration	34 (3.2)	21 (2.4)
Less than one semester	3 (1.1)	2 (1.0)
One semester	8 (2.4)	5 (1.2)
Entire school year	55 (3.3)	72 (2.5)
Frequency of Meetings		
No specified frequency	34 (3.2)	21 (2.4)
Less than once a month	15 (2.4)	15 (2.2)
Once a month	18 (2.5)	23 (2.2)
Twice a month	10 (1.8)	14 (1.8)
More than twice a month	24 (2.3)	27 (2.4)

† Includes only those schools that offered teacher study groups in the last three years.

Data about whether schools have had designated leaders for the teacher study groups and where those leaders come from are presented in Table 3.20. Roughly two-thirds of schools have had designated leaders for science and mathematics study groups, who most often come from within the school (50 and 55 percent, respectively.)

Table 3.20
Origin of Designated Leaders of Teacher Study Groups, by Subject

	PERCENT OF SCHOOLS†	
	SCIENCE	MATHEMATICS
No designated leader	37 (3.0)	36 (2.6)
The school	50 (3.1)	55 (2.5)
Elsewhere in the district/diocese‡	17 (2.6)	21 (2.5)
College/University	1 (0.3)	1 (0.5)
External consultants	6 (1.8)	8 (1.7)

† Includes only those schools that offered teacher study groups in the last three years.
‡ This item was presented only to public and Catholic schools.

Information about the composition of teacher study groups is shown in Table 3.21. Most schools organize their science- and mathematics-focused teacher study groups by grade level (51 and 66 percent, respectively), include teachers from multiple grade levels (63 and 59 percent), and limit participation in the study groups to teachers from their school (54 and 58 percent). Many study groups also include school and/or district administrators. It is rare for schools to include higher education faculty or other consultants, parents/guardians or other community members, or teachers from other schools outside the district in the study groups.

Table 3.21
Composition of Teacher Study Groups, by Subject

	PERCENT OF SCHOOLS†	
	SCIENCE	MATHEMATICS
Organized by grade level	51 (3.2)	66 (2.6)
Include teachers from multiple grade levels	63 (2.9)	59 (2.5)
Limited to teachers from this school	54 (3.5)	58 (3.2)
Include school and/or district/diocese administrators	46 (3.1)	55 (2.8)
Include teachers who teach different science/engineering/mathematics subjects	44 (3.2)	39 (2.8)
Include teachers from other schools in the district/diocese‡	27 (2.8)	24 (2.7)
Include higher education faculty or other "consultants"	11 (2.2)	18 (2.2)
Include teachers from other schools outside of your district/diocese	5 (1.8)	4 (1.4)
Include parents/guardians or other community members	0 (0.2)	1 (0.6)

† Includes only those schools that offered teacher study groups in the last three years.
‡ This item was presented only to public and Catholic schools.

School science and mathematics program representatives were also asked about the activities typically included in teacher study groups focused on their subject. As can be seen in Table 3.22 and Table 3.23, 65 percent of study groups in science and 81 percent in mathematics have involved teachers in analyzing student assessment results. Roughly one-half to two-thirds of study groups in each subject have had teachers plan lessons together and analyze student instructional materials. Considerably fewer study groups have had teachers provide feedback on each other's instruction, rehearse instructional practices, and observe each other's instruction.

Table 3.22
Description of Activities in Typical Science Teacher Study Groups

	PERCENT OF SCHOOLS†
Analyze student science assessment results	65 (3.1)
Plan science/engineering lessons together	67 (2.8)
Analyze science/engineering instructional materials (e.g., textbooks or modules)	51 (2.9)
Examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	38 (3.2)
Engage in science investigations	30 (3.4)
Rehearse instructional practices (i.e., try out, receive, feedback, and reflect on those practices)	24 (2.6)
Provide feedback on each other's science/engineering instruction	22 (2.4)
Observe each other's science/engineering instruction (either in-person or through video recording)	17 (2.3)
Engage in engineering design challenges	18 (2.9)

† Includes only those schools that offered teacher study groups in the last three years.

Table 3.23
Description of Activities in Typical Mathematics Teacher Study Groups

	PERCENT OF SCHOOLS†
Analyze student mathematics assessment results	81 (2.5)
Plan mathematics lessons together	63 (2.5)
Analyze mathematics instructional materials (e.g., textbooks)	60 (3.3)
Examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	42 (2.7)
Engage in mathematics investigations	36 (2.7)
Provide feedback on each other's mathematics instruction	30 (3.0)
Rehearse instructional practices (i.e., try out, receive feedback, and reflect on those practices)	28 (2.5)
Observe each other's mathematics instruction (either in-person or through video recording)	26 (2.7)

† Includes only those schools that offered teacher study groups in the last three years.

Further, school program representatives were asked about the extent to which the teacher study groups have addressed each of a number of topics. These data are presented in Table 3.24 and Table 3.25. Similar to the pattern seen with locally offered professional development workshops, in many schools, both science and mathematics teacher study groups in the last three years have focused heavily on deepening teachers' understanding of the state standards (66 and 61 percent, respectively). Other areas with a substantial emphasis are learning how to engage students in doing science/mathematics (56 and 59 percent); deepening teachers' understanding of how science/mathematics is done (46 and 53 percent); deepening teachers' understanding of how students think about various ideas (44 and 53 percent); and monitoring student understanding during instruction (44 and 52 percent). Only about a third of schools indicated that science-focused study groups have had a large emphasis on how to engage students in doing engineering and deepening teachers' understanding of how engineering is done.

In addition, study groups in mathematics are more likely than those in science to focus on how to differentiate instruction to meet the needs of diverse learners and how to adapt instruction to address student misconceptions. In contrast, science study groups are more likely than mathematics study groups to emphasize how to incorporate real-world issues into instruction.

Table 3.24
Science Teacher Study Groups Offered in the Last Three Years With a Substantial Emphasis† in Each of a Number of Areas

	PERCENT OF SCHOOLS
Deepening teachers' understanding of the state science/engineering standards	66 (3.2)
How to engage students in doing science (e.g., developing scientific questions, developing and using models, engaging in argumentation)	56 (2.9)
How to use technology in science/engineering instruction	47 (3.5)
Deepening teachers' understanding of how science is done (e.g., developing scientific questions, developing and using models, engaging in argumentation)	46 (3.1)
How to use particular science/engineering instructional materials (e.g., textbooks or modules)	46 (3.4)
Deepening teachers' understanding of how students think about various science ideas	44 (3.1)
How to monitor student understanding during science/engineering instruction	44 (3.0)
How to incorporate real-world issues (e.g., current events, community concerns) into science instruction	43 (2.7)
Deepening teachers' understanding of science concepts	41 (3.0)
How to adapt science instruction to address student misconceptions	38 (2.9)
How to differentiate science instruction to meet the needs of diverse learners	38 (3.0)
How to integrate science, engineering, mathematics, and/or computer science	38 (2.9)
How to engage students in doing engineering (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	36 (2.8)
Deepening teachers' understanding of how engineering is done (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	33 (3.2)
How to connect instruction to science/engineering career opportunities	27 (2.9)
How to develop students' confidence that they can successfully pursue careers in science/engineering	25 (2.8)
How to incorporate students' cultural backgrounds into science instruction	18 (2.5)

† Includes schools indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Table 3.25
Mathematics Teacher Study Groups Offered in the Last Three Years With a Substantial Emphasis† in Each of a Number of Areas

	PERCENT OF SCHOOLS
Deepening teachers' understanding of the state mathematics standards	61 (2.7)
How to engage students in doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	59 (2.7)
Deepening teachers' understanding of how mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	53 (2.7)
Deepening teachers' understanding of how students think about various mathematical ideas	53 (2.9)
How to differentiate mathematics instruction to meet the needs of diverse learners	52 (2.5)
How to monitor student understanding during mathematics instruction	52 (2.8)
How to adapt mathematics instruction to address student misconceptions	51 (2.9)
How to use particular mathematics instructional materials (e.g., textbooks)	49 (2.9)
Deepening teachers' understanding of mathematics concepts	48 (3.0)
How to use technology in mathematics instruction	39 (2.4)
How to incorporate real-world issues (e.g., current events, community concerns) into mathematics instruction	35 (2.7)
How to use investigation-oriented tasks in mathematics instruction	35 (2.8)
How to integrate science, engineering, mathematics, and/or computer science	26 (2.6)
How to connect instruction to mathematics career opportunities	21 (2.3)
How to develop students' confidence that they can successfully pursue careers in mathematics	21 (2.3)
How to incorporate students' cultural backgrounds into mathematics instruction	17 (2.1)

† Includes schools indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."

Although there is general agreement that teachers can benefit from participating in professional development workshops and study groups, it is often difficult to find time for them to do so. School representatives were given a list of ways in which time might be provided for teachers to participate in professional development, regardless of whether it is offered by the school, and asked to indicate which are used in their school. As can be seen in Table 3.26, roughly half of schools use teacher work days during the school year for science-related professional development; over two-thirds do so for mathematics-related professional development. It is less common for schools to use substitute teachers or early dismissal/late start for students as a means to provide time for professional development in science and mathematics. In mathematics, more schools at the elementary and middle level provide common planning time for professional development than schools at the high school level (58, 48, and 36 percent, respectively).

Table 3.26
How Schools Provide Time for Professional Development, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Science			
Professional days/teacher work days during the students' school year	43 (3.2)	54 (3.5)	54 (3.2)
Professional days/teacher work days before and/or after the students' school year	37 (3.3)	44 (3.3)	46 (3.2)
Substitute teachers to cover teachers' classes while they attend professional development	26 (2.8)	36 (3.1)	38 (3.0)
Early dismissal and/or late start for students	19 (2.2)	27 (2.5)	36 (2.9)
Common planning time for teachers	41 (3.1)	40 (3.4)	33 (2.9)
Mathematics			
Professional days/teacher work days during the students' school year	70 (2.8)	69 (3.3)	67 (3.3)
Professional days/teacher work days before and/or after the students' school year	53 (3.0)	54 (3.0)	57 (3.1)
Substitute teachers to cover teachers' classes while they attend professional development	36 (3.0)	36 (3.2)	39 (3.1)
Early dismissal and/or late start for students	35 (2.9)	36 (3.3)	39 (3.0)
Common planning time for teachers	58 (2.8)	48 (3.2)	36 (3.2)

As noted earlier, professional development workshops and teacher study groups can provide important opportunities for teachers to deepen their disciplinary and pedagogical content knowledge, and to develop skill in using that knowledge for key tasks of teaching, such as analyzing student work to determine what a student does and does not understand. When resources allow, one-on-one coaching to help teachers improve their practice can be a powerful tool.

School program representatives were asked whether any teachers in their school have access to one-on-one coaching focused on improving their science, mathematics, and computer science instruction; these data are shown in Table 3.27. Across subject areas and grade ranges, one-on-one coaching is relatively rare except in elementary school mathematics, where over 4 in 10 schools offer coaching.

Table 3.27
Schools Providing One-on-One Coaching, by Subject

	PERCENT OF SCHOOLS		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	27 (2.7)	43 (2.8)	28 (2.4)
Middle	23 (2.7)	33 (2.6)	27 (2.3)
High	30 (3.0)	29 (2.8)	21 (2.3)

Not only is one-on-one coaching a somewhat uncommon practice, but the proportion of teachers who are coached is small. In science, roughly 10 percent of teachers in schools are provided with one-on-one coaching (see Table 3.28). The proportion of teachers receiving coaching in mathematics ranges from 13–18 percent depending on grade range.

Table 3.28
Average Percentage of Teachers in Schools Receiving One-on-One Coaching, by Subject

	AVERAGE PERCENT	
	SCIENCE	MATHEMATICS
Elementary	7 (1.1)	18 (1.7)
Middle	9 (1.1)	16 (1.5)
High	11 (1.6)	13 (2.2)

In schools where science/mathematics teachers have access to one-on-one coaching, program representatives were asked who provides the coaching services. Roughly three-quarters of schools that offer coaching use a combination of administrators and teachers/coaches (see Table 3.29).

Table 3.29
Teaching Professionals Providing One-on-One Coaching, by Subject

	PERCENT OF SCHOOLS†	
	SCIENCE	MATHEMATICS
Both administrators and teachers/coaches‡	73 (3.6)	79 (2.8)
Teachers/coaches‡ only	20 (3.3)	17 (2.5)
Administrators only	7 (2.2)	4 (1.3)

† Includes only those schools that provide science-/mathematics-focused coaching.
‡ Includes teachers/coaches of all levels of teaching responsibility: full-time, part-time, and not teaching.

Although most schools have both teachers/coaches and administrators provide coaching, it appears that teachers/coaches are responsible for the bulk of it. Table 3.30 shows the percentage of schools with coaching provided by different professionals to a substantial extent. In science, 40 percent of schools have teachers/coaches who have full-time teaching loads provide one-on-one coaching to a substantial extent; 37 percent use teachers/coaches who do not have classroom teaching responsibilities. Fifty-six percent of schools have one-on-one mathematics coaching provided to a substantial extent by teachers/coaches who do not have classroom teaching responsibilities; 28 percent use teachers/coaches with full class loads to a substantial extent.

Table 3.30
Teaching Professionals Providing
One-on-One Coaching to a Substantial Extent,† by Subject

	PERCENT OF SCHOOLS‡	
	SCIENCE	MATHEMATICS
Teachers/coaches who do not have classroom teaching responsibilities	37 (3.5)	56 (3.3)
District/Diocese administrators including science/mathematics supervisors/ coordinators§	36 (4.6)	31 (2.9)
Teachers/coaches who have full-time classroom teaching responsibilities	40 (3.6)	28 (2.9)
The principal of the school	21 (3.2)	25 (2.9)
An assistant principal at the school	18 (2.9)	19 (2.1)
Teachers/coaches who have part-time classroom teaching responsibilities	16 (2.8)	15 (2.8)

† Includes schools indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."
‡ Includes only those schools that provide science-/mathematics-focused coaching.
§ This item was presented only to public and Catholic schools.

In addition, school science and mathematics program representatives were asked about the services provided to teachers in need of special assistance. In science, 33–44 percent of schools, depending on grades served, provide guidance from a formally designated mentor or coach (see Table 3.31). The likelihood of schools providing a higher level of supervision for these teachers increases as grade level increases. In mathematics, about half of the schools at each grade range have mentors or coaches who provide guidance to teachers in particular need of help. Schools that include elementary grades are more likely than schools at the high school level to provide seminars, classes, and/or study groups for these teachers (40 vs. 22 percent, respectively).

Table 3.31
Services Provided to Teachers
in Need of Special Assistance in Teaching, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Science			
Guidance from a formally designated mentor or coach	33 (2.5)	35 (2.9)	44 (3.4)
A higher level of supervision than for other teachers	15 (2.2)	22 (2.5)	33 (3.3)
Seminars, classes, and/or study groups	30 (3.1)	28 (3.6)	25 (2.9)
Mathematics			
Guidance from a formally designated mentor or coach	51 (2.8)	46 (3.4)	48 (3.8)
A higher level of supervision than for other teachers	31 (2.8)	27 (2.8)	32 (2.9)
Seminars, classes, and/or study groups	40 (2.9)	35 (3.3)	22 (2.5)

Responses to whether schools/districts provide science, mathematics, and computer science workshops, teacher study groups, and one-on-one coaching were combined to look at the proportion of schools that have not offered any of these types of professional development. As can be seen in Table 3.32, about a third of schools have not offered some form of professional development in science in the last three years; 16–28 percent of schools, depending on grade level, have not offered any type of professional development in mathematics. In contrast, about 40–50 percent of schools have not offered computer science professional development at all in the last three years.

Table 3.32
Schools Not Offering Any Type of Professional Development in the Last Three Years, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Science	33 (2.6)	32 (2.8)	29 (2.9)
Mathematics	16 (2.3)	22 (2.9)	28 (3.1)
Computer Science	40 (2.9)	43 (2.9)	52 (2.8)

Additional analyses were conducted to see if these three types of professional development offerings are equitably distributed across schools. In science, schools with the largest proportion of students eligible for free/reduced-price lunch are more likely to provide workshops than schools with the lowest proportion of students in this category (see Table 3.33). Not surprisingly, the largest schools are significantly more likely than the smallest schools to offer science-focused workshops and teacher study groups. In addition, schools in rural areas are less likely than urban schools to offer workshops and one-on-one coaching.

Table 3.33
Equity Analyses of Locally Offered Science Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	44 (3.6)	33 (3.3)	26 (3.4)
Second Quartile	51 (5.0)	38 (4.3)	26 (4.3)
Third Quartile	51 (3.9)	36 (4.0)	26 (3.5)
Highest Quartile	56 (4.6)	38 (3.9)	35 (4.6)
School Size			
Smallest Schools	39 (4.9)	22 (4.3)	22 (4.7)
Second Group	57 (4.4)	36 (4.6)	31 (4.4)
Third Group	46 (4.3)	39 (3.1)	26 (3.4)
Largest Schools	62 (3.3)	49 (3.7)	34 (3.5)
Community Type			
Rural	37 (4.4)	32 (3.9)	20 (3.9)
Suburban	53 (2.8)	40 (2.6)	27 (2.5)
Urban	59 (4.6)	36 (3.5)	38 (4.5)

Table 3.34 shows data for mathematics. The largest schools are substantially more likely than the smallest schools to offer each of these professional development services. Schools with the largest proportion of students eligible for free/reduced-price lunch are more likely than those in the lowest quartile to offer mathematics-focused one-on-one coaching. As is the case in science, schools in rural areas are less likely than urban schools to offer workshops and one-on-one coaching in mathematics.

Table 3.34
Equity Analyses of Locally Offered
Mathematics Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	61 (4.5)	56 (4.3)	29 (4.1)
Second Quartile	63 (4.6)	63 (4.9)	33 (4.7)
Third Quartile	67 (3.8)	57 (5.0)	49 (4.5)
Highest Quartile	73 (3.7)	56 (4.3)	54 (4.6)
School Size			
Smallest Schools	56 (5.8)	46 (5.0)	26 (4.9)
Second Group	67 (4.9)	61 (4.1)	40 (4.1)
Third Group	69 (3.9)	56 (4.7)	44 (3.3)
Largest Schools	73 (2.9)	69 (3.4)	54 (3.9)
Community Type			
Rural	62 (4.6)	56 (4.1)	25 (3.6)
Suburban	63 (2.9)	62 (3.5)	43 (3.1)
Urban	75 (3.6)	53 (3.9)	51 (4.0)

A somewhat similar pattern is seen in computer science. As can be seen in Table 3.35, the largest schools are significantly more likely than the smallest schools to offer computer science-focused workshops (42 vs. 19 percent, respectively) and teacher study groups (48 vs. 33 percent, respectively). There are also disparities by community type, with rural schools being less likely to provide workshops and study groups than their urban counterparts. The distribution of schools offering one-on-one coaching in computer science is relatively equal when analyzed by each of the different equity factors.

Table 3.35
Equity Analyses of Locally Offered
Computer Science Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	33 (4.1)	38 (4.6)	22 (3.5)
Second Quartile	33 (3.8)	50 (4.7)	34 (4.0)
Third Quartile	29 (3.5)	35 (3.5)	18 (2.8)
Highest Quartile	36 (4.4)	49 (4.1)	29 (4.0)
School Size			
Smallest Schools	19 (3.8)	33 (5.1)	22 (3.7)
Second Group	33 (4.0)	46 (5.4)	29 (3.8)
Third Group	35 (3.7)	44 (3.6)	25 (3.1)
Largest Schools	42 (3.4)	48 (3.4)	28 (2.9)
Community Type			
Rural	24 (3.1)	35 (4.7)	22 (3.3)
Suburban	33 (2.7)	43 (3.2)	29 (2.4)
Urban	39 (3.9)	48 (4.2)	25 (3.4)

Teacher Induction Programs

Formal induction programs provide critical support and guidance for beginning teachers and show promise for having a positive impact on teacher retention, instructional practices, and student achievement in schools.[16] However, the effectiveness of these programs greatly depends on their length and the nature of the supports offered to teachers. Accordingly, school coordinators were asked a series of questions about formal induction programs at the schools.

Table 3.36 shows that roughly 70 percent of schools across the grade bands offer formal teacher induction programs. About a third of schools have programs that last one year or less, and about a fourth of schools have programs that last two years. It is rare for schools to have an induction program of three years or more. Of schools that do offer induction programs, a majority of them are developed and implemented by either the district or the school (see Table 3.37).

Table 3.36
Typical Duration of Formal Induction Programs, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
No formal induction program	26 (2.4)	31 (2.7)	33 (2.9)
One year or less	32 (2.8)	30 (2.7)	31 (2.3)
Two years	26 (2.6)	28 (2.6)	23 (2.2)
Three or more years	15 (2.0)	12 (1.7)	13 (1.7)

[16] Ingersoll, R., & Strong, M. (2011). *The impact of induction and mentoring programs for beginning teachers: A critical review of the research.* Retrieved from https://repository.upenn.edu/gse_pubs/127.

Table 3.37
Organization Developing and Implementing Formal Induction Programs, by Grade Range

	PERCENT OF SCHOOLS†		
	ELEMENTARY	MIDDLE	HIGH
School	63 (2.8)	68 (3.4)	78 (2.6)
District/Diocese‡	86 (2.2)	80 (2.6)	74 (2.6)
Regional or county educational service	15 (2.8)	20 (3.4)	21 (3.1)
Local university	3 (1.2)	4 (1.0)	5 (1.4)

† Includes only those schools that provide a formal induction program.
‡ This item was presented only to public and Catholic schools.

The percentages of schools offering a formal teacher induction program are relatively equally distributed when analyzed by various school-based equity factors, including poverty level, community type, and region (see Table 3.38). In contrast, it is not surprising that the largest schools are more likely than the smallest schools to have induction programs for beginning teachers.

Table 3.38
Equity Analyses of Schools Offering Formal Induction Programs

	PERCENT OF SCHOOLS†
Percent of Students in School Eligible for FRL	
Lowest Quartile	70 (3.6)
Second Quartile	79 (3.6)
Third Quartile	77 (4.1)
Highest Quartile	78 (3.8)
School Size	
Smallest Schools	62 (4.9)
Second Group	69 (3.7)
Third Group	84 (3.0)
Largest Schools	89 (1.8)
Community Type	
Rural	71 (4.0)
Suburban	79 (2.4)
Urban	75 (3.7)
Region	
Midwest	73 (3.6)
Northeast	81 (4.6)
South	76 (2.8)
West	74 (4.1)

† Includes only those schools that provide a formal induction program.

The research on effective induction programs for beginning teachers also suggests a number of supports that are important for a program's success. One key element is having an experienced mentor, in particular one who teaches the same subject or grade level as the mentee. Other important components of effective induction programs are ongoing communication with administrators, including an orientation meeting; offering common planning time with mentors or other new teachers; providing regular professional development opportunities; allowing new teachers to observe other colleagues, and to be observed; and giving release time and reduced teaching loads.

As can be seen in Table 3.39, many schools at all grade levels have formal induction programs that include a number of these best practices. For example, the most predominant supports provided to beginning teachers include a meeting to orient them to school policies and practices (85–89 percent), formally assigned school-based mentors (81–85 percent), and professional development opportunities on teaching their subject (74–82 percent). In addition, 61–70 percent of schools give release time to observe other teachers in their grade/subject area. Schools at the elementary and middle grades level are more likely than schools at the high school level to offer common planning time with experienced teachers who teach the same subject or grade level (76, 68, and 52 percent, respectively). In contrast, high schools are more likely than their middle or elementary counterparts to provide release time for beginning teachers to attend national, state, or local conferences (51, 38, and 33 percent, respectively).

Table 3.39
Supports Provided as Part of Formal Induction Programs, by Grade Range

	PERCENT OF SCHOOLS†		
	ELEMENTARY	MIDDLE	HIGH
A meeting to orient them to school district/diocese policies and practices	88 (2.2)	85 (2.9)	89 (1.9)
Formally assigned school-based mentor teachers	85 (2.0)	81 (2.8)	84 (2.5)
Professional development opportunities on teaching their subject	80 (2.5)	82 (2.5)	74 (2.7)
Release time to observe other teachers in their grade/subject area	70 (3.1)	67 (3.2)	61 (2.9)
Common planning time with experienced teachers who teach the same subject or grade level	76 (2.6)	68 (3.4)	52 (3.3)
Release time to attend national, state, or local teacher conferences	33 (3.0)	38 (3.1)	51 (3.2)
Professional development opportunities on providing instruction that meets the needs of students from the cultural backgrounds represented in the school	44 (3.1)	43 (3.6)	48 (3.0)
Financial support to attend national, state, or local teacher conferences	22 (2.8)	23 (3.1)	35 (3.1)
District/Diocese-level or university-based mentors	30 (2.5)	30 (3.0)	26 (2.5)
Supplemental funding for classroom supplies	31 (3.2)	29 (3.0)	25 (2.4)
Classroom aides/teaching assistants	14 (2.3)	12 (2.1)	15 (1.9)
Reduced number of teaching preps	1 (0.9)	6 (1.5)	13 (1.6)
Reduced course load	2 (0.9)	3 (1.3)	4 (1.4)
Reduced class size	0 (0.3)	1 (0.4)	3 (1.1)

† Includes only those schools that provide a formal induction program.

Given that mentoring plays an important role in effective induction programs, the percentage of schools that formally assign school-based mentor teachers was examined by different school characteristics. As can be seen in Table 3.40, urban schools are significantly less likely than their suburban or rural counterparts to assign mentors (78, 87, and 90 percent, respectively). Schools in the West are also less likely to formally assign school-based mentors than schools in the Northeast (75 and 89 percent, respectively). No disparities exist in terms of proportion of students in the school eligible for free/reduced-price lunch or school size.

Table 3.40
Equity Analyses of Schools Providing Formally Assigned School-Based Mentors

	PERCENT OF SCHOOLS†
Percent of Students in School Eligible for FRL	
Lowest Quartile	85 (3.4)
Second Quartile	87 (2.7)
Third Quartile	87 (2.5)
Highest Quartile	83 (3.4)
School Size	
Smallest Schools	87 (3.6)
Second Group	85 (3.1)
Third Group	82 (3.6)
Largest Schools	87 (2.5)
Community Type	
Rural	90 (3.1)
Suburban	87 (1.9)
Urban	78 (3.3)
Region	
Midwest	87 (2.6)
Northeast	89 (4.2)
South	88 (2.2)
West	75 (4.2)

† Includes only those schools that provide a formally assigned school-based mentor in its induction program.

School coordinators who indicated having formally assigned school-based mentors as part of the school induction program were asked to describe the schools' incentives and requirements of these mentors. About 90 percent of schools, when feasible, intentionally assign a school-based mentor who teaches the same subject or grade level as the beginning teacher (see Table 3.41). Also, roughly two-thirds of schools give school-based mentors training on effective mentoring practices, common planning time with their mentees when feasible, and extra compensation for their service. Still, only a quarter of schools intentionally give mentors release time or a reduced course load to work with their mentee.

Table 3.41
Incentives and Requirements of Formally Assigned School-Based Mentors in Induction Programs, by Grade Range

	PERCENT OF SCHOOLS†		
	ELEMENTARY	MIDDLE	HIGH
When feasible, intentionally assigned to beginning teachers who teach the same subject or grade level	88 (2.5)	90 (2.0)	86 (2.4)
Given training on effective mentoring practices	66 (3.3)	61 (3.8)	66 (2.9)
When feasible, intentionally given common planning time with their mentees	71 (3.2)	65 (3.6)	64 (3.5)
Given extra compensation for being a mentor	66 (3.4)	61 (3.3)	63 (2.9)
Required to attend workshops with their mentees	38 (3.4)	38 (3.8)	36 (2.8)
Intentionally given release time or a reduced course load to work with their mentee	25 (3.0)	22 (3.2)	25 (3.1)

† Includes only those schools that provide a formally assigned school-based mentor in its induction program.

Summary

With the exception of elementary science, a large percentage of science, mathematics, and computer science teachers have participated in discipline-focused professional development in the last three years. However, the extent to which professional development experiences incorporate elements of best practice varies. For example, a relatively common professional development opportunity in any subject/grade-range combination is to work closely with other colleagues in the same grade level and/or subject, whether or not they are from the same school. In contrast, very few science, mathematics, and computer science teachers have had a substantial opportunity to engage in rehearsals to try out instructional practices during the professional development. Further, few science and mathematics teachers have had more than 35 hours of professional development in the last three years; slightly more than half of high school computer science teachers have had more than 35 hours of professional development in the last three years.

Workshops are the most prevalent form of professional development teachers experience across all subjects and grade ranges, and participation in teacher study groups is also quite common, especially at the secondary level. Mathematics teachers are more likely to have received assistance or feedback from a formally designated coach/mentor than their science and computer science colleagues. In contrast, high school computer science teachers are far more likely than high school science and mathematics teachers to have completed an online course/webinar in the last three years.

In both science and mathematics, professional development opportunities tend to emphasize deepening understanding of how science/mathematics is done, monitoring student understanding during instruction, and differentiating instruction to meet the needs of diverse learners. Despite the inclusion of engineering in the NGSS and many states' standards, relatively few science teachers across the grade ranges have had professional development that emphasized deepening their understanding of how engineering is done. In mathematics, learning how to use hands-on/ manipulatives has also been heavily emphasized in professional development, especially at the elementary level. High school computer science teachers' professional development most often focuses on deepening their computer science content knowledge, such as programming.

School program representatives were asked about locally offered professional development opportunities. Workshops are more common in mathematics than in science at the elementary and middle school. In many schools, these workshops have a substantial focus on state science/ mathematics standards, how science/mathematics is done, and science/mathematics content. Relatively few schools offer workshops that emphasize how to develop students' confidence that they can successfully pursue careers in science/engineering/mathematics, how to connect instruction to science/engineering/mathematics career opportunities, and how to incorporate students' cultural backgrounds into science/mathematics instruction.

Teacher study groups also have been fairly common in all three subjects, with the exception of elementary science. Typical activities in study groups involve teachers analyzing student assessment results, planning lessons, and analyzing student instructional materials. Having teachers provide feedback on each other's instruction, rehearse instructional practices, and observe each other's instruction are less common activities. One-on-one coaching is a relatively rare offering across subject areas and grade ranges, although it is somewhat more common for mathematics at the elementary level. In both science and mathematics, one-on-one coaching is more prevalent in urban schools. Also, coaching in science and mathematics is typically provided by both teachers/coaches and administrators; however, teachers/coaches tend to shoulder more of this responsibility.

A relatively large proportion of schools offer formal teacher induction programs, with many of them being developed and implemented by either the district or school. These programs tend to last 1–2 years. Not surprisingly, induction programs are more likely to be offered in the largest schools than their smaller counterparts. The most prominent supports offered as part of these programs include a meeting to orient teachers to school policies and practices, formally assigned school-based mentors, and professional development opportunities for teachers in their subject. However, mentors are less likely to be provided in urban schools. Of schools that provide mentoring as part of their induction program, most assign mentors who teach the same subject or grade as the beginning teachers, and about two-thirds provide mentors with training and extra compensation. Few schools give mentors release time or a reduced course load to work with their mentee.

Equity factors are related to the extent to which science, mathematics, and computer science classes with different demographic characteristics—in particular prior achievement level of the class and proportion of students from race/ethnicity groups historically underrepresented in STEM—have access to teachers with varying teacher professional development experiences. For example, science classes composed of mostly low prior achievers are less likely than classes of high prior achievers to be taught by teachers who have participated in: (1) a substantial amount of professional development, (2) professional learning experiences aligned with characteristics of effective professional development, and (3) professional development that supports student-centered instruction. In mathematics, classes with mostly low prior achievers and students from race/ethnicity groups historically underrepresented in STEM have an advantage over their counterparts when it comes to having access to teachers with a large amount of professional development and experiences aligned with effective practices.

In addition, school science, mathematics, and computer science professional development offerings—workshops, teacher study groups, one-on-one coaching—differ by school factors, such as size and community type. In both science and mathematics, schools in rural areas are less likely to offer workshops and one-on-one coaching than urban schools. The largest schools are also more likely than the smallest schools to provide workshops and teacher study groups in all three subjects.

Science, Mathematics, and Computer Science Courses

Overview

The 2018 NSSME+ collected data on science, mathematics, and computer science course offerings in the nation's schools. Teachers provided information about time spent on science and mathematics instruction in the elementary grades; titles and duration of secondary science, mathematics, and computer science courses; class sizes; gender and racial/ethnic composition; and prior achievement levels. These data are presented in the following sections.

Time Spent in Elementary Science and Mathematics Instruction

Self-contained elementary teachers were asked how often they teach mathematics and/or science. As can be seen in Table 4.1, mathematics is taught in virtually all classes on most or all school days in both grades K–3 and 4–6. In contrast, science is taught less frequently, with only 17 percent of grades K–3 classes and 35 percent of grades 4–6 classes receiving science instruction all or most days, every week of the school year. Many elementary classes receive science instruction only a few days a week or during some weeks of the year.

Table 4.1
Frequency With Which Self-Contained Elementary Teachers Teach Science and Mathematics, by Subject

	PERCENT OF CLASSES	
	SCIENCE	MATHEMATICS
Grades K–3		
All/Most days, every week	17 (1.5)	99 (0.2)
Three or fewer days, every week	40 (1.8)	1 (0.2)
Some weeks, but not every week	43 (2.0)	0 (0.1)
Grades 4–6		
All/Most days, every week	35 (3.1)	99 (0.4)
Three or fewer days, every week	36 (3.1)	1 (0.4)
Some weeks, but not every week	29 (2.4)	0 ---†

† No grades 4–6 teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

The survey also asked the approximate number of minutes typically spent teaching mathematics, science, social studies, and reading/language arts in self-contained classes. The average number of minutes per day typically spent on instruction in each subject in grades K–3 and 4–6 is shown in Table 4.2; to facilitate comparisons among the subject areas, only teachers who teach all four of these subjects to one class of students were included in this analysis. In 2018, grades K–3 self-contained classes spent an average of 89 minutes per day on reading instruction and 57 minutes on mathematics instruction, compared to only 18 minutes on science and 16 minutes on social studies instruction. The pattern in grades 4–6 is similar, with 82 minutes per day devoted to reading, 63 minutes to mathematics, 27 minutes to science, and 21 minutes to social studies instruction.

Table 4.2
Average Number of Minutes Per Day Spent Teaching Each Subject in Self-Contained Classes,† by Grade Range

	NUMBER OF MINUTES	
	GRADES K–3	GRADES 4–6
Reading/Language Arts	89 (1.7)	82 (2.4)
Mathematics	57 (0.8)	63 (1.6)
Science	18 (0.5)	27 (0.8)
Social Studies	16 (0.4)	21 (0.8)

† Includes only self-contained elementary teachers who indicated they teach reading, mathematics, science, and social studies to one class of students.

Science, Mathematics, and Computer Science Course Offerings

Middle and high schools were asked about course offerings in each subject. Schools were also asked about opportunities for students to take courses not offered on site, such as virtually or at another school.

For science, middle schools were asked whether they offer single-discipline courses (e.g., life science, physical science), coordinated/integrated science courses, or both in each grade 6–8 contained in the school. As can be seen in Table 4.3, 45 percent of schools containing 6th grade offer only coordinated/integrated science, and 35 percent offer only single-discipline courses; in grades 7 and 8, the percentage of schools offering only coordinated/integrated science is approximately the same as the those offering only single-discipline courses (about 40 percent). Fewer than 1 in 5 schools containing these grades offer both types of courses.

Table 4.3
Type of Middle School Science Courses Offered, by Grade

	PERCENT OF SCHOOLS		
	GRADE 6	GRADE 7	GRADE 8
Multi-Discipline Science Courses Only	45 (3.5)	41 (3.5)	42 (3.4)
Single-Discipline Science Courses Only	35 (3.5)	40 (3.8)	40 (3.7)
Both	19 (3.2)	18 (3.0)	18 (2.9)

Table 4.4 shows science courses offered in high schools. Almost all schools (97 percent) with grades 9–12 offer courses in biology/life science, with 70 percent offering non-college prep courses, 73 percent offering 1st year college preparatory courses, and 60 percent offering at least one 2nd year biology/life science course. Overall, 94 percent of high schools offer some form of chemistry course. First-year college prep chemistry courses are offered in 72 percent and 2nd year chemistry in 45 percent of high schools. Most high schools (82 percent) offer physics courses. Three-fifths offer 1st year physics, and two-fifths offer 2nd year physics. Most high schools (84 percent) offer coursework in coordinated/integrated science (including physical science). Fewer high schools offer courses in environmental science (66 percent) or Earth/space science (59 percent) than in the other science disciplines. Only 27 percent offer a second course in environmental science; 6 percent of schools offer 2nd year Earth/space science courses. Nearly one-half of high schools offer at least one engineering course; 31 percent offer non-college prep,

and 29 percent offer 1st year college prep engineering courses. Only 17 percent of high schools offer a 2nd year engineering course.

Table 4.4
High Schools Offering Various Science Courses

	PERCENT OF SCHOOLS
Biology/Life Science	
Any level	97 (1.7)
Non-college prep	70 (3.0)
1st year college prep, including honors	73 (3.4)
2nd year advanced	60 (3.8)
Chemistry	
Any level	94 (1.9)
Non-college prep	58 (3.0)
1st year college prep, including honors	72 (3.3)
2nd year advanced	45 (3.3)
Physics	
Any level	82 (3.0)
Non-college prep	45 (3.4)
1st year college prep, including honors	60 (3.2)
2nd year advanced	40 (2.8)
Coordinated/Integrated/Interdisciplinary Science Courses (including General Science and Physical Science)	
Any level	84 (2.3)
Non-college prep	70 (2.6)
College prep, including honors	46 (3.4)
Environmental Science/Ecology	
Any level	66 (3.2)
Non-college prep	44 (3.5)
1st year college prep, including honors	26 (2.5)
2nd year advanced	27 (2.4)
Earth/Space Science	
Any level	59 (3.5)
Non-college prep	47 (3.6)
1st year college prep, including honors	23 (2.5)
2nd year advanced	6 (1.2)
Engineering	
Any level	46 (3.2)
Non-college prep	31 (2.7)
1st year college prep, including honors	29 (2.5)
2nd year advanced	17 (2.1)

Table 4.5 shows the percentage of high schools offering each of the Advanced Placement (AP) science courses and the percentage of grades 9–12 students in the nation at those schools. Biology is the most commonly offered AP course, available in about 4 in 10 high schools. About the same proportion offer some form of AP Physics, with AP Physics 1 being the most common type. AP Chemistry is offered in roughly 1 in 3 schools and AP Environmental Science in about 1 in 4 high schools. That the percentage of high school students with access to each

course is much larger than the percentage of schools offering it indicates that larger schools are more likely than smaller schools to offer AP science courses. However, 27–80 percent of students do not have access to the various AP science courses.

Table 4.5
Access to AP Science Courses, by Schools and Students

	PERCENT OF HIGH SCHOOLS OFFERING	PERCENT OF HIGH SCHOOL STUDENTS WITH ACCESS
AP Biology	**43 (3.1)**	**73 (2.4)**
AP Physics (any course)	**41 (3.2)**	**63 (2.6)**
AP Physics 1	31 (2.9)	56 (2.6)
AP Physics 2	13 (1.7)	26 (2.8)
AP Physics C: Mechanics	12 (1.5)	24 (2.3)
AP Physics C: Electricity and Magnetism	8 (1.2)	20 (2.3)
AP Chemistry	**36 (2.8)**	**65 (2.4)**
AP Environmental Science	**23 (2.4)**	**48 (2.6)**

Across the disciplines, 51 percent of high schools offer at least one AP science course, either this year or in alternating years (see Table 4.6). Approximately the same percentage of schools offer 1–5 AP science courses, with about 10 percent of schools in each category. Only 3 percent of schools offer all of the currently available AP science courses.

Table 4.6
Number of AP Science Courses Offered at High Schools

	PERCENT OF SCHOOLS
0 courses	49 (3.7)
1 course	10 (2.1)
2 courses	9 (1.4)
3 courses	10 (1.6)
4 courses	9 (1.3)
5 courses	8 (1.2)
6 courses	2 (0.5)
7 courses	3 (0.7)

Table 4.7 shows the average number of AP science courses offered by various equity factors. Not surprisingly, small schools tend to offer fewer AP science courses than large schools. On average, suburban and urban schools offer more AP science courses than rural schools. In addition, schools in the top two quartiles in terms of the percentage of students eligible for free/reduced-price lunch offer fewer AP science courses than schools with lower proportions of such students.

Table 4.7
Equity Analyses of Number of AP Science Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	2.0 (0.3)
Second Quartile	2.2 (0.3)
Third Quartile	1.1 (0.2)
Highest Quartile	1.4 (0.2)
School Size	
Smallest Schools	0.5 (0.2)
Second Group	1.0 (0.2)
Third Group	1.7 (0.2)
Largest Schools	3.2 (0.2)
Community Type	
Rural	0.9 (0.1)
Suburban	2.3 (0.2)
Urban	1.9 (0.3)

The survey also asked if high schools offer International Baccalaureate (IB) courses. As can be seen in Table 4.8, very few schools offer the IB program and fewer than 1 in 10 high school students have access to any of these science courses.

Table 4.8
Access to IB Science Courses, by Schools and Students

	PERCENT OF HIGH SCHOOLS OFFERING	PERCENT OF HIGH SCHOOL STUDENTS WITH ACCESS
IB Biology	3 (0.7)	8 (1.6)
IB Chemistry	2 (0.5)	6 (1.2)
IB Physics	2 (0.6)	5 (1.4)
IB Environmental Systems and Societies	2 (0.5)	4 (1.1)

The survey asked high schools about opportunities provided to students to take science and engineering courses not offered on-site. As previously described, 82 percent of high schools offer at least one physics course; a small additional percentage of schools provide students with access to physics either by offering it in alternative years or by allowing students to take the course off campus (see Table 4.9). Over half of high schools have students take science and/or engineering courses at a college/university, and almost half provide access to concurrent credit/ dual enrollment courses—courses that count for high school and college credit. About 2 in 5 high schools allow students to take science and/or engineering courses at a Career and Technical Education center or virtually through other schools/institutions. Fewer than 1 in 5 high schools have students take science/engineering courses at another high school or provide their own science and/or engineering courses virtually.

Table 4.9
Science Programs and Practices Currently Being Implemented in High Schools

	PERCENT OF SCHOOLS
Physics courses are offered this school year or in alternating years, on or off site.	87 (2.8)
Students can go to a college or university for science and/or engineering courses.	54 (3.0)
Concurrent college and high school credit/dual enrollment courses are offered this school year or in alternating years.	46 (3.2)
Students can go to a Career and Technical Education center for science and/or engineering instruction.	41 (2.3)
This school provides students access to virtual science and/or engineering courses offered by other schools/ institutions.	41 (3.4)
Students can go to another K–12 school for science and/or engineering courses.	17 (2.1)
This school provides its own science and/or engineering courses virtually.	15 (2.1)

In mathematics, middle schools were asked how many 8th grade students would complete Algebra 1 and Geometry prior to 9th grade. As can be seen in Table 4.10, about three-fourths of middle schools have some students completing Algebra 1, and about one-fourth have students completing Geometry. Approximately a quarter of middle schools have 51 percent or more of their students completing Algebra 1; in schools that offer Geometry, only a small percentage of students typically complete the course prior to 9th grade.

Table 4.10
Middle Schools With Various Percentages of 8th Graders Completing Algebra 1 and Geometry Prior to 9th Grade

	PERCENT OF SCHOOLS	
	ALGEBRA 1	GEOMETRY
0 percent of students	26 (3.9)	74 (3.1)
1–10 percent of students	6 (1.4)	13 (1.5)
11–20 percent of students	12 (1.8)	4 (1.5)
21–30 percent of students	13 (1.9)	2 (0.5)
31–40 percent of students	11 (1.6)	0 (0.2)
41–50 percent of students	8 (2.0)	1 (0.5)
51–60 percent of students	5 (1.9)	0 (0.1)
61–70 percent of students	4 (1.6)	1 (0.9)
71–80 percent of students	2 (1.1)	1 (0.5)
81–90 percent of students	3 (1.1)	1 (0.6)
Over 90 percent of students	11 (2.7)	4 (2.2)

The data also show that students in high-poverty schools are less likely than students in low-poverty schools to complete either of these courses prior to 9th grade (see Table 4.11). In addition, a smaller proportion of students in rural middle schools complete Algebra 1 than in suburban and urban middle schools, and a smaller proportion of students in rural and urban middle schools complete Geometry than in suburban middle schools.

Table 4.11
Equity Analyses of Average Percentage of 8th Graders Completing Algebra 1 and Geometry Prior to 9th Grade

	PERCENT OF STUDENTS	
	ALGEBRA 1	GEOMETRY
Percent of Students in School Eligible for FRL		
Lowest Quartile	48 (5.1)	17 (5.5)
Second Quartile	25 (4.1)	2 (0.8)
Third Quartile	20 (4.2)	2 (0.9)
Highest Quartile	29 (6.1)	7 (5.9)
Community Type		
Rural	19 (3.5)	1 (0.3)
Suburban	43 (3.7)	16 (5.3)
Urban	32 (4.9)	3 (1.0)

Table 4.12 shows mathematics courses offered at the high school level. Nearly all high schools offer a 1st year formal/college prep mathematics course such as Algebra 1 or Integrated Math 1. The vast majority of high schools also offer a second, third, and fourth year of formal mathematics. Almost three-fourths of high schools offer mathematics courses that might qualify for college credit such as AP Calculus or AP Statistics.

Table 4.12
High Schools Offering Various Mathematics Courses

	PERCENT OF SCHOOLS
Non-college prep (e.g., Remedial Math, General Math, Consumer Math)	79 (2.8)
Formal/College prep level 1 (e.g., Algebra 1, Integrated Math 1)	98 (1.0)
Formal/College prep level 2 (e.g., Geometry, Integrated Math 2)	93 (1.9)
Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry)	91 (2.2)
Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3)	90 (2.5)
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	72 (3.5)

Almost all high schools (98 percent) offer single-discipline mathematics courses, with 80 percent offering only these types of courses (see Table 4.13). Close to 1 in 5 high schools also offer coordinated or integrated mathematics courses; only 2 percent of high schools offer coordinated or integrated mathematics courses exclusively.

Table 4.13
Type of High School Mathematics Courses Offered

	PERCENT OF SCHOOLS
Single-subject mathematics courses only	80 (2.2)
Integrated mathematics courses only	2 (0.7)
Both	18 (2.1)

As can be seen in Table 4.14, just over half of high schools offer AP Calculus, typically AP Calculus AB. AP Calculus BC and AP Statistics are each offered by about one-third of high schools. As was the case in science, the percentage of grades 9–12 students with access to each course is substantially greater than the percentage of schools offering it, indicating that AP mathematics courses are more likely to be offered in larger schools.

Table 4.14
Access to AP Mathematics Courses, by Schools and Students

	PERCENT OF HIGH SCHOOLS OFFERING	PERCENT OF HIGH SCHOOL STUDENTS WITH ACCESS
AP Calculus	**53 (3.2)**	**82 (1.6)**
AP Calculus AB	53 (3.2)	81 (1.7)
AP Calculus BC	30 (2.4)	56 (2.5)
AP Statistics	**34 (2.8)**	**63 (2.4)**

Although 46 percent of high schools do not offer any AP mathematics courses, 24 percent offer all three AP mathematics courses currently available (see Table 4.15). Fourteen percent of high schools offer one AP mathematics course, and 16 percent offer two different AP mathematics courses.

Table 4.15
Number of AP Mathematics Courses Offered at High Schools

	PERCENT OF SCHOOLS
0 courses	46 (3.3)
1 course	14 (2.2)
2 courses	16 (2.4)
3 courses	24 (2.2)

The data on the number of AP mathematics courses offered by various equity factors follow the same pattern as in science. As can be seen in Table 4.16, small schools tend to offer fewer AP mathematics courses than large schools, and suburban and urban schools offer more AP mathematics courses than rural schools. High-poverty schools offer fewer AP mathematics courses on average than low-poverty schools.

Table 4.16
Equity Analyses of Number of AP Mathematics Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	1.3 (0.2)
Second Quartile	1.6 (0.2)
Third Quartile	0.9 (0.1)
Highest Quartile	0.8 (0.1)
School Size	
Smallest Schools	0.3 (0.1)
Second Group	0.9 (0.2)
Third Group	1.4 (0.1)
Largest Schools	2.0 (0.1)
Community Type	
Rural	0.6 (0.1)
Suburban	1.5 (0.1)
Urban	1.5 (0.2)

The survey also asked if high schools offer IB mathematics courses. As schools tend to offer IB courses in all disciplines or not at all, it is not surprising that the data for mathematics (see Table 4.17) mirror those for science.

Table 4.17
Access to IB Mathematics Courses, by Schools and Students

	PERCENT OF HIGH SCHOOLS OFFERING	PERCENT OF HIGH SCHOOL STUDENTS WITH ACCESS
IB Mathematical Studies Standard Level	3 (0.7)	8 (1.5)
IB Mathematics Standard Level	3 (0.6)	8 (1.5)
IB Mathematics Higher Level	3 (0.6)	7 (1.5)
IB Further Mathematics Standard Level	1 (0.2)	2 (0.7)

The mathematics program questionnaire also asked about a number of specific course-taking opportunities provided to students. As can be seen in Table 4.18, 76 percent of high schools offer some form of calculus course, including AP and non-AP courses, and 52 percent offer some form of probability and/or statistics course. More than 2 in 5 high schools offer Algebra 1 as a two-course sequence (e.g., Algebra A and Algebra B). Students going to a college or university for courses, earning college credit through dual enrollment, or taking virtual courses are more common practices in mathematics (59–68 percent of high schools) than in science (41–54 percent of high schools).

Table 4.18
Mathematics Programs and Practices Currently Being Implemented in High Schools

	PERCENT OF SCHOOLS
Calculus courses (beyond pre-calculus) are offered this school year or in alternating years, on or off site.	76 (3.8)
Students can go to a college or university for mathematics courses.	68 (3.1)
Concurrent college and high school credit/dual enrollment courses are offered this school year or in alternating years.	67 (3.0)
This school provides students access to virtual mathematics courses offered by other schools/institutions.	59 (3.2)
Probability and/or statistics course are offered.	52 (3.2)
Algebra 1 course, or its equivalent, is offered over two years or as two separate block courses (e.g., Algebra A and Algebra B).	44 (3.0)
Students can go to a Career and Technical Education center for mathematics instruction.	23 (2.3)
This school provides its own mathematics courses virtually.	15 (2.5)
Students can go to another K–12 school for mathematics courses.	11 (1.7)

Computer science instruction is offered at only some schools, unlike science and mathematics (see Table 4.19). About 1 in 4 elementary schools and 1 in 3 middle schools offer computer programming instruction as part of the regular school day. About half of high schools offer one or more computer courses. In high schools, the proportion of students with access to computer science instruction is higher than the proportion of schools offering it, indicating that larger high schools are more likely to offer computer science courses.

Table 4.19
Access to Computer Science Instruction, by Schools and Students

	PERCENT OF SCHOOLS OFFERING	PERCENT OF STUDENTS WITH ACCESS
Elementary	26 (3.2)	26 (3.1)
Middle	38 (3.2)	44 (3.2)
High	53 (2.9)	70 (1.9)

Table 4.20 shows the percentage of schools that offer computer science instruction by equity factors. Unsurprisingly, high-poverty schools are less likely to offer computer science than low-poverty schools, and larger schools are more likely to offer computer science than smaller schools. There are also regional differences, with schools in the West more likely to offer computer science than schools in the Midwest and South, and schools in the Northeast more likely to offer it than schools in the South.

Table 4.20
Equity Analyses of Schools Offering Computer Science Instruction

	PERCENT OF SCHOOLS
Percent of Students in School Eligible for FRL	
Lowest Quartile	44 (3.9)
Second Quartile	38 (3.8)
Third Quartile	26 (3.4)
Highest Quartile	26 (3.5)
School Size	
Smallest Schools	23 (4.6)
Second Group	33 (3.7)
Third Group	34 (3.0)
Largest Schools	43 (3.1)
Region	
Midwest	30 (3.8)
Northeast	43 (5.2)
South	24 (2.2)
West	44 (4.9)

The percentages of schools offering different types of computer science and computer technology courses are shown in Table 4.21. Almost half of high schools offer computer technology courses that do not include programming. Introductory high school computer science courses and computer science courses that might qualify for college credit are each offered at about a third of high schools. Specialized computer science courses that require programming are offered at only about 1 in 5 high schools.

Table 4.21
High Schools Offering Various Computer Science and Technology Courses

	PERCENT OF SCHOOLS
Computer technology courses that do not include programming (e.g., Computer Literacy, Keyboarding, Computer Applications, Web Design)	47 (2.4)
Introductory high school computer science courses that include programming but do not qualify for college credit (e.g., Computer Science Discoveries, Computer Science Essentials)	36 (2.4)
Specialized/elective computer science courses with programming as a prerequisite that do not qualify for college credit (e.g., game or mobile app development, robotics)	21 (1.7)
Courses that might qualify for college credit (e.g., AP Computer Science A)	35 (2.1)

As can be seen in Table 4.22, AP Computer Science A and AP Computer Science Principles are offered in about 1 in 6 high schools. Similar to science and mathematics, the percentage of grades 9–12 students with access to each course is substantially greater than the percentage of schools offering it.

Table 4.22
Access to AP Computer Science Courses, by Schools and Students

	PERCENT OF HIGH SCHOOLS OFFERING	PERCENT OF HIGH SCHOOL STUDENTS WITH ACCESS
AP Computer Science A	16 (1.4)	34 (2.3)
AP Computer Science Principles	14 (1.5)	28 (2.2)

Almost four-fifths of high schools do not offer any AP computer science course (see Table 4.23). Twelve percent offer one AP computer science course, and 9 percent offer both AP courses.

Table 4.23
Number of AP Computer Science Courses Offered at High Schools

	PERCENT OF SCHOOLS
0 courses	79 (1.6)
1 course	12 (1.4)
2 courses	9 (1.1)

Patterns in the number of AP computer science courses offered by equity factors are similar to those in science and mathematics. Large schools are more likely to offer AP computer science courses than small schools. Rural schools are less likely than suburban or urban schools, and high-poverty schools less likely than low-poverty schools, to offer AP computer science (see Table 4.24).

Table 4.24
Equity Analyses of Number of
AP Computer Science Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	0.5 (0.1)
Second Quartile	0.3 (0.1)
Third Quartile	0.2 (0.1)
Highest Quartile	0.2 (0.1)
School Size	
Smallest Schools	0.1 (0.1)
Second Group	0.2 (0.0)
Third Group	0.3 (0.0)
Largest Schools	0.6 (0.1)
Community Type	
Rural	0.1 (0.0)
Suburban	0.4 (0.0)
Urban	0.4 (0.1)

Students can take computer science courses from a teacher in their school at about half of high schools (see Table 4.25). Fewer high schools offer virtual computer science courses (35 percent of high schools) than virtual mathematics courses (59 percent of high schools), and students earning college credit through dual enrollment or by going to a college or university are less common practices in computer science (19 and 30 percent of high schools, respectively) than in science or mathematics (46–68 percent of high schools).

Table 4.25
Computer Science Course-Offering Practices Currently Being Implemented in High Schools

	PERCENT OF SCHOOLS
From a teacher in this school	52 (2.7)
Through virtual courses offered by other schools/institutions (e.g., online, videoconference)	35 (2.6)
By going to a college or university	30 (2.4)
By going to a Career and Technical Education (CTE) center	24 (2.5)
Concurrent college and high school credit/dual enrollment courses	19 (1.9)
By going to another high school	9 (1.8)

In addition to gathering school-level information about course offerings, the survey asked each teacher for the course type of a randomly selected class, which allows for an estimate of the percentage of courses of each type in schools. As can be seen in Table 4.26, 1st year college prep biology accounts for 22 percent of high school science classes; 16 percent of the classes are 1st year chemistry, and 8 percent are 1st year physics.

Table 4.26
Most Commonly Offered High School Science Courses

	PERCENT OF CLASSES
Biology/Life Science	
Non-college prep	7 (0.9)
1st year college prep, including honors	22 (1.4)
2nd year advanced	8 (1.3)
Chemistry	
Non-college prep	3 (0.5)
1st year college prep, including honors	16 (1.1)
2nd year advanced	3 (0.5)
Physics	
Non-college prep	2 (0.4)
1st year college prep, including honors	8 (0.8)
2nd year advanced	2 (0.4)
Earth/Space Science	
Non-college prep	3 (0.8)
1st year college prep, including honors	2 (0.5)
2nd year advanced	0 (0.2)
Environmental Science/Ecology	
Non-college prep	3 (0.6)
1st year college prep, including honors	2 (0.6)
2nd year advanced	2 (0.4)
Multi-Discipline Science Courses (e.g., General Science, Integrated Science, Physical Science)	
Non-college prep	8 (0.8)
1st year college prep, including honors	5 (0.8)
2nd year advanced	1 (0.4)

In mathematics, formal/college prep levels 1, 2, and 3 courses each account for 20 percent or more of grades 9–12 mathematics classes (see Table 4.27). Formal level 4 courses make up 14 percent of the classes, non-college prep mathematics 13 percent, and courses that might qualify for college credit account for 10 percent of classes.

Table 4.27
Most Commonly Offered High School Mathematics Courses

	PERCENT OF CLASSES
Non-college prep (e.g., Remedial Math, General Math, Consumer Math)	13 (1.2)
Formal/College prep level 1 (e.g., Algebra 1, Integrated/Unified Math I)	20 (1.1)
Formal/College prep level 2 (e.g., Geometry, Integrated/Unified Math II)	21 (1.4)
Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry)	23 (1.3)
Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3)	14 (1.0)
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	10 (0.8)

In computer science, introductory courses account for almost half of all computer science courses that include programming or have programming as a prerequisite (see Table 4.28). Just over a third of classes might qualify for college credit; only 16 percent of classes are specialized or elective computer science courses.

Table 4.28
Most Commonly Offered High School Computer Science Courses

	PERCENT OF CLASSES
Introductory high school computer science courses that include programming (e.g., Computer Science Discoveries, Computer Science Essentials)	48 (4.0)
Specialized/elective computer science courses with programming as a prerequisite (e.g., Robotics, Game or Mobile App Development)	16 (2.8)
Courses that might qualify for college credit (e.g., AP Computer Science A)	36 (4.2)

Other Characteristics of Science, Mathematics, and Computer Science Classes

The 2018 NSSME+ found that the average size of science and mathematics classes is generally around 21–24 students (see Table 4.29), whereas high school computer science classes tend to have around 17 students. Table 4.30 shows average class size in different high school courses. As can be seen in Figure 4.1, however, these averages can obscure a wide variation in class sizes. For example, 15 percent of high school science and mathematics classes have 30 or more students.

Table 4.29
Average Class Size, by Grade Range

	AVERAGE NUMBER OF STUDENTS		
	ELEMENTARY	MIDDLE	HIGH
Science	21.6 (0.2)	23.4 (0.4)	20.9 (0.3)
Mathematics	21.0 (0.2)	21.7 (0.4)	20.5 (0.3)
Computer Science	n/a	n/a	17.0 (0.8)

Table 4.30
Average High School Class Size

	AVERAGE NUMBER OF STUDENTS
Science Courses	
Non-college prep	20.5 (0.7)
1st Year biology	23.0 (0.5)
1st Year chemistry	22.2 (0.6)
1st Year physics	19.2 (1.0)
Advanced science courses	18.4 (0.7)
Mathematics Courses	
Non-college prep	18.0 (0.6)
Formal/College prep level 1	21.1 (0.6)
Formal/College prep level 2	22.0 (0.5)
Formal/College prep level 3	21.9 (0.6)
Formal/College prep level 4	19.8 (0.7)
Courses that might qualify for college credit	18.1 (0.9)
Computer Science Courses	
Introductory high school computer science courses that include programming	18.0 (1.1)
Specialized/elective computer science courses with programming as a prerequisite	13.5 (1.6)
Computer science courses that might qualify for college credit	17.4 (1.2)

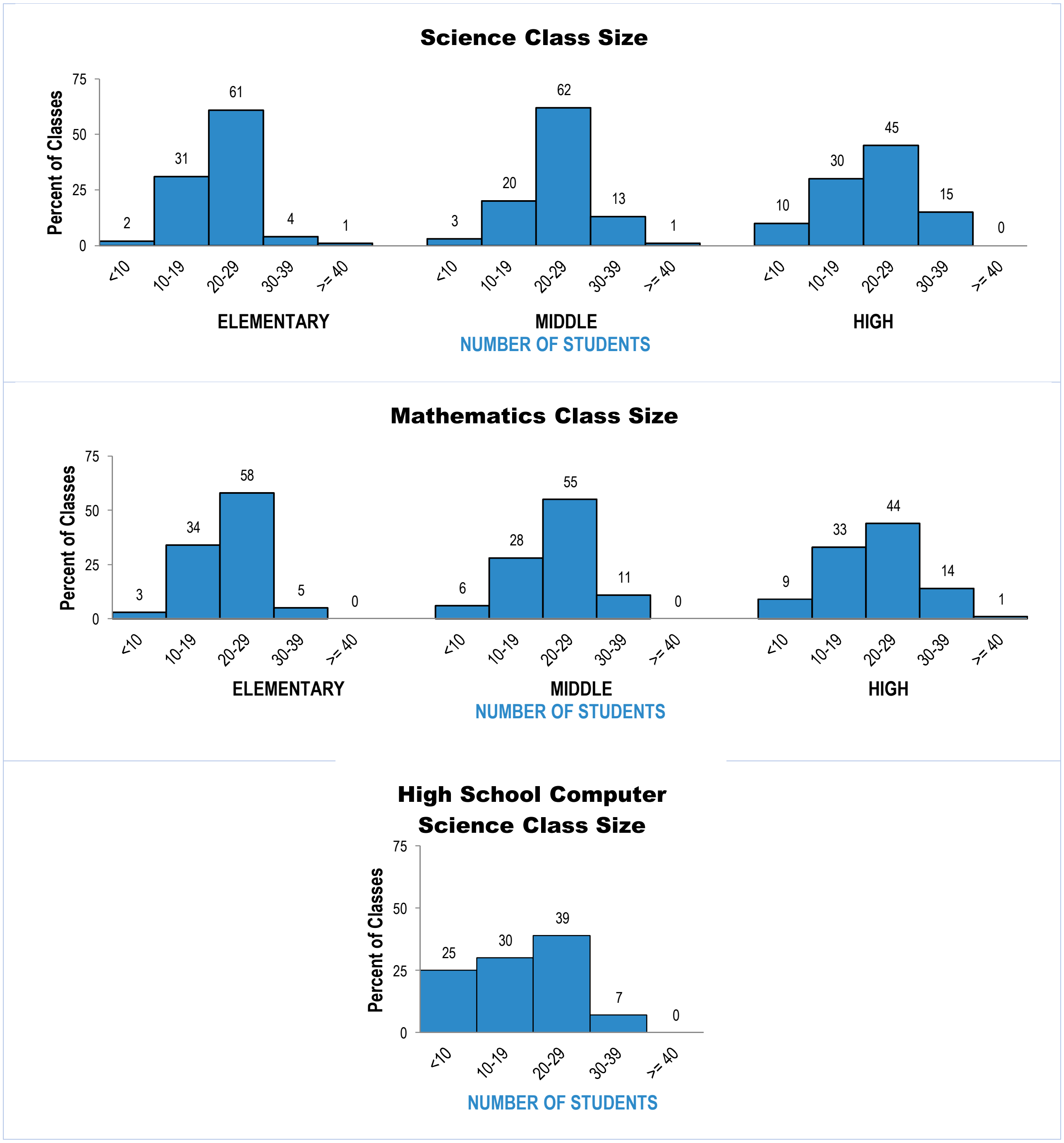

Figure 4.1

Table 4.31 shows the percentages of female students and students from race/ethnicity groups historically underrepresented in STEM in classes in the different grade bands. Elementary and middle school data mirror those of students in the nation, as students typically are required to take science and mathematics at each grade level. In high school, where students are generally not required to take each subject every year, the data show that historically underrepresented students are less likely to take science and mathematics classes. In high school computer science classes, only about a quarter of students are female or from a historically underrepresented race/ ethnicity group.

Table 4.31
Average Percentages of Female and Historically Underrepresented Students in Classes, by Grade Range

	PERCENT OF FEMALE			PERCENT OF HISTORICALLY UNDERREPRESENTED		
	ELEMENTARY	MIDDLE	HIGH	ELEMENTARY	MIDDLE	HIGH
Science	49 (0.5)	48 (0.7)	48 (0.7)	46 (1.9)	45 (1.7)	36 (1.5)
Mathematics	48 (0.7)	47 (0.7)	48 (0.9)	44 (1.7)	44 (2.0)	38 (1.6)
Computer Science	n/a	n/a	28 (2.2)	n/a	n/a	28 (2.9)

A pattern of decreasing enrollment of students from race/ethnicity groups historically underrepresented in STEM is seen in the class composition data across the progression of high school science and mathematics courses (see Table 4.32). For example, students from these groups make up 43 percent of students in non-college prep science classes and 35 percent of students in 1st year biology classes, compared to only 27 percent in advanced science classes. In mathematics, 38 percent of students in formal/college prep level 1 classes are from race/ethnicity groups historically underrepresented in STEM, compared to only 22 percent of students in classes that might qualify for college credit. In computer science, students from these groups make up 30 percent of students in introductory classes and 23 percent of students in courses that might qualify for college credit. In terms of gender, high school science and mathematics courses tend to have classes that are evenly split between male and female students on average. Exceptions are non-college prep science and mathematics classes and 1st year physics classes, which have smaller percentages of female students.

Table 4.32
Average Percentages of Female and Historically Underrepresented Students in High School Courses

	PERCENT OF STUDENTS	
	FEMALE	HISTORICALLY UNDERREPRESENTED
Science Courses		
Non-college prep	45 (1.2)	43 (2.8)
1st Year biology	51 (1.5)	35 (3.0)
1st Year chemistry	51 (1.1)	35 (2.2)
1st Year physics	41 (1.9)	30 (3.0)
Advanced science courses	54 (3.1)	27 (3.9)
Mathematics Courses		
Non-college prep	43 (1.8)	53 (4.4)
Formal/College prep level 1	47 (1.9)	38 (2.5)
Formal/College prep level 2	50 (1.2)	39 (3.2)
Formal/College prep level 3	50 (1.2)	37 (2.4)
Formal/College prep level 4	51 (1.7)	33 (2.5)
Courses that might qualify for college credit	50 (3.0)	22 (2.4)
Computer Science Courses		
Introductory high school computer science courses that include programming	30 (3.7)	30 (3.3)
Specialized/elective computer science courses with programming as a prerequisite	27 (5.7)	30 (9.2)
Computer science courses that might qualify for college credit	25 (2.5)	23 (5.8)

Teachers were asked to indicate the prior achievement level of students in the selected class relative to other students in the school. At the elementary level, 41 percent of science and 51 percent of mathematics classes are heterogeneous in terms of prior achievement; most of the remaining classes are composed primarily of average-achieving students (see Table 4.33). Heterogeneous grouping is less common in middle school mathematics and in high school science and mathematics. However, 41 percent of high school computer science classes include students with a mixture of prior achievement levels. In contrast to science and mathematics, almost no computer science classes are composed of mostly low prior achievers.

Table 4.33
Prior Achievement Grouping in Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science Classes			
Mostly low achievers	11 (1.3)	17 (1.8)	13 (1.3)
Mostly average achievers	43 (1.8)	26 (1.8)	28 (1.5)
Mostly high achievers	6 (0.9)	15 (1.6)	31 (1.6)
A mixture of levels	41 (1.9)	43 (2.3)	28 (1.5)
Mathematics Classes			
Mostly low achievers	12 (1.4)	26 (1.8)	22 (1.4)
Mostly average achievers	30 (1.5)	24 (1.7)	28 (1.6)
Mostly high achievers	7 (1.0)	22 (1.8)	27 (1.3)
A mixture of levels	51 (1.8)	29 (2.0)	24 (1.6)
Computer Science Classes			
Mostly low achievers	n/a	n/a	0 (0.4)
Mostly average achievers	n/a	n/a	23 (2.8)
Mostly high achievers	n/a	n/a	36 (4.4)
A mixture of levels	n/a	n/a	41 (4.4)

The percentage of science classes composed mostly of high prior achievers tends to increase across the traditional course sequence; for example, about 30 percent of 1st year biology and chemistry classes consist mostly of high prior achievers, compared to 42 percent of 1st year physics classes and 65 percent of advanced science classes (see Table 4.34). A similar trend occurs in mathematics, where few level 1, a quarter of level 2 and level 3, half of level 4, and a large majority of classes that might qualify for college credit are composed of mostly high prior achievers. In computer science, 24 percent of introductory computer science classes, 41 percent of specialized/elective classes, and 49 percent of classes that might qualify for college credit consist of mostly high prior achievers.

Table 4.34
Prior Achievement Grouping in High School Courses

	PERCENT OF CLASSES			
	MOSTLY LOW ACHIEVERS	MOSTLY AVERAGE ACHIEVERS	MOSTLY HIGH ACHIEVERS	A MIXTURE OF LEVELS
Science Courses				
Non-college prep	26 (3.2)	34 (2.5)	12 (2.6)	28 (3.4)
1st Year biology	9 (1.8)	32 (4.1)	29 (4.2)	30 (3.5)
1st Year chemistry	5 (0.9)	32 (2.4)	32 (2.6)	31 (2.7)
1st Year physics	6 (1.7)	24 (3.2)	42 (5.0)	28 (4.5)
Advanced science courses	5 (4.8)	9 (2.2)	65 (5.4)	21 (3.0)
Mathematics Courses				
Non-college prep	56 (5.3)	19 (3.7)	8 (2.7)	17 (4.4)
Formal/College prep level 1	36 (4.3)	30 (3.2)	8 (1.9)	26 (3.8)
Formal/College prep level 2	15 (2.4)	32 (3.4)	26 (2.7)	28 (2.9)
Formal/College prep level 3	14 (2.1)	34 (3.1)	25 (3.3)	27 (3.3)
Formal/College prep level 4	6 (1.8)	28 (3.1)	47 (3.6)	19 (2.4)
Courses that might qualify for college credit	1 (0.5)	9 (2.5)	70 (3.7)	20 (3.6)
Computer Science Courses				
Introductory high school computer science courses that include programming	1 (0.8)	30 (5.1)	24 (5.6)	45 (5.8)
Specialized/elective computer science courses with programming as a prerequisite	0 ---†	13 (4.8)	41 (9.8)	46 (10.6)
Computer science courses that might qualify for college credit	0 ---†	17 (5.7)	49 (7.1)	34 (6.4)

† No high school computer science teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Prior achievement grouping also varies by the percentage of students from race/ethnicity groups historically underrepresented in STEM in classes. Across all grade levels in both science (see Table 4.35) and mathematics (see Table 4.36), classes composed of 40 percent or more of students from race/ethnicity groups historically underrepresented in STEM are more likely to be classified as consisting of mostly low prior achievers than classes with smaller proportions of students from these groups. For example, 32 percent of high school mathematics classes with a high percentage of students from race/ethnicity groups historically underrepresented in STEM are classified as being composed mostly of low prior achievers, compared to 16 percent of classes with a low percentage of students from these groups. In high school computer science, classes composed of fewer than 10 percent of students from these groups are more likely to be classified as consisting of mostly high prior achievers than classes in which 40 percent or more of students are from these groups (see Table 4.37).

Table 4.35
Prior Achievement Grouping in Grades K–12 Science Classes With Low, Medium, and High Percentages of Students From Race/Ethnicity Groups Historically Underrepresented in STEM

	PERCENT OF CLASSES			
	MOSTLY LOW ACHIEVERS	MOSTLY AVERAGE ACHIEVERS	MOSTLY HIGH ACHIEVERS	A MIXTURE OF LEVELS
Elementary				
< 10% Historically underrepresented students in class	5 (1.7)	45 (3.6)	9 (2.5)	40 (3.6)
10–39% Historically underrepresented students in class	4 (1.2)	45 (2.8)	7 (1.7)	44 (3.3)
≥ 40% Historically underrepresented students in class	17 (2.3)	40 (2.7)	4 (1.2)	40 (2.8)
Middle				
< 10% Historically underrepresented students in class	4 (1.3)	28 (4.6)	22 (4.1)	47 (5.5)
10–39% Historically underrepresented students in class	10 (1.9)	27 (3.3)	19 (3.3)	44 (3.9)
≥ 40% Historically underrepresented students in class	27 (3.3)	24 (2.7)	9 (1.9)	41 (3.0)
High				
< 10% Historically underrepresented students in class	5 (1.2)	25 (3.0)	45 (3.1)	25 (2.6)
10–39% Historically underrepresented students in class	9 (1.4)	28 (2.4)	35 (2.4)	29 (2.9)
≥ 40% Historically underrepresented students in class	23 (2.8)	31 (3.4)	15 (1.9)	30 (2.6)

Table 4.36
Prior Achievement Grouping in Grades K–12 Mathematics Classes With Low, Medium, and High Percentages of Students From Race/Ethnicity Groups Historically Underrepresented in STEM

	PERCENT OF CLASSES			
	MOSTLY LOW ACHIEVERS	MOSTLY AVERAGE ACHIEVERS	MOSTLY HIGH ACHIEVERS	A MIXTURE OF LEVELS
Elementary				
< 10% Historically underrepresented students in class	5 (1.2)	32 (3.8)	10 (1.9)	54 (3.9)
10–39% Historically underrepresented students in class	5 (1.4)	35 (3.2)	8 (2.2)	52 (3.3)
≥ 40% Historically underrepresented students in class	20 (2.6)	27 (2.2)	4 (1.1)	49 (2.7)
Middle				
< 10% Historically underrepresented students in class	18 (4.1)	17 (3.1)	40 (4.7)	25 (4.0)
10–39% Historically underrepresented students in class	16 (2.9)	32 (3.8)	25 (3.1)	27 (3.6)
≥ 40% Historically underrepresented students in class	35 (3.0)	22 (2.6)	12 (2.1)	32 (2.8)
High				
< 10% Historically underrepresented students in class	16 (1.9)	27 (2.6)	39 (2.8)	18 (2.4)
10–39% Historically underrepresented students in class	16 (2.0)	28 (2.8)	31 (3.1)	25 (2.9)
≥ 40% Historically underrepresented students in class	32 (2.8)	27 (2.7)	14 (1.6)	27 (2.4)

Table 4.37
Prior Achievement Grouping in High School Computer Science Classes With Low, Medium, and High Percentages of Students From Race/Ethnicity Groups Historically Underrepresented in STEM

	PERCENT OF CLASSES			
	MOSTLY LOW ACHIEVERS	MOSTLY AVERAGE ACHIEVERS	MOSTLY HIGH ACHIEVERS	A MIXTURE OF LEVELS
High				
< 10% Historically underrepresented students in class	0 ---†	15 (3.2)	48 (6.6)	38 (5.5)
10–39% Historically underrepresented students in class	0 ---†	29 (7.9)	32 (5.9)	39 (7.7)
≥ 40% Historically underrepresented students in class	2 (1.6)	25 (7.2)	26 (9.2)	47 (10.2)

† No high school computer science teachers in the sample selected this response option. Thus, it is not possible to calculate the standard error of this estimate.

Summary

Data from the 2018 NSSME+ indicate that in the early grades, mathematics is taught much more frequently than science. Almost all elementary classes spend time on mathematics instruction every school day; in contrast, only 1 in 3 classes in grades 4–6 and 1 in 5 classes in grades K–3 receive science instruction every school day. In addition, elementary mathematics lessons tend to be substantially longer than science lessons, although the amount of time devoted to science and mathematics is substantially less than reading/language arts. Computer programming instruction is offered in only about 1 in 4 elementary schools.

In terms of the number of high schools offering various courses, virtually all schools offer at least one biology course, and nearly all offer chemistry; somewhat fewer offer physics. Environmental science and Earth/space science courses are each offered in about two-thirds of high schools. In mathematics, although most middle schools offer Algebra 1, relatively few students complete it prior to 9th grade. At the high school level, almost all schools offer the three-course sequence of Algebra 1, Geometry, and Algebra 2. Nearly as many high schools offer a fourth year in the formal mathematics sequence; three-fourths of high schools offer a calculus course, though only about half offer AP Calculus. In computer science, about half of high schools offer at least one computer science course. Students taking courses at a college or university, earning college credit through dual enrollment, or taking virtual courses are more common practices in mathematics than in science or computer science.

AP courses in science and mathematics are offered in about half of high schools. AP courses in computer science are offered in about one-fifth of high schools. These courses are less likely to be offered in schools with a high proportion of students eligible for free/reduced-price lunch and more likely to be offered in large schools. AP courses are also more common in suburban and urban schools than in rural schools.

The 2018 NSSME+ found that the percentage of classes that are heterogeneous in terms of prior achievement declines with increasing grade level. Further, students are assigned to classes that are homogeneous in regards to prior achievement disproportionally by race/ethnicity; classes with higher proportions of students from race/ethnicity groups historically underrepresented in STEM are more likely to be labeled as consisting of "mostly low prior achievers."

In science, about half of the students in high school biology, chemistry, and physics classes are female, though students in advanced science courses are more likely to be female than male. The proportion of female and male students in college preparatory mathematics classes is about equal. Students from historically underrepresented race/ethnicity groups make up about 45 percent of the enrollment in grades K–12, but at the high school level, the proportion of students from these groups decreases as the level of science and mathematics increases. Female students and students from race/ethnicity groups historically underrepresented in STEM each make up fewer than a third of the students in high school computer science classes.

Instructional Decision Making, Objectives, and Activities

Overview

The 2018 NSSME+ collected data about teachers' perceptions of their autonomy in making curricular and instructional decisions. Questions also focused on teachers' instructional objectives, class activities they use in accomplishing these objectives, and how student performance is assessed in a particular, randomly selected class. These data are discussed in the following sections.

Teachers' Perceptions of Their Decision-Making Autonomy

Many in education believe that classroom teachers are in the best position to know their students' needs and interests and, therefore, should be the ones making decisions about tailoring instruction to a particular group of students. Teachers were asked the extent to which they had control over a number of curricular and instructional decisions for their classes.

As can be seen in Table 5.1, in science classes across all grade levels, teachers tend to perceive themselves as having strong control over pedagogical decisions such as determining the amount of homework to be assigned (59–74 percent), selecting teaching techniques (48–68 percent), and choosing criteria for grading student performance (41–59 percent). In contrast, especially in the elementary grades, teachers are less likely to feel strong control in determining course goals and objectives (17–36 percent); selecting textbooks/modules/programs (15–36 percent); and selecting content, topics, and skills to be taught (13–34 percent). In fact, in about a third of elementary classes, teachers report having no control over these decisions (see Table 5.2).

Table 5.1
Science Classes in Which Teachers Report Having Strong Control Over Various Curricular and Instructional Decisions, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determining the amount of homework to be assigned	59 (2.5)	73 (2.2)	74 (1.8)
Selecting teaching techniques	48 (2.3)	67 (2.4)	68 (2.3)
Choosing criteria for grading student performance	41 (2.5)	59 (2.6)	54 (2.2)
Selecting the sequence in which topics are covered	30 (2.6)	41 (2.9)	51 (2.1)
Determining the amount of instructional time to spend on each topic	21 (2.7)	43 (3.2)	48 (2.1)
Determining course goals and objectives	17 (2.7)	33 (3.0)	36 (2.5)
Selecting curriculum materials (e.g., textbooks/modules)	15 (2.5)	28 (2.9)	36 (2.0)
Selecting content, topics, and skills to be taught	13 (2.6)	27 (3.0)	34 (2.2)

Table 5.2
Science Classes in Which Teachers Report Having No Control Over Various Curricular and Instructional Decisions, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determining the amount of homework to be assigned	4 (0.9)	0 (0.2)	1 (0.5)
Selecting teaching techniques	2 (0.5)	0 (0.1)	1 (1.3)
Choosing criteria for grading student performance	5 (0.9)	3 (1.3)	2 (0.5)
Selecting the sequence in which topics are covered	18 (2.1)	13 (2.0)	6 (1.0)
Determining the amount of instructional time to spend on each topic	15 (2.1)	6 (1.6)	4 (1.5)
Determining course goals and objectives	27 (2.2)	20 (2.0)	12 (1.4)
Selecting curriculum materials (e.g., textbooks/modules)	29 (2.3)	17 (2.3)	12 (1.7)
Selecting content, topics, and skills to be taught	34 (2.6)	24 (2.9)	11 (1.3)

A similar pattern appears in mathematics classes (see Tables 5.3 and 5.4). In a majority of mathematics classes, teachers report having strong control over determining the amount of homework to assign (61–75 percent) and selecting teaching techniques (52–71 percent). In relatively few mathematics classes do teachers feel strong control over determining course goals and objectives (16–30 percent); selecting curriculum materials (11–27 percent); and selecting content, topics, and skills to be taught (11–26 percent). In general, teachers of secondary mathematics classes perceive greater control over curriculum and instruction decisions than teachers of elementary mathematics. Further, in a sizeable proportion of classes at each grade band, teachers report having no control over curriculum decisions.

Table 5.3
Mathematics Classes in Which Teachers Report Having Strong Control Over Various Curricular and Instructional Decisions, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determining the amount of homework to be assigned	61 (2.2)	71 (2.4)	75 (1.6)
Selecting teaching techniques	52 (2.2)	68 (2.5)	71 (1.5)
Choosing criteria for grading student performance	34 (2.0)	52 (2.9)	53 (2.0)
Determining the amount of instructional time to spend on each topic	21 (1.8)	37 (2.7)	49 (2.0)
Selecting the sequence in which topics are covered	19 (1.7)	31 (2.6)	45 (1.7)
Determining course goals and objectives	16 (1.7)	28 (2.4)	30 (1.6)
Selecting curriculum materials (e.g., textbooks)	11 (1.5)	18 (2.1)	27 (1.8)
Selecting content, topics, and skills to be taught	11 (1.3)	21 (2.1)	26 (1.6)

Table 5.4
Mathematics Classes in Which Teachers Report Having No Control Over Various Curricular and Instructional Decisions, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determining the amount of homework to be assigned	3 (1.0)	1 (0.4)	2 (0.6)
Selecting teaching techniques	2 (0.6)	0 (0.0)	0 (0.2)
Choosing criteria for grading student performance	6 (1.2)	2 (0.7)	3 (0.6)
Determining the amount of instructional time to spend on each topic	17 (1.7)	6 (0.9)	3 (0.5)
Selecting the sequence in which topics are covered	25 (2.1)	12 (1.4)	8 (1.2)
Determining course goals and objectives	34 (2.3)	26 (2.2)	14 (1.4)
Selecting curriculum materials (e.g., textbooks)	33 (2.3)	27 (2.2)	20 (1.8)
Selecting content, topics, and skills to be taught	40 (2.6)	31 (2.0)	17 (1.8)

In high school computer science classes, teachers also tend to report more control over instruction than curriculum, but in general report having more control over curriculum than their science and mathematics counterparts (see Table 5.5). In very few classes, perhaps because of the largely elective nature of computer science, do teachers feel like they have no control over these decisions (see Table 5.6).

Table 5.5
High School Computer Science Classes in Which Teachers Report Having Strong Control Over Various Curricular and Instructional Decisions

	PERCENT OF CLASSES
Determining the amount of homework to be assigned	77 (3.6)
Choosing criteria for grading student performance	71 (4.1)
Selecting teaching techniques	68 (4.5)
Determining the amount of instructional time to spend on each topic	63 (4.4)
Selecting the sequence in which topics are covered	63 (4.2)
Selecting curriculum materials (e.g., textbooks/online courses)	58 (4.7)
Determining course goals and objectives	57 (4.3)
Selecting content, topics, and skills to be taught	53 (4.2)
Selecting programming languages to use	49 (4.3)

Table 5.6
High School Computer Science Classes in Which Teachers Report Having No Control Over Various Curricular and Instructional Decisions

	PERCENT OF CLASSES
Determining the amount of homework to be assigned	0 (0.3)
Choosing criteria for grading student performance	1 (0.6)
Selecting teaching techniques	0 (0.4)
Determining the amount of instructional time to spend on each topic	1 (0.9)
Selecting the sequence in which topics are covered	2 (1.0)
Selecting curriculum materials (e.g., textbooks/online courses)	4 (1.3)
Determining course goals and objectives	5 (1.5)
Selecting content, topics, and skills to be taught	4 (1.3)
Selecting programming languages to use	13 (2.2)

These items were combined into two composite variables—Curriculum Control and Pedagogy Control. Curriculum Control consists of the following items:

- Determining course goals and objectives;
- Selecting curriculum materials;
- Selecting content, topics, and skills to be taught;
- Selecting the sequence in which topics are covered; and
- Selecting programming languages to use.[17]

For Pedagogy Control, the items are:

- Selecting teaching techniques;
- Determining the amount of homework to be assigned; and
- Choosing criteria for grading student performance.

Table 5.7 displays the mean scores on these composite. These scores indicate that teachers perceive more control over decisions related to pedagogy than curriculum, especially in science and mathematics classes. They also show that perceived control for both composite variables is greater in secondary science and mathematics classes than in elementary classes.

[17] This item was presented only to high school computer science teachers.

Table 5.7
Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Science Classes		
Elementary	45 (2.1)	79 (1.2)
Middle	57 (2.2)	87 (1.1)
High	67 (1.4)	87 (1.0)
Mathematics Classes		
Elementary	39 (1.4)	78 (0.9)
Middle	50 (1.5)	86 (0.9)
High	60 (1.2)	87 (0.7)
Computer Science Classes		
High	78 (1.7)	89 (1.4)

When looking at the composite scores by equity factors, a number of differences are apparent by both class and school factors. For example, teachers of science classes composed mostly of low prior achievers report having less control over both curriculum and pedagogy than teachers of classes containing mostly high prior achievers (see Table 5.8). A similar pattern exists in terms of race/ethnicity composition—teachers of classes serving a high proportion of students from race/ethnicity groups historically underrepresented in STEM report lower instructional control than teachers of classes with relatively few students from these groups. Teachers of classes in higher-poverty schools and in large schools tend to report less control than their counterparts in low-poverty and small schools.

Table 5.8
Equity Analyses of Science Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	65 (1.9)	90 (1.0)
Average/Mixed	53 (1.4)	82 (0.9)
Mostly Low	46 (2.7)	79 (2.2)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	63 (1.8)	87 (1.1)
Second Quartile	56 (1.8)	83 (1.3)
Third Quartile	47 (1.7)	82 (1.1)
Highest Quartile	49 (4.1)	79 (2.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	56 (1.8)	84 (1.4)
Second Quartile	56 (2.2)	85 (1.3)
Third Quartile	55 (3.1)	84 (1.4)
Highest Quartile	47 (1.8)	79 (1.5)
School Size		
Smallest Schools	64 (3.5)	89 (1.8)
Second Group	60 (3.3)	81 (2.0)
Third Group	52 (1.6)	81 (1.4)
Largest Schools	49 (1.4)	83 (0.9)
Community Type		
Rural	61 (1.6)	87 (1.0)
Suburban	52 (1.0)	81 (0.8)
Urban	52 (3.4)	82 (1.8)
Region		
Midwest	59 (1.9)	82 (1.4)
Northeast	58 (3.7)	82 (2.2)
South	46 (1.6)	82 (1.0)
West	58 (1.7)	84 (1.2)

Similar patterns are evident in mathematics classes, though differences tend to be limited to curriculum control (see Table 5.9). Computer science results are shown in Table 5.10. Although there appear to be differences in curriculum control by school size and community type, they are not statistically significant.

Table 5.9
Equity Analyses of Mathematics Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	59 (1.7)	88 (1.1)
Average/Mixed	45 (1.1)	81 (0.6)
Mostly Low	45 (1.8)	81 (1.0)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	56 (1.5)	85 (1.0)
Second Quartile	50 (1.8)	83 (0.9)
Third Quartile	41 (1.7)	81 (1.3)
Highest Quartile	42 (1.8)	79 (1.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	51 (1.9)	82 (0.8)
Second Quartile	49 (1.9)	84 (1.1)
Third Quartile	47 (1.6)	82 (1.2)
Highest Quartile	43 (2.0)	80 (1.3)
School Size		
Smallest Schools	61 (3.0)	84 (1.4)
Second Group	53 (2.3)	83 (1.0)
Third Group	46 (1.5)	81 (1.2)
Largest Schools	43 (1.4)	82 (0.7)
Community Type		
Rural	57 (1.7)	85 (1.0)
Suburban	45 (1.2)	81 (0.8)
Urban	45 (1.8)	81 (1.2)
Region		
Midwest	51 (1.9)	82 (1.2)
Northeast	50 (2.3)	82 (1.1)
South	43 (1.4)	82 (0.9)
West	50 (1.9)	83 (1.2)

Table 5.10
Equity Analyses of High School Computer Science
Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	78 (2.7)	90 (2.2)
Average/Mixed	78 (2.3)	89 (1.8)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	76 (3.3)	93 (1.6)
Second Quartile	78 (4.0)	87 (3.5)
Third Quartile	75 (4.1)	89 (2.7)
Highest Quartile	83 (2.9)	89 (3.1)
Percent of Students in School Eligible for FRL		
Lowest Quartile	78 (2.5)	90 (1.9)
Second Quartile	78 (3.8)	89 (2.8)
Third Quartile	77 (3.8)	88 (3.6)
Highest Quartile	80 (4.1)	90 (2.3)
School Size		
Smallest Schools	88 (5.3)	96 (2.1)
Second Group	79 (4.8)	93 (2.4)
Third Group	77 (2.6)	87 (3.4)
Largest Schools	78 (2.3)	89 (1.7)
Community Type		
Rural	72 (4.3)	85 (4.0)
Suburban	77 (2.1)	92 (1.3)
Urban	82 (3.3)	88 (2.6)
Region		
Midwest	77 (3.2)	89 (3.1)
Northeast	77 (3.5)	90 (2.1)
South	75 (3.5)	89 (2.0)
West	85 (2.9)	89 (2.6)

Instructional Objectives

The survey provided a list of possible objectives of instruction and asked teachers how much emphasis each would receive in an entire course of a particular, randomly selected class. Table 5.11 shows the percentage of science classes by grade range with a heavy emphasis for each objective. Understanding science concepts is the most frequently emphasized objective, although more so in secondary classes (about three-quarters of middle and high school classes) than in elementary (fewer than half of classes). Given the adoption in many states of the NGSS or NGSS-like standards, it is somewhat surprising that fewer than half of secondary classes, and only a quarter of elementary classes have a heavy emphasis on students learning how to do science. In addition, about a third of classes have a heavy emphasis on students learning science vocabulary and/or facts. Objectives least likely to be emphasized are learning about different fields of science and engineering and learning how to do engineering (10 percent or fewer science classes). In fact, 18–31 percent of science classes, depending on grade range, have no emphasis on learning how to do engineering (see Table 5.12)

Table 5.11
Science Classes With Heavy Emphasis on Various Instructional Objectives, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Understanding science concepts	47 (1.7)	77 (1.8)	76 (1.8)
Learning how to do science (develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)	26 (2.0)	46 (2.1)	41 (1.3)
Developing students' confidence that they can successfully pursue careers in science/engineering	23 (2.0)	30 (1.9)	35 (1.5)
Learning science vocabulary and/or facts	27 (1.9)	37 (2.2)	32 (1.6)
Increasing students' interest in science/engineering	27 (2.2)	35 (2.1)	31 (1.5)
Learning about real-life applications of science/engineering	20 (2.1)	28 (2.0)	29 (1.2)
Learning test-taking skills/strategies	20 (1.5)	23 (1.8)	23 (1.4)
Learning about different fields of science/engineering	8 (1.9)	7 (1.2)	7 (0.8)
Learning how to do engineering (e.g., identify criteria and constraints, design solutions, optimize solutions)	8 (1.8)	10 (1.2)	5 (0.7)

Table 5.12
Science Classes With No Emphasis on Learning How To Do Engineering

	PERCENT OF CLASSES
Elementary	22 (1.6)
Middle	18 (1.9)
High	31 (1.5)

The objectives related to reform-oriented instruction (understanding science concepts, learning about different fields of science/engineering, learning how to do science, learning how to do engineering, learning about real-life applications of science/engineering, increasing students' interest in science/engineering, and developing students' confidence that they can successfully pursue careers in science/engineering) were combined into a composite variable. Overall, scores on this composite are not very high (see Table 5.13), indicating that science classes are only somewhat likely to emphasize reform-oriented instructional objectives. In addition, secondary classes are somewhat more likely than elementary classes to emphasize these objectives.

Table 5.13
Science Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Elementary	60 (0.9)
Middle	67 (0.8)
High	65 (0.5)

Scores on this composite were also analyzed by a number of equity factors. The only factor that has a clear relationship with this composite is the prior achievement level of the class. As can be seen in Table 5.14, classes containing mostly high-achieving students are more likely to stress reform-oriented instructional objectives than classes with mostly low-achieving students.

Table 5.14
Equity Analysis of Science Class Mean Scores for the Reform-Oriented Instructional Objectives Composite by Prior Achievement Level of Class

	MEAN SCORE
Mostly High Achievers	68 (0.9)
Average/Mixed Achievers	63 (0.6)
Mostly Low Achievers	57 (1.3)

In mathematics, about 7 out of 10 elementary, middle, and high school mathematics classes focus heavily on having students understand mathematical ideas (see Table 5.15). Other objectives heavily emphasized by over half of classes across grade levels are learning how to do mathematics and learning mathematical procedures and/or algorithms.

The data also reveal two notable differences in emphasis by grade range. One is that 41 percent of elementary mathematics classes focus heavily on increasing students' interest in mathematics, compared to 34 percent and 26 percent of middle and high school classes, respectively. The other is that learning to perform computations with speed and accuracy is more likely to be heavily emphasized in elementary classes than in middle and high school classes (33, 20, and 21 percent, respectively).

Table 5.15
Mathematics Classes With Heavy Emphasis on Various Instructional Objectives, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Understanding mathematical ideas	67 (1.7)	71 (1.9)	69 (1.7)
Learning how to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	62 (1.9)	61 (2.1)	63 (1.6)
Learning mathematical procedures and/or algorithms	52 (1.7)	53 (2.6)	55 (1.8)
Developing students' confidence that they can successfully pursue careers in mathematics	37 (1.7)	41 (2.0)	37 (1.5)
Learning about real-life applications of mathematics	34 (1.9)	37 (1.9)	32 (1.4)
Learning mathematics vocabulary	36 (1.7)	27 (1.9)	29 (1.5)
Increasing students' interest in mathematics	41 (1.9)	34 (2.0)	26 (1.3)
Learning test-taking skills/strategies	30 (1.8)	23 (1.5)	25 (1.3)
Learning to perform computations with speed and accuracy	33 (2.1)	20 (1.6)	21 (1.3)

Table 5.16 presents mean scores on the reform-oriented instructional objectives in mathematics composite by grade range. Mathematics classes are, on average, likely to emphasize reform-oriented instructional objectives at all grade levels—more so than science classes do.

Table 5.16
Mathematics Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Elementary	79 (0.6)
Middle	79 (0.6)
High	77 (0.4)

Similar to science, there are differences in composite scores by the prior achievement level of the class in mathematics. Reform-oriented instructional objectives are more heavily emphasized in mathematics classes with mostly high-prior-achieving students than in classes with mostly average/mixed or low-prior-achieving students (see Table 5.17).

Table 5.17
Equity Analysis of Mathematics Class Mean Scores for the Reform-Oriented Instructional Objectives Composite by Prior Achievement Level of Class

	MEAN SCORE
Mostly High Achievers	83 (0.6)
Average/Mixed Achievers	78 (0.4)
Mostly Low Achievers	77 (0.9)

In high school computer science classes, learning how to do computer science, understanding computer science concepts, developing students' confidence that they can successfully pursue computer science careers, and increasing student interest receive a heavy emphasis in a majority of classes (see Table 5.18). Learning vocabulary and/or the syntax of a particular language receives a heavy emphasis in only a third of classes.

Table 5.18
High School Computer Science Classes With Heavy Emphasis on Various Instructional Objectives

	PERCENT OF CLASSES
Learning how to do computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	60 (3.5)
Understanding computer science concepts	55 (3.6)
Developing students' confidence that they can successfully pursue careers in computer science	52 (3.9)
Increasing students' interest in computer science	50 (3.6)
Learning how to develop computational solutions	43 (4.1)
Learning about real-life applications of computer science	39 (4.3)
Learning computer science vocabulary and/or program syntax	33 (3.9)

Table 5.19 shows scores on the reform-oriented instructional objectives composite for high school computer science classes overall and by two equity factors. Interestingly, classes with a higher proportion of students from race/ethnicity groups historically underrepresented in STEM fields are more likely to emphasize reform-oriented objectives, as are classes in schools with a higher proportion of students eligible for free/reduced-price lunch.

Table 5.19
Equity Analyses of High School Computer Science Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Overall	**81 (1.0)**
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	75 (1.9)
Second Quartile	80 (2.1)
Third Quartile	81 (1.7)
Highest Quartile	86 (2.2)
Percent of Students in School Eligible for FRL	
Lowest Quartile	78 (1.4)
Second Quartile	80 (1.8)
Third Quartile	82 (2.7)
Highest Quartile	85 (2.9)

Class Activities

Teachers were asked several items about their instruction in the randomly selected class. One item asked how often they use different pedagogies (e.g., explaining ideas to students, small group work). Another asked how often they engage students in practices associated with the discipline. Response options for both of these sets of items were: never, rarely (e.g., a few times a year), sometimes (e.g., once or twice a month), often (e.g., once or twice a week), and all or almost all science/mathematics/computer science lessons. Teachers were also asked two questions about their most recent lesson in this class: (1) how instructional time was apportioned and (2) what instructional activities took place. Results for science instruction are presented first, followed by mathematics and then computer science instruction.

Science Instruction

Depending on grade range, 42–48 percent of classes include the teacher explaining science ideas in all or almost all lessons (see Table 5.20). The majority of elementary science classes engage in whole-class discussions in nearly every lesson, though this activity becomes less frequent as the grade level increases. Approximately a third of K–12 science classes have students work in small groups in all or almost all science lessons.

Table 5.20
Science Classes in Which Teachers Report Using Various Activities in All or Almost All Lessons, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Explain science ideas to the whole class	48 (1.8)	46 (2.1)	42 (1.7)
Engage the whole class in discussions	55 (1.5)	42 (2.1)	31 (1.6)
Have students work in small groups	30 (2.0)	33 (2.1)	30 (1.5)
Have students do hands-on/laboratory activities	16 (1.9)	11 (1.4)	12 (1.0)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	14 (1.3)	17 (1.9)	8 (0.9)
Focus on literacy skills (e.g., informational reading or writing strategies)	20 (1.5)	11 (1.4)	6 (0.9)
Engage the class in project-based learning (PBL) activities	8 (2.0)	8 (1.4)	6 (0.7)
Have students practice for standardized tests	5 (0.9)	4 (0.8)	5 (0.8)
Have students read from a textbook, module, or other material in class, either aloud or to themselves	11 (1.4)	8 (1.7)	4 (0.7)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	3 (0.5)	2 (0.5)	4 (0.7)

As can be seen in Table 5.21, three instructional activities occur at least once a week in a large majority of science classes across grade levels: explaining science ideas to the whole class (85–92 percent), engaging the whole class in discussions (78–90 percent), and having students work in small groups (75–87 percent). Over half of elementary and about two-thirds of secondary science classes include hands-on/laboratory activities on a weekly basis. In addition, roughly 30 percent of classes engage students in project-based learning activities weekly.

Elementary and middle school science classes are much more likely than high school classes to include literacy activities at least once a week. For example, students read from a science textbook, module, or other material on a weekly basis in approximately 4 out of 10 elementary and middle grades classes, compared to a quarter of high school classes. Having students write reflections at least once a week is also more common in elementary and middle school classes than high school classes. In addition, 60 percent of elementary classes focus on literacy skills at least once a week, compared to only one-third of high school classes.

Table 5.21
Science Classes in Which Teachers Report Using Various Activities at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Explain science ideas to the whole class	85 (1.9)	92 (1.0)	92 (0.9)
Engage the whole class in discussions	90 (1.0)	89 (1.2)	78 (1.3)
Have students work in small groups	75 (1.6)	87 (1.5)	84 (1.5)
Have students do hands-on/laboratory activities	53 (1.9)	63 (2.0)	68 (1.6)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	43 (2.0)	47 (2.1)	28 (1.4)
Focus on literacy skills (e.g., informational reading or writing strategies)	60 (1.6)	46 (2.3)	33 (1.6)
Engage the class in project-based learning (PBL) activities	29 (2.2)	31 (2.3)	28 (1.7)
Have students practice for standardized tests	17 (1.3)	19 (1.7)	20 (1.5)
Have students read from a textbook, module, or other material in class, either aloud or to themselves	37 (1.7)	39 (2.6)	26 (1.7)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	10 (1.1)	10 (1.2)	15 (1.3)

The survey also asked how often students in science classes are engaged in doing science as described in documents like *A Framework for K–12 Science Education*[18]—i.e., the practices of science such as formulating scientific questions, designing and implementing investigations, developing models and explanations, and engaging in argumentation. As can be seen in Table 5.22, students often engage in aspects of science related to conducting investigations and analyzing data. For example, about half of middle and high school classes have students organize and represent data, make and support claims with evidence, conduct scientific investigations, and analyze data at least once a week. At the elementary level, about a third of classes engage students in these activities weekly.

Across all grade bands, students tend to not be engaged very often in aspects of science related to evaluating the strengths/limitations of evidence and the practice of argumentation. For example, fewer than a quarter of secondary science classes have students, at least once a week, pose questions about scientific arguments, evaluate the credibility of scientific information, identify strengths and limitations of a scientific model, evaluate the strengths and weaknesses of competing scientific explanations, determine what details about an investigation might persuade a targeted audience about a scientific claim, or construct a persuasive case. Even fewer elementary classes engage students in these activities weekly, and about a third never do so (see Table 5.23).

[18] National Research Council. 2012. *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Table 5.22
Science Classes in Which Teachers Report Students Engaging in Various Aspects of Science Practices at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Organize and/or represent data using tables, charts, or graphs in order to facilitate analysis of the data	34 (2.1)	49 (2.3)	58 (1.5)
Make and support claims with evidence	32 (2.0)	51 (2.1)	50 (1.5)
Conduct a scientific investigation	36 (2.2)	48 (2.2)	50 (1.6)
Analyze data using grade-appropriate methods in order to identify patterns, trends, or relationships	27 (1.9)	43 (2.4)	47 (1.4)
Determine what data would need to be collected in order to answer a scientific question	29 (2.1)	39 (2.1)	39 (1.4)
Generate scientific questions	38 (2.2)	44 (2.2)	38 (1.8)
Compare data from multiple trials or across student groups for consistency in order to identify potential sources of error or inconsistencies in the data	19 (2.2)	31 (2.3)	36 (1.5)
Develop scientific models—physical, graphical, or mathematical representations of real-world phenomena	19 (1.7)	34 (2.3)	34 (1.5)
Use multiple sources of evidence to develop an explanation	26 (2.0)	37 (2.3)	33 (1.6)
Develop procedures for a scientific investigation to answer a scientific question	29 (2.2)	35 (2.1)	32 (1.4)
Select and use grade-appropriate mathematical and/or statistical techniques to analyze data	15 (1.4)	21 (1.8)	30 (1.6)
Determine whether or not a question is scientific	19 (1.6)	31 (1.8)	28 (1.5)
Revise their explanations based on additional evidence	22 (2.0)	30 (2.1)	28 (1.4)
Summarize patterns, similarities, and differences in scientific information obtained from multiple sources	18 (2.2)	25 (2.0)	28 (1.5)
Use data and reasoning to defend, verbally or in writing, a claim or refute alternative scientific claims	17 (1.6)	28 (1.8)	27 (1.7)
Consider how missing data or measurement error can affect the interpretation of data	14 (1.5)	21 (2.1)	27 (1.5)
Use mathematical and/or computational models to generate data to support a scientific claim	12 (1.2)	19 (1.4)	26 (1.3)
Pose questions that elicit relevant details about the important aspects of a scientific argument	14 (1.4)	24 (1.8)	23 (1.6)
Evaluate the credibility of scientific information—e.g., its reliability, validity, consistency, logical coherence, lack of bias, or methodological strengths and weaknesses	8 (1.1)	19 (1.7)	23 (1.4)
Identify the strengths and limitations of a scientific model—in terms of accuracy, clarity, generalizability, accessibility to others, strength of evidence supporting it	12 (1.8)	22 (2.0)	22 (1.1)
Evaluate the strengths and weaknesses of competing scientific explanations	12 (1.3)	19 (1.7)	20 (1.6)
Determine what details about an investigation might persuade a targeted audience about a scientific claim	11 (1.2)	15 (1.6)	17 (1.3)
Construct a persuasive case, verbally or in writing, for the best scientific model or explanation for a real-world phenomenon	10 (1.1)	17 (1.5)	15 (1.1)

Table 5.23
Science Classes in Which Teachers Report Students Never Engaging in Various Aspects of Science Practices, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Organize and/or represent data using tables, charts, or graphs in order to facilitate analysis of the data	6 (0.7)	1 (0.3)	1 (0.3)
Make and support claims with evidence	10 (1.1)	1 (0.3)	2 (0.5)
Conduct a scientific investigation	4 (0.6)	2 (0.6)	2 (0.4)
Analyze data using grade-appropriate methods in order to identify patterns, trends, or relationships	12 (1.1)	3 (1.0)	3 (0.6)
Determine what data would need to be collected in order to answer a scientific question	8 (0.9)	2 (0.5)	3 (0.5)
Generate scientific questions	6 (0.8)	2 (0.4)	3 (0.5)
Compare data from multiple trials or across student groups for consistency in order to identify potential sources of error or inconsistencies in the data	22 (1.4)	4 (0.8)	4 (0.6)
Develop scientific models—physical, graphical, or mathematical representations of real-world phenomena	19 (1.1)	3 (0.6)	5 (0.7)
Use multiple sources of evidence to develop an explanation	15 (1.2)	3 (0.6)	5 (0.6)
Develop procedures for a scientific investigation to answer a scientific question	9 (1.0)	3 (0.6)	4 (0.8)
Select and use grade-appropriate mathematical and/or statistical techniques to analyze data	27 (1.5)	12 (1.6)	8 (0.9)
Determine whether or not a question is scientific	20 (1.4)	5 (0.8)	8 (0.7)
Revise their explanations based on additional evidence	17 (1.2)	4 (0.7)	5 (0.8)
Summarize patterns, similarities, and differences in scientific information obtained from multiple sources	24 (1.2)	9 (1.5)	10 (1.1)
Use data and reasoning to defend, verbally or in writing, a claim or refute alternative scientific claims	27 (1.5)	8 (1.6)	9 (0.8)
Consider how missing data or measurement error can affect the interpretation of data	24 (1.5)	4 (1.0)	4 (0.7)
Use mathematical and/or computational models to generate data to support a scientific claim	28 (1.6)	10 (1.5)	9 (1.0)
Pose questions that elicit relevant details about the important aspects of a scientific argument	31 (1.4)	12 (1.5)	13 (1.3)
Evaluate the credibility of scientific information—e.g., its reliability, validity, consistency, logical coherence, lack of bias, or methodological strengths and weaknesses	38 (1.6)	13 (1.5)	11 (0.9)
Identify the strengths and limitations of a scientific model—in terms of accuracy, clarity, generalizability, accessibility to others, strength of evidence supporting it	31 (1.4)	8 (1.3)	6 (0.9)
Evaluate the strengths and weaknesses of competing scientific explanations	33 (1.4)	10 (1.5)	11 (1.2)
Determine what details about an investigation might persuade a targeted audience about a scientific claim	33 (1.7)	15 (1.8)	16 (1.3)
Construct a persuasive case, verbally or in writing, for the best scientific model or explanation for a real-world phenomenon	35 (1.6)	16 (1.7)	17 (1.4)

These items were combined into a composite variable titled Engaging Students in the Practices of Science. The scores on this composite indicate that students are more likely to be engaged in doing science in middle and high school classes than they are in elementary classes (see Table 5.24). In addition, the scores indicate that students engage in this set of practices, on average, just once or twice a month or less.

Table 5.24
Science Class Mean Scores for Engaging Students in the Practices of Science Composite

	MEAN SCORE
Elementary	39 (0.8)
Middle	50 (0.8)
High	50 (0.6)

Table 5.25 displays scores on this composite by the two class-level equity factors. Students in classes of mostly high prior achievers are more likely to be engaged in these practices than classes of average or low prior achievers. In addition, when considering the percentage of students in classes from race/ethnicity groups historically underrepresented in STEM, classes in the highest quartile are more likely to be engaged in these practices than classes in the other three quartiles.

Table 5.25
Equity Analyses of Science Class Mean Scores for Engaging Students in the Practices of Science Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	51 (1.1)
Average/Mixed	43 (0.5)
Mostly Low	42 (1.5)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	43 (0.9)
Second Quartile	42 (0.9)
Third Quartile	43 (1.0)
Highest Quartile	47 (1.3)

Given recent trends to incorporate engineering and computer science into science education, the 2018 NSSME+ asked teachers how frequently they do so. As can be seen in Table 5.26, the typical science class experiences engineering a few times per year (48–51 percent of classes depending on grade level). About a third of science classes incorporate engineering at least monthly. In terms of coding, a large majority (71–89 percent) of classes never include coding as part of their science instruction. Interestingly, coding occurs somewhat more often in elementary classes than in middle or high school classes.

Table 5.26
Science Classes in Which Teachers Report Incorporating Engineering and Coding Into Science Instruction, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Engineering			
Never	16 (1.8)	10 (1.8)	20 (1.8)
Rarely (e.g., a few times per year)	48 (2.5)	51 (2.4)	50 (1.9)
Sometimes (e.g., once or twice a month)	26 (2.2)	32 (2.2)	24 (1.5)
Often (e.g., once or twice a week)	8 (2.7)	5 (1.0)	6 (1.1)
All or almost all science lessons	1 (0.5)	1 (0.6)	1 (0.2)
Coding			
Never	71 (3.4)	81 (1.9)	89 (1.2)
Rarely (e.g., a few times per year)	16 (2.0)	14 (1.8)	6 (0.9)
Sometimes (e.g., once or twice a month)	11 (2.8)	3 (0.8)	4 (0.8)
Often (e.g., once or twice a week)	3 (0.7)	1 (0.5)	0 (0.1)
All or almost all science lessons	0 ---†	0 (0.3)	0 (0.0)

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

In addition to asking about class activities in the course as a whole, teachers were asked about activities that took place during their most recent science lesson in the randomly selected class. As can be seen in Table 5.27, small group work and the teacher explaining science ideas to the whole class are the most common activities, occurring in three-quarters or more of classes. Whole class discussions are also relatively common, though more so in elementary classes than middle or high school classes (86, 67, and 59 percent of classes, respectively). Almost half of elementary and middle school classes include students doing hands-on/laboratory activities and students writing about science in the most recent lesson, compared to 4 in 10 or fewer high school classes.

Table 5.27
Science Classes Participating in Various Activities in Most Recent Lesson, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Students working in small groups	78 (1.5)	85 (1.3)	81 (1.4)
Teacher explaining a science idea to the whole class	83 (1.5)	74 (2.2)	81 (1.3)
Whole class discussion	86 (1.2)	67 (2.3)	59 (1.6)
Students completing textbook/worksheet problems	35 (1.8)	39 (2.2)	44 (1.6)
Students doing hands-on/laboratory activities	47 (2.1)	46 (2.0)	40 (1.6)
Students writing about science	45 (2.3)	46 (2.6)	34 (1.8)
Teacher conducting a demonstration while students watched	37 (2.1)	30 (2.1)	31 (1.6)
Students reading about science	45 (2.1)	48 (2.6)	29 (1.6)
Test or quiz	9 (1.1)	14 (1.5)	16 (1.2)
Practicing for standardized tests	2 (0.6)	8 (1.0)	8 (0.9)

The survey also asked teachers to estimate the time spent on each of a number of types of activities in this most recent science lesson. Across the grades, about 40 percent of class time is spent on whole class activities, 30 percent on small group work, and 20 percent on students working individually (see Table 5.28). Non-instructional activities, including attendance taking and interruptions, account for about 10 percent or less of science class time.

Table 5.28
Average Percentage of Time Spent on Different Activities in the Most Recent Science Lesson, by Grade Range

	PERCENT OF CLASS TIME		
	ELEMENTARY	MIDDLE	HIGH
Whole class activities (e.g., lectures, explanations, discussions)	41 (0.9)	32 (0.8)	38 (0.8)
Small group work	33 (1.0)	35 (1.1)	34 (0.8)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	18 (0.8)	22 (0.8)	19 (0.8)
Non-instructional activities (e.g., attendance taking, interruptions)	8 (0.4)	12 (0.3)	10 (0.2)

Mathematics Instruction

Table 5.29 shows the percentage of K–12 mathematics classes in which teachers use various activities in all or almost all mathematics lessons. The teacher explaining mathematical ideas is very common across all grade levels, occurring in all or almost all lessons in 59–73 percent of mathematics classes. As is the case in science, the use of whole class discussion is more common in elementary classes, taking place in nearly all lessons in 71 percent of classes, compared to 54 percent and 50 percent of middle and high school classes, respectively. Another striking difference between the grade ranges is manipulative use in problem-solving/ investigations, with 35 percent of elementary classes providing manipulatives to students in all or almost all lessons, compared to about 5 percent of secondary classes.

Table 5.29
Mathematics Classes in Which Teachers Report Using Various Activities in All or Almost All Lessons, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Explain mathematical ideas to the whole class	73 (2.0)	59 (2.2)	65 (1.7)
Engage the whole class in discussions	71 (1.5)	54 (2.0)	50 (1.7)
Have students work in small groups	51 (2.4)	35 (2.1)	30 (1.7)
Have students practice for standardized tests	8 (0.8)	7 (1.0)	8 (0.8)
Have students read from a textbook or other material in class, either aloud or to themselves	12 (1.1)	7 (1.2)	6 (1.0)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	13 (1.2)	8 (1.1)	5 (0.9)
Provide manipulatives for students to use in problem-solving/investigations	35 (2.0)	6 (0.9)	4 (0.8)
Focus on literacy skills (e.g., informational reading or writing strategies)	16 (1.5)	4 (0.7)	4 (0.8)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	6 (1.2)	2 (0.5)	4 (1.1)

The percentage of mathematics classes including these same activities at least once a week is displayed in Table 5.30. Not unexpectedly, nearly all classes at each grade level include the teacher explaining mathematical ideas and leading whole class discussions on a weekly basis. Having students work in small groups is also a fairly common weekly occurrence across grade ranges, though its frequency decreases from 88 percent in elementary classes to 71 percent in high school classes. Elementary classes are also much more likely than secondary classes to provide manipulatives for students to use, have students write their reflections, and focus on literacy skills.

Table 5.30
Mathematics Classes in Which Teachers Report Using Various Activities at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Explain mathematical ideas to the whole class	95 (0.9)	95 (1.0)	95 (0.7)
Engage the whole class in discussions	95 (0.8)	91 (1.1)	84 (1.2)
Have students work in small groups	88 (1.2)	77 (2.2)	71 (1.7)
Have students practice for standardized tests	26 (1.7)	32 (2.1)	29 (1.5)
Have students read from a textbook or other material in class, either aloud or to themselves	28 (1.7)	24 (2.1)	16 (1.5)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	41 (1.8)	30 (1.8)	19 (1.4)
Provide manipulatives for students to use in problem-solving/investigations	78 (1.4)	29 (2.1)	20 (1.3)
Focus on literacy skills (e.g., informational reading or writing strategies)	41 (2.0)	20 (1.6)	17 (1.2)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	13 (1.6)	10 (1.2)	11 (1.2)

Teachers were also asked how often they engage students in the practices of mathematics described in the *Common Core State Standards—Mathematics*[19] such as making sense of problems, constructing arguments, critiquing the reasoning of others, and modeling with mathematics. Table 5.31 represents the percentage of K–12 mathematics classes that engage students in various aspects of these practices in all or almost all lessons. Across all grade levels, students are unlikely to be engaged in aspects of these practices on a daily basis. For example, in only 39–46 percent of classes, depending on grade level, are students asked to determine whether their answer makes sense in all or almost all lessons. Similarly, only 36–44 percent of classes have students provide mathematical reasoning this regularly. A quarter or fewer of classes have students work on challenging problems, analyze the mathematical reasoning of others, and compare and contrast different solution strategies in all or almost all lessons.

[19] National Governors Association Center for Best Practices, & Council of Chief State School Officers. (2010). Common Core State Standards for mathematics. Washington, DC: Author.

Table 5.31
Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices in All or Almost All Lessons, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determine whether their answer makes sense	46 (2.0)	44 (2.0)	39 (1.3)
Provide mathematical reasoning to explain, justify, or prove their thinking	44 (1.8)	39 (2.3)	36 (1.6)
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	49 (1.8)	33 (1.9)	33 (1.6)
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	39 (2.2)	32 (1.9)	32 (1.8)
Identify relevant information and relationships that could be used to solve a mathematics problem	30 (1.5)	32 (2.0)	31 (1.7)
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	33 (1.9)	31 (1.9)	27 (1.5)
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	29 (1.9)	30 (2.0)	27 (1.3)
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	33 (1.9)	29 (1.9)	26 (1.3)
Determine what tools are appropriate for solving a mathematics problem	34 (1.6)	26 (1.7)	26 (1.5)
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	25 (1.5)	22 (1.7)	24 (1.7)
Develop a mathematical model to solve a mathematics problem	36 (1.7)	26 (1.7)	23 (1.5)
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	22 (1.5)	24 (1.6)	22 (1.3)
Figure out what a challenging problem is asking	32 (1.8)	22 (1.5)	21 (1.6)
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	31 (2.1)	22 (1.6)	20 (1.2)
Work on generating a rule or formula	20 (1.3)	22 (1.9)	20 (1.4)
Analyze the mathematical reasoning of others	23 (1.7)	21 (1.8)	15 (1.1)
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	21 (1.6)	15 (1.4)	15 (1.2)

Although students tend not to be engaged in these activities daily, they are relatively likely to engage with them at least once a week (see Table 5.32). For example, in three-quarters or more of classes across the grade bands, students are asked to determine whether their answer makes sense; provide mathematics reasoning to explain, justify, or prove their thinking; develop representations of aspects of problems; and continue working through mathematics problems when they reach points of difficulty, challenge, or error. In addition, given the emphasis in recent years on the importance of students critiquing different approaches to solving mathematics problems, it is somewhat surprising that only two-thirds or fewer classes have students analyze the mathematical thinking of others or compare and contrast different solution strategies on a weekly basis.

Table 5.32
Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Determine whether their answer makes sense	85 (1.5)	85 (1.9)	84 (1.2)
Provide mathematical reasoning to explain, justify, or prove their thinking	85 (1.5)	83 (1.7)	76 (1.3)
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	88 (1.1)	75 (2.1)	75 (1.5)
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	81 (1.5)	81 (1.8)	79 (1.3)
Identify relevant information and relationships that could be used to solve a mathematics problem	72 (1.8)	79 (2.0)	73 (1.7)
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	78 (1.5)	77 (1.8)	74 (1.3)
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	69 (2.2)	69 (1.8)	63 (1.5)
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	72 (1.8)	74 (1.5)	67 (1.6)
Determine what tools are appropriate for solving a mathematics problem	71 (1.8)	62 (2.2)	59 (1.7)
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	74 (1.6)	75 (1.9)	71 (1.3)
Develop a mathematical model to solve a mathematics problem	75 (1.8)	70 (2.0)	64 (1.8)
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	62 (1.8)	66 (2.0)	61 (1.8)
Figure out what a challenging problem is asking	78 (1.8)	73 (2.1)	63 (1.5)
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	75 (2.0)	65 (2.1)	61 (1.7)
Work on generating a rule or formula	59 (1.9)	70 (1.9)	61 (1.5)
Analyze the mathematical reasoning of others	65 (1.9)	61 (2.3)	53 (1.3)
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	60 (1.9)	55 (2.2)	54 (1.7)

Table 5.33 shows the means for the Engaging Students in the Practices of Mathematics composite by grade band, and Table 5.34 shows scores by the prior achievement level of students and percentage of students in the class from race/ethnicity groups historically underrepresented in STEM. Overall, scores are similar across grade bands, though a little higher for elementary classes than high school classes. Scores are also slightly higher for classes composed of mostly high prior achievers than for classes of mostly low prior achievers.

Table 5.33
Mathematics Class Mean Scores for Engaging Students in Practices of Mathematics Composite

	MEAN SCORE
Elementary	74 (0.7)
Middle	73 (0.6)
High	71 (0.5)

Table 5.34
Equity Analyses of Mathematics Class Mean Scores for Engaging Students in Practices of Mathematics Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	75 (0.8)
Average/Mixed	73 (0.5)
Mostly Low	72 (0.9)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	73 (0.5)
Second Quartile	72 (0.9)
Third Quartile	73 (0.8)
Highest Quartile	74 (0.9)

Similar to science, very few mathematics classes incorporate coding into instruction (see Table 5.35). The practice is somewhat more common in the elementary grades than secondary grades, but even at the elementary level tends to be done only a few times a year if at all.

Table 5.35
Mathematics Classes in Which Teachers Report Incorporating Coding Into Mathematics Instruction, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Never	74 (2.0)	86 (2.1)	89 (1.0)
Rarely (e.g., a few times per year)	15 (1.7)	11 (1.6)	9 (0.9)
Sometimes (e.g., once or twice a month)	7 (1.1)	3 (1.3)	2 (0.4)
Often (e.g., once or twice a week)	3 (0.8)	0 (0.3)	1 (0.2)
All or almost all mathematics lessons	0 (0.3)	0 (0.1)	0 (0.1)

Table 5.36 presents the percentage of most recent lessons in K–12 mathematics classes that include various activities. With only a few exceptions, the frequency of activities in each grade range is fairly similar. For example, most elementary, middle, and high school lessons include the explanation of mathematical ideas (88–91 percent) and students working in small groups (78–87 percent). Having students complete textbook/worksheet problems is also prevalent, occurring in roughly 3 out of 4 K–12 mathematics lessons. Lessons vary across the grade ranges in the use of hands-on/manipulatives and whole class discussion. At the elementary level, 65 percent of lessons include students doing hands-on/manipulative activities compared to only 24 and 17 percent of middle and high school mathematics lessons, respectively. In addition, 87 percent of elementary lessons include whole class discussion compared to 78 and 70 percent of middle and high school mathematics lessons.

Table 5.36
Mathematics Classes Participating in Various Activities in Most Recent Lesson, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Teacher explaining a mathematical idea to the whole class	89 (1.3)	88 (1.6)	91 (1.0)
Students working in small groups	87 (1.4)	83 (1.7)	78 (1.2)
Students completing textbook/worksheet problems	77 (1.6)	76 (1.7)	78 (1.4)
Whole class discussion	87 (1.5)	78 (1.5)	70 (1.4)
Teacher conducting a demonstration while students watched	78 (1.9)	65 (2.1)	64 (1.3)
Test or quiz	18 (1.8)	15 (1.5)	19 (1.2)
Students doing hands-on/manipulative activities	65 (2.1)	24 (1.8)	17 (1.5)
Practicing for standardized tests	13 (1.7)	17 (1.5)	15 (1.0)
Students reading about mathematics	17 (1.4)	15 (1.5)	15 (1.3)
Students writing about mathematics	27 (1.6)	19 (1.6)	14 (1.1)

The proportion of time spent on various instructional arrangements in mathematics lessons is relatively similar across the grade levels (see Table 5.37), though there is some variation. On average, more time is spent in whole class activities in high school mathematics classes than in elementary classes, ranging from 35–42 percent of class time. In contrast, the time spent in small group work decreases with increasing grade range, from 33 percent of time in elementary classes to 26 percent of time in high school mathematics classes.

Table 5.37
Average Percentage of Time Spent on Different Activities in the Most Recent Mathematics Lesson, by Grade Range

	AVERAGE PERCENT OF CLASS TIME		
	ELEMENTARY	MIDDLE	HIGH
Whole class activities (e.g., lectures, explanations, discussions)	35 (0.7)	39 (0.8)	42 (0.7)
Small group work	33 (0.8)	28 (1.0)	26 (0.8)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	24 (0.6)	22 (0.7)	22 (0.7)
Non-instructional activities (e.g., attendance taking, interruptions)	8 (0.3)	11 (0.3)	10 (0.2)

Computer Science Instruction

Table 5.38 shows the percentage of high school computer science classes in which teachers use various activities in all or almost all lessons. Having students work on programming activities using a computer is by far the most common mode of instruction in high school computer science classes (69 percent). Students working in small groups, the teacher explaining ideas to the class, and whole class discussions occur daily in about a quarter to a third of high school computer science classes.

Table 5.38
High School Computer Science Classes in Which Teachers Report Using Various Activities in All or Almost All Lessons

	PERCENT OF CLASSES
Have students work on programming activities using a computer	69 (3.7)
Have students work in small groups	30 (2.8)
Engage the whole class in discussions	27 (3.4)
Explain computer science ideas to the whole class	27 (3.4)
Have students explain and justify their method for solving a problem	19 (4.2)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	13 (3.4)
Have students compare and contrast different methods for solving a problem	8 (2.4)
Have students do hands-on/manipulative programming activities that do not require a computer	8 (2.3)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	8 (2.4)
Have students present their solution strategies to the rest of the class	6 (2.2)
Have students read from a textbook/online course in class, either aloud or to themselves	6 (2.1)
Focus on literacy skills (e.g., informational reading or writing strategies)	4 (2.0)

On a weekly basis, the same activities are the most common (see Table 5.39). For example, 97 percent of classes have students work on programming activities using a computer, 84 percent include lecture, 71 percent whole class discussions, and 66 percent small group work at least once a week. Although it does not occur daily in many classes, having students explain and justify their method for solving a problem occurs weekly in nearly two-thirds of high school computer science classes.

Table 5.39
High School Computer Science Classes in Which Teachers Report Using Various Activities at Least Once a Week

	PERCENT OF CLASSES
Have students work on programming activities using a computer	97 (1.4)
Have students work in small groups	66 (3.6)
Engage the whole class in discussions	71 (3.3)
Explain computer science ideas to the whole class	84 (2.9)
Have students explain and justify their method for solving a problem	63 (3.4)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	32 (4.4)
Have students compare and contrast different methods for solving a problem	41 (3.8)
Have students do hands-on/manipulative programming activities that do not require a computer	21 (3.6)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	24 (3.2)
Have students present their solution strategies to the rest of the class	35 (4.0)
Have students read from a textbook/online course in class, either aloud or to themselves	31 (4.1)
Focus on literacy skills (e.g., informational reading or writing strategies)	21 (3.3)

Teachers were asked how often they engage students in the practices of computer science described in the Computer Science Teachers Association's K–12 Computer Science Standards.[20]

[20] Computer Science Teachers Association (2017). CSTA K–12 Computer Science Standards. Retrieved from http://www.csteachers.org/standards.

These practices include developing and using abstractions, recognizing and defining computational problems, testing and refining computational artifacts, communicating about computing, and fostering an inclusive computing culture. As can be seen in Table 5.40, activities related to testing and refining computational artifacts occur most frequently. For example, creating computational artifacts, writing comments within code, considering how to break a program into modules/procedures/objects, and adapting existing code to a new problem occur weekly in 60 percent or more of classes. Aspects of computer science related to end users are less often emphasized. For example, only 30 percent of classes have students create instructions for an end-user explaining a computational artifact on a weekly basis. Similarly, fewer than a quarter of high school computer science classes have students create a computational artifact to be used by someone else or get input on computational products from people with different perspectives at least once a week.

Table 5.40
High School Computer Science Classes in Which Teachers Report Students Engaging in Various Aspects of Computer Science Practices at Least Once a Week

	PERCENT OF CLASSES
Create computational artifacts (e.g., programs, simulations, visualizations, digital animations, robotic systems, or apps)	75 (2.8)
Write comments within code to document purposes or features	72 (2.8)
Consider how a program they are creating can be separated into modules/procedures/objects	62 (3.1)
Identify and adapt existing code to solve a new computational problem	60 (3.6)
Provide feedback on other students' computational products or designs	47 (4.1)
Systematically use test cases to verify program performance and/or identify problems	46 (4.2)
Identify real-world problems that might be solved computationally	45 (4.3)
Use computational methods to simulate events or processes (e.g., rolling dice, supply and demand)	45 (3.6)
Explain computational solution strategies verbally or in writing	42 (3.6)
Create instructions for an end-user explaining how to use a computational artifact	30 (3.6)
Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures	22 (3.3)
Create a computational artifact designed to be used by someone outside the class or other students	22 (3.6)
Get input on computational products or designs from people with different perspectives	21 (3.2)
Analyze datasets using a computer to detect patterns	20 (3.3)

Table 5.41 shows the percentage of classes that never have students engage in these practices. A quarter of classes never have students analyze datasets to detect patterns, and about a fifth never have students compare and contrast the strengths and limitations of different representations. Roughly 1 in 6 classes never have students consider end-users or get input from other people.

Table 5.41
High School Computer Science Classes in Which Teachers Report Students Never Engaging in Various Aspects of Computer Science Practices

	PERCENT OF CLASSES
Create computational artifacts (e.g., programs, simulations, visualizations, digital animations, robotic systems, or apps)	3 (1.0)
Write comments within code to document purposes or features	0 (0.2)
Consider how a program they are creating can be separated into modules/procedures/objects	2 (0.9)
Identify and adapt existing code to solve a new computational problem	2 (0.9)
Provide feedback on other students' computational products or designs	3 (1.6)
Systematically use test cases to verify program performance and/or identify problems	11 (2.7)
Identify real-world problems that might be solved computationally	1 (0.6)
Use computational methods to simulate events or processes (e.g., rolling dice, supply and demand)	7 (2.0)
Explain computational solution strategies verbally or in writing	4 (1.1)
Create instructions for an end-user explaining how to use a computational artifact	17 (3.2)
Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures	19 (2.8)
Create a computational artifact designed to be used by someone outside the class or other students	14 (2.7)
Get input on computational products or designs from people with different perspectives	16 (3.1)
Analyze datasets using a computer to detect patterns	25 (3.7)

These items were combined into a composite variable; mean scores on this composite, overall and by equity factors, are shown in Table 5.42. The overall score of 56 indicates that, on average, students are engaged in this set of activities once or twice a month. There are no statistically significant differences by subgroups.

Table 5.42
Equity Analyses of High School Computer Science Class Mean Scores for Engaging Students in Practices of Computer Science Composite

	MEAN SCORE
Overall	56 (1.3)
Prior Achievement Level of Class	
Mostly High	55 (1.7)
Average/Mixed	56 (1.7)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	53 (2.0)
Second Quartile	54 (4.1)
Third Quartile	57 (3.0)
Highest Quartile	59 (2.9)
Percent of Students in School Eligible for FRL	
Lowest Quartile	54 (1.9)
Second Quartile	57 (2.4)
Third Quartile	54 (3.4)
Highest Quartile	60 (4.1)

High school computer science teachers were also asked which activities took place in their most recent lesson. As can be seen in Table 5.43, 84 percent of lessons include students working on programming tasks using a computer, and 70 percent include the teacher explaining ideas to the whole class. About half include small group work, whole class discussion, or students watching a demonstration.

Table 5.43
High School Computer Science Classes
Participating in Various Activities in Most Recent Lesson

	PERCENT OF CLASSES
Students working on programming tasks using a computer	84 (2.8)
Teacher explaining a computer science idea to the whole class	70 (3.7)
Students working in small groups	57 (4.2)
Whole class discussion	49 (4.1)
Teacher conducting a demonstration while students watched	46 (3.6)
Students reading about computer science	20 (2.8)
Students doing hands-on/manipulative programming activities not using a computer	19 (2.9)
Students completing textbook/worksheet problems	16 (3.0)
Students writing about computer science	13 (3.0)
Test or quiz	9 (1.6)

On average, 40 percent of time in high school computer science classes is spent with students working individually (see Table 5.44). Whole class activities and small group work take up 29 and 22 percent of class time, respectively.

Table 5.44
Average Percentage of Time Spent on Different
Activities in the Most Recent High School Computer Science Lesson

	AVERAGE PERCENT OF CLASS TIME
Students working individually (e.g., reading textbooks, programming, taking a test or quiz)	40 (2.1)
Whole class activities (e.g., lectures, explanations, discussions)	29 (2.3)
Small group work	22 (2.1)
Non-instructional activities (e.g., attendance taking, interruptions)	9 (0.5)

Homework and Assessment Practices

Teachers were asked about the amount of homework assigned per week in the randomly selected class. Across the grade levels, students in mathematics classes are assigned more homework than students in science classes, particularly when looking at the percentage of classes assigned 31 minutes or more per week (see Table 5.45). This pattern is particularly evident in elementary classes, where students in 31 percent of classes are given 31–60 minutes of mathematics homework a week; only 8 percent of elementary classes are assigned this much science homework. Not surprisingly, the amount of time students are asked to spend on science and mathematics homework increases with grade range. For example, over half of high school mathematics classes are assigned one or more hours of homework per week, compared to under one-fifth of elementary classes. Homework expectations in high school computer science classes are similar to those in high school science classes.

Table 5.45
Amount of Homework Assigned in Classes Per Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
None	57 (2.8)	8 (1.8)	3 (0.5)
1–15 minutes per week	21 (2.2)	15 (1.9)	9 (1.3)
16–30 minutes per week	12 (1.4)	33 (2.8)	19 (1.3)
31–60 minutes per week	8 (2.6)	31 (2.7)	33 (1.6)
61–90 minutes per week	2 (1.1)	8 (1.4)	22 (1.9)
91–120 minutes per week	0 (0.1)	3 (1.0)	7 (0.9)
More than 2 hours per week	0 ---†	2 (1.2)	7 (0.9)
Mathematics			
None	9 (1.5)	5 (1.5)	4 (0.7)
1–15 minutes per week	17 (1.7)	7 (1.3)	4 (0.7)
16–30 minutes per week	25 (1.9)	16 (2.1)	12 (1.6)
31–60 minutes per week	31 (2.3)	34 (2.4)	29 (1.7)
61–90 minutes per week	11 (1.5)	21 (2.2)	26 (1.6)
91–120 minutes per week	6 (1.0)	13 (2.0)	14 (1.3)
More than 2 hours per week	1 (0.4)	4 (1.3)	12 (1.5)
Computer Science			
None	n/a	n/a	16 (2.6)
1–15 minutes per week	n/a	n/a	13 (2.9)
16–30 minutes per week	n/a	n/a	22 (4.4)
31–60 minutes per week	n/a	n/a	29 (3.9)
61–90 minutes per week	n/a	n/a	12 (2.5)
91–120 minutes per week	n/a	n/a	4 (1.0)
More than 2 hours per week	n/a	n/a	4 (1.2)

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

In science and mathematics, the survey asked how often students in the randomly selected class are required to take assessments the teachers did not develop, such as state or district benchmark assessments. Given that mathematics tends to be included in the high stakes accountability systems of states at more grades than science, it is not surprising that the frequency of external testing is greater in mathematics classes than in science classes, particularly at the elementary and middle grades levels (see Table 5.46). At the elementary level, 62 percent of classes never administer external science assessments; only 9 percent never administer external mathematics assessments.

Table 5.46
Frequency of Required External Testing in Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
Never	62 (2.4)	17 (1.8)	31 (2.0)
Once a year	17 (2.6)	33 (2.7)	33 (2.0)
Twice a year	4 (0.8)	11 (1.8)	14 (1.7)
Three or four times a year	11 (1.5)	28 (2.8)	16 (1.5)
Five or more times a year	6 (1.1)	11 (1.9)	6 (0.9)
Mathematics			
Never	9 (1.3)	1 (0.4)	20 (1.6)
Once a year	9 (1.3)	12 (2.1)	25 (1.9)
Twice a year	9 (1.4)	11 (1.6)	22 (1.8)
Three or four times a year	48 (2.8)	43 (2.7)	24 (1.7)
Five or more times a year	25 (2.2)	33 (2.7)	10 (1.3)

The prior achievement level of the class, percentage of students in the class from race/ethnicity groups historically underrepresented in STEM, percentage of students in the school eligible for free/reduced-price lunch, and school size are all related to the frequency with which classes are required to take external assessments. As can be seen in Table 5.47, classes with mostly low-achieving students are more likely than classes with mostly high prior achievers to take external mathematics assessments two or more times per year. Similarly, in both science and mathematics, the greater the percentage of students from race/ethnicity groups historically underrepresented in STEM in the class and the greater the percentage of students eligible for free/reduced-price lunch in the school, the more likely students are to be tested this frequently.

Table 5.47
Equity Analyses of Classes Required to Take External Assessments Two or More Times Per Year, by Subject

	PERCENT OF CLASSES	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	35 (3.2)	66 (2.4)
Average/Mixed	29 (1.5)	78 (1.6)
Mostly Low	39 (4.2)	78 (2.7)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	21 (2.1)	70 (2.2)
Second Quartile	28 (2.6)	73 (2.2)
Third Quartile	36 (3.1)	78 (2.3)
Highest Quartile	38 (4.0)	81 (2.7)
Percent of Students in School Eligible for FRL		
Lowest Quartile	20 (2.3)	68 (2.7)
Second Quartile	32 (3.2)	77 (2.2)
Third Quartile	36 (3.6)	83 (2.2)
Highest Quartile	36 (3.1)	77 (2.8)
School Size		
Smallest Schools	24 (4.4)	69 (4.5)
Second Group	22 (2.8)	73 (2.7)
Third Group	29 (2.9)	79 (2.3)
Largest Schools	37 (2.2)	77 (1.8)

Summary

Data from 2018 NSSME+ indicate that science, mathematics, and computer science teachers perceive more control over decisions related to pedagogy than curriculum. Perceived autonomy over curriculum and pedagogy tends to increase with grade range in both science and mathematics classes, with teachers of elementary classes having less control over what and how they teach than teachers of high school classes.

Teachers of classes at all grade levels, and in all three subjects, are somewhat likely to emphasize reform-oriented instructional objectives, such as developing understanding of science concepts/mathematics ideas/computer science ideas, and learning how to do science/mathematics/computer science. However, mathematics and computer science classes are more likely than science classes to emphasize these objectives. There are also some important differences among grade levels. For example, elementary mathematics classes are more likely than middle and high school classes to focus heavily on increasing students' interest in mathematics and learning to perform computations with speed and accuracy.

In terms of instructional activities, teacher explanation of science ideas, whole group discussion, and small group work are very common across the grade levels. Students are engaged in various aspects of science practices (e.g., formulating scientific questions, designing and implementing investigations, engaging in argumentation), on average, once or twice a month or less. Further, students in elementary science classes are less likely than middle and high school students to be engaged in these practices. Across grade levels, there is little incorporation of engineering and almost no coding in science instruction.

Explanation of ideas, whole group discussion, and small group work are also very prominent in mathematics instruction. Students across grade ranges are likely to be engaged in the practices of mathematics at least once per week, with smaller percentages experiencing these practices in all or almost all lessons. Similar to science, very few mathematics classes incorporate coding.

In high school computer science instruction, having students work on programming activities using a computer is by far the most common mode of instruction. Similar to science and mathematics, teacher explanation of ideas, whole group discussion, and small group work are also frequently utilized. Students are engaged in various aspects of computer science practices, on average, once or twice a month. Activities related to testing and refining computational artifacts occur most frequently, including creating computational artifacts, writing comments within code, considering how to break a problem into modules/procedures/objects, and adapting existing code to a new problem.

Across grade levels, students in mathematics classes are assigned more homework than students in science classes. Further, the amount of time students are asked to spend on science and mathematics homework increases with grade range, with homework expectations in high school computer science classes similar to those in high school science classes. Not surprisingly, external testing occurs more frequently in mathematics classes than in science classes. However, in both subjects, the frequency of external testing varies by grade range.

Equity factors, in particular prior achievement level of the class, are related to instruction in science and mathematics. For example, teachers of science classes composed of mostly low prior achievers report having less control over both curriculum and pedagogy than teachers of classes containing mostly high prior achievers. In addition, in both science and mathematics, classes with mostly high-achieving students are more likely to stress reform-oriented objectives than classes consisting of mostly low-achieving students. Classes of mostly low prior-achieving students also are required to take external assessments more frequently than classes of mostly high prior-achieving students. In high school computer science, the percentage of students in the class from race/ethnicity groups historically underrepresented in STEM is often positively correlated with aspects of instruction considered to be high quality, though even the most diverse computer science classes tend to have relatively few students from these groups.

Instructional Resources

Overview

The quality and availability of instructional resources is a major factor in science, mathematics, and computer science teaching. The 2018 NSSME+ included a series of items on textbooks and instructional programs—which ones teachers use and how teachers use them. Teachers were also asked about the availability and use of a number of other instructional resources, including various types of computing devices and Internet capabilities. The following sections present these results.

Use of Textbooks and Other Instructional Resources

The 2018 NSSME+ collected data on the use of various instructional resources, including commercially published textbooks or programs, both print and electronic. Of particular interest is how much latitude teachers have in selecting instructional resources. Table 6.1 shows that instructional materials are designated by the district for most science and mathematics classes. The likelihood of having designated materials decreases from elementary school to high school in mathematics. Also, mathematics classes are generally more likely to have designated materials, perhaps due to the greater accountability emphasis in mathematics. High school computer science classes are very unlikely to have designated materials; only about a quarter have materials designated for them.

Table 6.1
Classes for Which the District Designates Instructional Materials to Be Used, by Subject

	PERCENT OF CLASSES		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Elementary	72 (2.4)	91 (1.3)	n/a
Middle	66 (2.8)	80 (2.1)	n/a
High	58 (2.0)	66 (1.7)	26 (3.7)

When teachers responded that their randomly selected class had a designated instructional material, the survey presented them with a list of possible types of materials. Despite the increasing variety of instructional materials, it is clear that in science, the textbook still dominates, with the most commonly designated materials being commercially published textbooks and modules (see Table 6.2). The percentage of elementary and middle grades classes (39 percent each) that have fee-based websites as the designated material is considerably larger than in high school (16 percent). State- and district-developed resources are also relatively common in elementary grades. The data also indicate that for many classes, multiple types of materials are designated by the district.

Table 6.2
Science Classes for Which Various Types of Instructional Resources Are Designated,† by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets, laboratory handouts) that accompany the textbooks	67 (2.9)	87 (1.8)	95 (0.9)
State, county, district, or diocese-developed units or lessons	43 (2.2)	32 (2.3)	27 (1.7)
Lessons or resources from websites that are free (e.g., Khan Academy, PhET)	20 (1.9)	26 (2.2)	25 (2.0)
Commercially published kits/modules (printed or electronic)	51 (2.7)	36 (3.1)	22 (2.0)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	39 (2.7)	39 (2.8)	16 (1.5)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	9 (1.2)	15 (2.0)	11 (1.8)

† Includes only those teachers who indicated that their randomly selected science class had an instructional material designated by the state, district, or diocese.

The textbook is just as prominent in mathematics as in science (see Table 6.3). In addition, almost half of elementary classes have a material developed by their education agency as the designated material, and close to one-third have fee-based or free websites as the designated material. One-third of elementary and middle grades mathematics classes have online materials that students work through at their own pace.

Table 6.3
Mathematics Classes for Which Various Types of Instructional Resources Are Designated,† by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	89 (1.4)	88 (1.9)	91 (1.3)
State, county, district, or diocese-developed units or lessons	44 (2.2)	37 (2.5)	32 (1.9)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	28 (1.8)	30 (2.5)	24 (1.7)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	31 (2.0)	22 (2.0)	15 (1.5)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	33 (2.0)	33 (2.9)	13 (1.7)

† Includes only those teachers who indicated that their randomly selected mathematics class had an instructional material designated by the state, district, or diocese.

As reported above, teachers of only about a quarter of high school computer science classes indicate having instructional materials designated. Among these classes, free, web-based resources are just as prominent as the textbook (see Table 6.4).

Table 6.4
High School Computer Science Classes for Which Various Types of Instructional Resources Are Designated†

	PERCENT OF CLASSES
Lessons or resources from websites that are free (e.g., Khan Academy, code.org)	59 (9.8)
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	54 (11.3)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	33 (10.1)
Online units or courses that students work through at their own pace (e.g., MOOCs, EdX, IMACS)	16 (4.6)
State, county, district, or diocese-developed units or lessons	10 (3.9)

† Includes only those teachers who indicated that their randomly selected computer science class had an instructional material designated by the state, district, or diocese.

Regardless of whether instructional materials had been designated for their class, teachers were asked how often instruction was based on various types of materials. As can be seen in Table 6.5, teacher-created units or lessons are very likely to be used on a weekly basis in science, and their prominence increases considerably with grade range, from 47 percent of elementary science classes to 86 percent of high school classes. In high school, after teacher-created lessons, commercially published textbooks and units or lessons from any other source are a distant second, with all the rest being relatively uncommon. In middle school science classes, the pattern is similar but less pronounced. In elementary science classes, fee-based websites and teacher-created units and lessons share roughly equal influence, followed by the textbook.

Table 6.5
Science Classes Basing Instruction on Various Instructional Resources at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Units or lessons you created (either by yourself or with others)	47 (2.4)	76 (2.0)	86 (1.0)
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets, laboratory handouts) that accompany the textbooks	38 (1.9)	45 (2.6)	50 (1.7)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	28 (2.0)	43 (2.4)	49 (1.7)
Lessons or resources from websites that are free (e.g., Khan Academy, PhET)	23 (2.1)	31 (1.8)	31 (1.8)
Commercially published kits/modules (printed or electronic)	29 (2.1)	21 (2.4)	21 (1.5)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	49 (2.2)	34 (1.9)	16 (1.1)
State, county, district, or diocese-developed units or lessons	32 (2.4)	21 (1.9)	14 (1.2)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	7 (1.0)	9 (1.0)	9 (1.0)

In mathematics, the influence of teacher-created units and lessons is much more prominent in high school than in elementary school classes (78 and 44 percent, respectively; see Table 6.6). The textbook is especially prominent at the elementary level, where three-fourths of classes are frequently based on this type of instructional resource, considerably more than any other resource. Also, elementary mathematics classes are much more likely than those at other levels to rely on fee-based websites and, to a lesser extent, on online self-paced materials.

Table 6.6
Mathematics Classes Basing Instruction on Various Instructional Resources at Least Once a Week, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Units or lessons you created (either by yourself or with others)	44 (2.0)	65 (2.5)	78 (1.5)
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	76 (2.0)	65 (2.5)	61 (1.7)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	30 (1.8)	31 (1.9)	35 (1.6)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	37 (1.9)	39 (2.4)	27 (1.4)
State, county, district, or diocese-developed units or lessons	41 (1.8)	26 (1.9)	23 (1.3)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	54 (2.1)	34 (2.4)	19 (1.2)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	36 (2.1)	24 (1.9)	12 (1.2)

In high school computer science, like science and mathematics, classes are most likely to be based on teacher-created lessons (64 percent at least once a week; see Table 6.7), with lessons from free websites a distant second (43 percent). Compared to high school classes in the other subjects, computer science instruction is much less likely to be based on a commercially published textbook and considerably more likely to be based on free websites and online self-paced materials.

Table 6.7
High School Computer Science Classes Basing Instruction on Various Instructional Resources at Least Once a Week

	PERCENT OF CLASSES
Units or lessons you created (either by yourself or with others)	64 (3.9)
Lessons or resources from websites that are free (e.g., Khan Academy, code.org)	43 (4.0)
Online units or courses that students work through at their own pace (e.g., MOOCs, EdX, IMACS)	32 (4.6)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	28 (3.6)
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	26 (3.4)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	9 (2.2)
State, county, district, or diocese-developed units or lessons	7 (2.8)

Table 6.8, showing the percentage of high school classes that never base instruction on these resources, highlights differences between computer science and the other two subjects. Computer science classes are considerably more likely to never base instruction on state/district-developed materials, fee-based resources from websites, and commercially published textbooks. In contrast, high school science and mathematics classes are much more likely to never base instruction on online self-paced materials.

Table 6.8
High School Classes Never Basing Instruction on Various Instructional Resources, by Subject

	PERCENT OF CLASSES		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
State, county, district, or diocese-developed units or lessons	46 (1.7)	39 (1.8)	69 (4.4)
Lessons or resources from websites that have a subscription fee or per lesson cost	47 (2.0)	42 (1.4)	63 (4.0)
Commercially published textbooks, including the supplementary materials that accompany the textbooks	9 (1.0)	13 (1.4)	36 (3.6)
Online units or courses that students work through at their own pace	59 (1.9)	59 (1.8)	33 (3.2)
Lessons or resources from websites that are free	10 (1.2)	16 (1.0)	14 (2.8)
Units or lessons you collected from any other source	6 (0.9)	13 (1.2)	14 (2.9)
Units or lessons you created	1 (0.2)	3 (0.6)	6 (2.2)
Commercially published kits/modules	18 (1.2)	n/a	n/a

Teachers who indicated that instruction in their randomly selected class was based substantially on a commercially published textbook or module 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. Tables 6.9–6.11 show the market share held by each of the major science, mathematics, and computer science textbook publishers. It is interesting to note that three publishers—Pearson, McGraw-Hill, and Houghton Mifflin Harcourt—account for instructional materials used in more than 75 percent of middle school and high school science classes and more than 70 percent of all mathematics classes. The only other publishers with a substantial share of the market are Delta Education in elementary science and Great Minds in elementary mathematics. In high school computer science, Pearson again has a considerable market share, followed closely by Cengage.

Table 6.9
Market Share of Commercial Textbook Publishers Used in Science Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Pearson	16 (2.6)	27 (2.2)	43 (2.0)
McGraw-Hill Education	16 (2.3)	25 (2.5)	20 (2.1)
Houghton Mifflin Harcourt	27 (3.5)	27 (2.9)	19 (1.6)
Cengage	2 (1.0)	0 (0.2)	5 (0.7)
Macmillan	0 ---†	0 ---†	2 (0.4)
Alpha Omega Publications	0 (0.1)	1 (0.7)	1 (0.5)
Frey Scientific	0 ---†	1 (0.7)	1 (0.4)
Continental Press	0 ---†	0 ---†	1 (0.8)
Kendall Hunt	0 (0.3)	0 ---†	1 (0.3)
OpenStax	0 ---†	0 ---†	1 (0.4)
Wiley	0 ---†	0 ---†	1 (0.3)
Accelerate Learning	4 (1.3)	4 (1.1)	0 (0.1)
Lab-Aids	0 ---†	3 (1.1)	0 (0.1)
Delta Education	13 (2.2)	2 (0.9)	0 ---†
Carolina Biological Supply Company	4 (1.3)	2 (0.8)	0 ---†
Abeka	0 (0.1)	1 (1.0)	0 ---†
Activate Learning	0 (0.0)	1 (0.5)	0 (0.1)
CK-12	0 ---†	1 (0.4)	0 (0.0)
Kindle Direct Publishing	0 (0.2)	1 (0.7)	0 (0.0)
Wieser Educational	0 ---†	1 (0.3)	0 ---†
Museum of Science, Boston	4 (2.9)	0 ---†	0 ---†
Knowing Science	2 (1.4)	0 ---†	0 ---†
Amplify	1 (0.8)	0 ---†	0 ---†
Learning Design Group	1 (0.5)	0 ---†	0 ---†
Mystery Science	1 (0.6)	0 ---†	0 ---†
NSTA Press	1 (0.4)	0 ---†	0 (0.3)
Project Lead The Way	1 (0.6)	0 (0.2)	0 (0.1)
Studies Weekly	1 (0.3)	0 ---†	0 ---†
TCI	1 (1.2)	0 ---†	0 ---†

† 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.

Table 6.10
Market Share of Commercial Textbook Publishers Used in Mathematics Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Pearson	21 (3.1)	17 (2.5)	27 (2.2)
Houghton Mifflin Harcourt	39 (3.2)	37 (3.1)	26 (1.9)
McGraw-Hill Education	19 (2.6)	26 (2.8)	19 (1.9)
Cengage	0 ---†	0 ---†	9 (1.1)
CPM Educational Program	0 (0.1)	3 (1.4)	3 (0.9)
Larson Texts	0 ---†	2 (0.8)	2 (0.5)
Macmillan	0 ---†	0 ---†	2 (0.4)
Great Minds	10 (1.9)	6 (1.7)	1 (0.6)
Carnegie Learning	0 ---†	3 (1.0)	1 (0.4)
The College Board	0 ---†	1 (0.6)	1 (0.4)
Wiley	3 (0.9)	0 (0.3)	1 (0.3)
Birkhäuser	0 ---†	0 ---†	1 (0.6)
eMATHinstruction	0 ---†	0 ---†	1 (0.6)
Haese Mathematics	0 ---†	0 ---†	1 (0.2)
Key Curriculum Press	0 ---†	0 ---†	1 (0.4)
Oxford University Press	0 ---†	0 ---†	1 (0.3)
Curriculum Associates	2 (0.7)	2 (0.5)	0 ---†
Sadlier	0 (0.2)	2 (0.7)	0 ---†
Marshall Cavendish Education	1 (0.6)	1 (0.3)	0 ---†
AgileMind	0 ---†	1 (0.6)	0 ---†
Origo Education	2 (1.0)	0 ---†	0 ---†
Sharon Wells Mathematics	1 (0.1)	0 ---†	0 ---†
The Math Learning Center	1 (0.4)	0 ---†	0 ---†

† 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.

Table 6.11
Market Share of Commercial Textbook Publishers Used in High School Computer Science Classes

	PERCENT OF CLASSES
Pearson	24 (5.6)
Cengage	23 (5.9)
Skylight	12 (4.6)
Wiley	8 (3.8)
Project Lead The Way	6 (2.5)
Jones & Bartlett Learning	5 (3.2)
D&S Marketing Systems	3 (2.9)
Goodheart-Wilcox	3 (2.0)
Stacey Armstrong	3 (2.2)
Apple Inc. Education	2 (1.6)
EMC Publishing	2 (2.1)
Microsoft Press	2 (1.6)
O'Reilly Media	2 (1.4)
Virtualbookworm.com Publishing	2 (1.4)
Barron's Educational Series	1 (1.3)
McGraw-Hill Education	1 (0.5)
Oracle	1 (0.8)
Oxford University Press	1 (1.0)
Springer Nature	1 (0.9)

Tables 6.12 and 6.13 list the science and mathematics textbooks in each grade range used by at least 10 percent of classes; secondary textbooks are shown by course type, as well.

Table 6.12
Most Commonly Used Science Textbooks in Each Grade Range and Course

	PUBLISHER	TITLE
Elementary		
Science	Houghton Mifflin Harcourt	*Science Fusion*
	Delta Education	*FOSS*
	Houghton Mifflin Harcourt	*Harcourt Science*
	Pearson	*Interactive Science*
Middle		
Earth/Space Science	Houghton Mifflin Harcourt	*Science Fusion*
	McGraw-Hill Education	*Glencoe iScience*
General/Integrated Science	Pearson	*Interactive Science*
	Houghton Mifflin Harcourt	*Science Fusion*
	McGraw-Hill Education	*Glencoe iScience*
	McGraw-Hill Education	*Glencoe Science*
	Houghton Mifflin Harcourt	*Holt Science & Technology*
Life Science	Pearson	*Interactive Science*
	Houghton Mifflin Harcourt	*Science Fusion*
	McGraw-Hill Education	*Glencoe iScience*
	Houghton Mifflin Harcourt	*Life Science*
	Houghton Mifflin Harcourt	*Holt Science & Technology*
Physical Science	McGraw-Hill Education	*Glencoe iScience*
	Houghton Mifflin Harcourt	*Physical Science*
High		
Biology/Life Science	Pearson	*Biology*
	Houghton Mifflin Harcourt	*Biology*
Chemistry	Pearson	*Chemistry*
	Houghton Mifflin Harcourt	*Modern Chemistry*
	McGraw-Hill Education	*Chemistry Matter and Change*
Earth/Space Science	Pearson	*Earth Science*
	McGraw-Hill Education	*Earth Science*
Environmental Science/Ecology	Houghton Mifflin Harcourt	*Environmental Science*
	Cengage	*Living in the Environment*
Multi-discipline	McGraw-Hill Education	*Physical Science*
	Houghton Mifflin Harcourt	*Physical Science*
Physics	Pearson	*Conceptual Physics*
	Houghton Mifflin Harcourt	*Physics*

Table 6.13
Most Commonly Used Mathematics Textbooks in Each Grade Range and Course

	PUBLISHER	TITLE
Elementary		
Mathematics	Houghton Mifflin Harcourt	*Go Math!*
	Pearson	*Envision Math*
	McGraw-Hill Education	*My Math*
Middle		
6th Grade Mathematics	Houghton Mifflin Harcourt	*Go Math!*
	Pearson	*Envision Math*
	McGraw-Hill Education	*Math Course 1*
7th Grade Mathematics	Houghton Mifflin Harcourt	*Go Math!*
	Houghton Mifflin Harcourt	*Big Ideas Math*
	McGraw-Hill Education	*Math Course 2*
8th Grade Mathematics	Houghton Mifflin Harcourt	*Go Math!*
Algebra 1, Grade 7 or 8	Pearson	*Algebra 1*
	Houghton Mifflin Harcourt	*Algebra 1*
	McGraw-Hill Education	*Algebra 1*
High		
Non-College Prep Mathematics	McGraw-Hill Education	*Algebra 1*
Formal/College Prep Mathematics Level 1	Pearson	*Algebra 1*
	Houghton Mifflin Harcourt	*Algebra 1*
	McGraw-Hill Education	*Algebra 1*
	Houghton Mifflin Harcourt	*Big Ideas Math*
Formal/College Prep Mathematics Level 2	Houghton Mifflin Harcourt	*Geometry*
	Pearson	*Geometry*
	McGraw-Hill Education	*Geometry*
Formal/College Prep Mathematics Level 3	Houghton Mifflin Harcourt	*Algebra 2*
	McGraw-Hill Education	*Algebra 2*
	Pearson	*Algebra 2*
Formal/College Prep Mathematics Level 4	McGraw-Hill Education	*Precalculus*
Courses that might qualify for college credit	Macmillan	*The Practice of Statistics*
	Pearson	*Calculus: Graphical, Numerical, Algebraic*
	Cengage	*Calculus of a Single Variable*

In high school computer science, only one textbook is used by more than 10 percent of classes: HTML and CSS, by Pearson. If computer science teachers reported that their class was sometimes based on lessons from free or fee-based websites, they were asked to list up to three online sources of lessons or activities they use most frequently. Only one online source—code.org—is used in more than 10 percent of high school computer science classes.

Table 6.14 shows the publication year of science, mathematics, and computer science textbooks. In 2018, 43–51 percent of science classes used textbooks published in 2009 or earlier. Science classes are considerably more likely than mathematics classes to use older textbooks. For example, 51 percent of middle grades science classes are using textbooks published in 2009 or earlier, compared to only 15 percent of middle grades mathematics classes. Given the growing presence of computer science classes, it is surprising that a third of them are using textbooks published in 2009 or earlier, but it is important to remember that a relatively small proportion of these classes use published materials at all.

Table 6.14
Publication Year of Textbooks/Programs, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
2009 or earlier	45 (4.4)	51 (3.7)	43 (2.1)
2010–12	26 (4.7)	27 (2.9)	27 (1.9)
2013–15	21 (3.9)	12 (1.8)	20 (1.8)
2016–18	9 (1.6)	11 (2.4)	9 (1.4)
Mathematics			
2009 or earlier	13 (2.0)	15 (2.5)	29 (1.9)
2010–12	32 (2.4)	21 (2.7)	31 (2.1)
2013–15	46 (3.1)	51 (3.0)	29 (2.1)
2016–18	9 (1.8)	13 (2.5)	10 (1.3)
Computer Science			
2009 or earlier	n/a	n/a	33 (7.3)
2010–12	n/a	n/a	26 (5.9)
2013–15	n/a	n/a	24 (6.5)
2016–18	n/a	n/a	17 (5.1)

Teachers were also asked whether the most recent unit in their randomly selected class was based primarily on either a commercially published textbook or materials developed by the state or district. (Computer science teachers were asked about commercially published online courses in addition.) As shown in Table 6.15, more than half of classes—mathematics classes in particular—are based on such materials.

Table 6.15
Classes in Which the Most Recent Unit Was Based on a Commercially Published Textbook or a Material Developed by the State or District, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science	65 (2.1)	54 (2.3)	54 (1.9)
Mathematics	81 (1.5)	70 (2.3)	73 (1.8)
Computer Science	n/a	n/a	63 (5.4)

When teachers responded that their most recent unit was based on one of these materials, they were asked how they used the material (see Table 6.16). Two important findings emerge from these data. First, when classes use commercially published and state/district-developed materials, the materials heavily influence instruction in all subjects at all grade ranges. Teachers in more than 70 percent of classes in the various subject and grade-level categories use the textbook substantially to guide the overall structure and content emphasis of their units. Second, it is clear that teachers modify their materials substantially when designing instruction. In roughly half or more of classes, teachers incorporate activities from other sources substantially, "pick and choose" from the material, and modify activities from the materials.

Table 6.16
Ways Teachers Substantially† Used Their Materials in Most Recent Unit,‡ by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	65 (2.7)	78 (2.8)	78 (2.1)
I used these materials to guide the structure and content emphasis of the unit.	77 (3.1)	72 (2.8)	76 (2.0)
I modified activities from these materials.	59 (2.9)	69 (3.0)	71 (2.7)
I picked what is important from these materials and skipped the rest.	51 (3.1)	54 (3.4)	53 (2.6)
Mathematics			
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	69 (1.9)	65 (3.1)	64 (2.0)
I used these materials to guide the structure and content emphasis of the unit.	87 (1.6)	82 (1.9)	81 (1.5)
I modified activities from these materials.	61 (2.4)	62 (2.9)	60 (1.9)
I picked what is important from these materials and skipped the rest.	49 (2.5)	52 (2.8)	52 (1.9)
Computer Science			
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	n/a	n/a	70 (5.2)
I used these materials to guide the structure and content emphasis of the unit.	n/a	n/a	84 (3.6)
I modified activities from these materials.	n/a	n/a	56 (6.4)
I picked what is important from these materials and skipped the rest.	n/a	n/a	49 (7.3)

† Includes teachers indicating 4 or 5 on a five-point scale ranging from 1 "not at all" to 5 "to a great extent."
‡ Includes only those classes in which the most recent unit was based on a commercially published or state/district-developed material.

Teachers in roughly half of science, mathematics, and computer science classes skip activities in the material substantially. As can be seen in Table 6.17, in all subjects, some of the most frequently selected reasons for skipping parts of the materials are: (1) having another activity that works better than the one skipped, (2) the science ideas addressed not being included in pacing guides or standards, (3) not having enough instructional time, and (4) the activities skipped being too difficult for the students. In more than 40 percent of classes, teachers skip activities that they deem unnecessary (students either already knew the ideas or could learn them without the activities). Differences across grades, however, are also apparent. For example, in mathematics, teachers in 38 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. A similar pattern is evident in science. Also, not having materials for an activity is much more likely to be cited as a reason in science classes (54–62 percent) than in mathematics classes (24–27 percent) or high school computer science classes (28 percent).

Table 6.17
Reasons Why Parts of Materials Are Skipped,† by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
I have different activities for those science ideas that work better than the ones I skipped.	69 (3.9)	83 (3.4)	77 (4.0)
I did not have enough instructional time for the activities I skipped.	74 (4.5)	73 (3.6)	74 (3.5)
The science ideas addressed in the activities I skipped are not included in my pacing guide/standards.	63 (3.9)	76 (3.4)	73 (3.2)
The activities I skipped were too difficult for my students.	38 (3.7)	43 (3.9)	59 (3.4)
I did not have the materials needed to implement the activities I skipped.	62 (4.5)	56 (4.1)	54 (3.7)
My students already knew the science ideas or were able to learn them without the activities I skipped.	49 (3.5)	52 (4.4)	52 (3.5)
I did not have the knowledge needed to implement the activities I skipped.	24 (3.3)	25 (4.4)	20 (2.6)
Mathematics			
I have different activities for those mathematical ideas that work better than the ones I skipped.	80 (2.2)	80 (2.5)	74 (2.2)
I did not have enough instructional time for the activities I skipped.	61 (3.1)	71 (3.1)	69 (2.4)
The mathematical ideas addressed in the activities I skipped are not included in my pacing guide/standards.	65 (2.8)	72 (3.1)	73 (2.1)
The activities I skipped were too difficult for my students.	38 (2.8)	44 (3.6)	55 (2.5)
I did not have the materials needed to implement the activities I skipped.	26 (2.3)	27 (3.0)	24 (2.2)
My students already knew the mathematical ideas or were able to learn them without the activities I skipped.	67 (2.9)	59 (3.5)	54 (2.5)
I did not have the knowledge needed to implement the activities I skipped.	9 (2.5)	11 (2.4)	9 (1.6)
Computer Science			
I have different activities for those computer science ideas that work better than the ones I skipped.	n/a	n/a	68 (5.6)
I did not have enough instructional time for the activities I skipped.	n/a	n/a	60 (5.8)
The computer science ideas addressed in the activities I skipped are not included in my pacing guide/standards.	n/a	n/a	49 (6.7)
The activities I skipped were too difficult for my students.	n/a	n/a	51 (7.2)
I did not have the materials needed to implement the activities I skipped.	n/a	n/a	28 (7.0)
My students already knew the computer science ideas or were able to learn them without the activities I skipped.	n/a	n/a	44 (6.2)
I did not have the knowledge needed to implement the activities I skipped.	n/a	n/a	35 (7.5)

† Includes only those classes in which the most recent unit was based on a commercially published or state/district-developed material.

Given that teachers often skip activities in their materials because they know of better ones, it is perhaps not surprising that teachers in well more than half of science, mathematics, and computer science classes supplement their materials. Of the reasons listed on the questionnaire, three stand out above the rest: (1) teachers having additional activities that they like, (2) providing students with additional practice, and (3) differentiating instruction for students at different achievement levels (see Table 6.18). The influence of standardized testing is also evident, with teachers in anywhere from about half to almost three-fourths of classes across subjects supplementing for test-preparation purposes. Finally, in 34–49 percent of classes, depending on subject and grade level, teachers supplement their published material because their pacing guide indicates that they should. This finding both speaks to the prevalence of pacing guides and suggests that supplementing is at least to some extent sanctioned or prescribed by schools and districts.

Table 6.18
Reasons Why Materials Are Supplemented,† by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
I had additional activities that I liked.	82 (3.2)	86 (2.6)	88 (2.6)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	84 (2.4)	90 (2.6)	86 (3.5)
Supplemental activities were needed to provide students with additional practice.	77 (2.8)	90 (2.3)	86 (3.7)
Supplemental activities were needed to prepare students for standardized tests.	47 (3.7)	60 (3.9)	53 (3.6)
My pacing guide indicated that I should use supplemental activities.	42 (3.6)	49 (3.9)	46 (3.3)
Mathematics			
I had additional activities that I liked.	80 (2.0)	85 (2.3)	80 (1.9)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	94 (1.3)	97 (1.0)	89 (1.9)
Supplemental activities were needed to provide students with additional practice.	95 (1.0)	94 (1.3)	91 (1.6)
Supplemental activities were needed to prepare students for standardized tests.	60 (2.9)	72 (3.4)	56 (2.6)
My pacing guide indicated that I should use supplemental activities.	45 (3.0)	37 (3.7)	41 (2.6)
Computer Science			
I had additional activities that I liked.	n/a	n/a	79 (5.7)
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	n/a	n/a	73 (5.6)
Supplemental activities were needed to provide students with additional practice.	n/a	n/a	79 (5.0)
Supplemental activities were needed to prepare students for standardized tests.	n/a	n/a	52 (6.9)
My pacing guide indicated that I should use supplemental activities.	n/a	n/a	34 (6.3)

† Includes only those classes in which the most recent unit was based on a commercially published or state/district-developed material.

Finally, when teachers reported that they modified their published material (which over half did), they rated each of several factors that may have contributed to their decision (see Table 6.19). Two factors stand out: teachers do not have enough time to implement the activities as designed (52–71 percent of classes), and the activities are too difficult for students (43–58 percent of classes). In science, teachers are also likely to cite not having the necessary materials or supplies for the original activities (53–62 percent of classes). Teachers are about equally likely to point to the structure of activities (either too much or too little) across subjects and grade ranges as the reason for modifications.

Table 6.19
Reasons Why Materials Are Modified,† by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Science			
I did not have enough instructional time to implement the activities as designed.	70 (3.9)	70 (3.5)	71 (2.8)
The original activities were too difficult conceptually for my students.	46 (4.1)	54 (3.9)	58 (3.3)
I did not have the necessary materials/supplies for the original activities.	60 (3.8)	62 (3.6)	53 (3.4)
The original activities were too easy conceptually for my students.	35 (3.5)	46 (4.0)	44 (3.6)
The original activities were not structured enough for my students.	42 (4.3)	41 (3.8)	40 (3.5)
The original activities were too structured for my students.	36 (4.2)	33 (4.0)	38 (3.1)
Mathematics			
I did not have enough instructional time to implement the activities as designed.	52 (2.7)	68 (2.7)	58 (2.6)
The original activities were too difficult conceptually for my students.	50 (3.1)	55 (3.2)	54 (2.8)
I did not have the necessary materials/supplies for the original activities.	27 (2.4)	29 (3.0)	28 (2.0)
The original activities were too easy conceptually for my students.	52 (3.2)	44 (3.2)	38 (2.1)
The original activities were not structured enough for my students.	31 (2.5)	39 (3.1)	35 (2.0)
The original activities were too structured for my students.	32 (2.4)	35 (3.2)	31 (2.2)
Computer Science			
I did not have enough instructional time to implement the activities as designed.	n/a	n/a	54 (6.5)
The original activities were too difficult conceptually for my students.	n/a	n/a	43 (6.5)
I did not have the necessary materials/supplies for the original activities.	n/a	n/a	32 (7.1)
The original activities were too easy conceptually for my students.	n/a	n/a	33 (6.3)
The original activities were not structured enough for my students.	n/a	n/a	37 (7.3)
The original activities were too structured for my students.	n/a	n/a	31 (6.6)

† Includes only those classes in which the most recent unit was based on a commercially published or state/district-developed material.

Facilities and Equipment

Given the increased emphasis on computing in instruction across STEM disciplines, the 2018 NSSME+ included several questions about availability of computing resources. As shown in Table 6.20, virtually all schools have school-wide Wi-Fi. Laptop/tablet carts and computer labs are also present in a large majority of schools. Perhaps most striking is the percentage of schools (35–44 percent) where every student has a laptop or tablet. Obviously, these initiatives represent a substantial investment.

Table 6.20
Schools With Various Computing Resources, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
School-wide Wi-Fi	98 (0.8)	99 (0.4)	99 (0.4)
Laptop/tablet carts available for teachers to use with their classes	89 (1.7)	87 (1.9)	76 (2.5)
One or more computer labs available for teachers to schedule for their classes	69 (2.9)	68 (3.2)	74 (2.7)
A 1-to-1 initiative (every student is provided with a laptop or tablet)	35 (2.4)	40 (2.9)	44 (3.2)

Because of the potential inequities inherent in students using their own computing devices, policies governing device use are also of interest. Virtually no schools require students to provide their own computers (see Table 6.21). The extent to which students are allowed to bring their laptops and tablets to school and use them in classes increases with grade range. The likelihood that students are not allowed to bring their computers to school follows an opposite trend.

Table 6.21
Schools With Various Policies About Students Bringing Their Own Computers to School, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
School has a 1-to-1 initiative (every student is provided with a laptop or tablet).	35 (2.4)	40 (2.9)	44 (3.2)
Students are not required but are allowed to bring their own laptops or tablets for use in classes.	14 (2.1)	22 (2.3)	39 (3.2)
Students are not allowed to use their own laptops or tablets in classes.	51 (2.6)	38 (2.8)	15 (2.3)
Students are required to provide their own laptops or tablets for use in classes.	0 (0.1)	0 (0.2)	1 (0.4)

Regarding computer science instruction specifically, high school computer science teachers were asked about school policies related to provision of instructional resources in their randomly selected class. Typically, if a particular technology is required, the school provides it for students (see Table 6.22). It is somewhat surprising that any classes require students to provide their own computers or mobile computing devices, but a small percentage do. Even data storage devices (which 13 percent of high school computer science classes require students to provide) can present a financial obstacle to students.

Table 6.22
Provision of Technologies in High School Computer Science Classes

	PERCENT OF CLASSES		
	COMPUTERS	MOBILE COMPUTING DEVICES	DATA STORAGE DEVICES
Not required for this class	n/a	57 (4.2)	46 (3.3)
Provided by the school, and students are not allowed to use their own	35 (4.5)	9 (2.2)	9 (2.8)
Provided by the school, but students are allowed to use their own	58 (4.5)	15 (2.3)	26 (3.4)
Students are expected to provide their own, but the school has some available for use	2 (0.7)	10 (2.9)	7 (2.2)
Students are required to provide their own	5 (1.6)	8 (3.4)	13 (2.4)

Science teachers were presented with a list of more general instructional technologies as indicators of whether classes have access to basic resources for science instruction and asked about availability in their randomly selected class. The three response options were:

- Not available;
- Available upon request; and
- Always available in your classroom.

The percentages of science classes with at least some availability of these resources (either in the classroom or upon request) are shown in Table 6.23. More than 80 percent of classes at all levels have access to balances. The availability of probes for collecting data increases with grade range, and microscopes are much more available in middle and high school classes than in elementary classes.

Table 6.23
Availability† of Instructional Technologies in Science Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Balances (e.g., pan, triple beam, digital scale)	80 (2.0)	96 (1.0)	97 (0.8)
Microscopes	56 (2.7)	93 (1.3)	94 (1.0)
Probes for collecting data (e.g., motion sensors, temperature probes)	39 (2.7)	68 (2.4)	81 (2.3)

† Includes only those teachers indicating the resource is always available in their classroom or available upon request.

Computer science teachers were asked a similar question.[21] Almost all high school computer science classes have access to projection devices (e.g., Smartboard, document camera, LCD projector), and more than half have access to robotics equipment (see Table 6.24). It is particularly interesting that only 40 percent of computer science classes have access to probes for collecting data but 81 percent of high school science classes do. Perhaps these two groups of teachers define the technology differently, or perhaps computer science teachers simply are not aware that the technology exists in the school.

Table 6.24
Availability† of Instructional Technologies in High School Computer Science Classes

	PERCENT OF CLASSES
Projection devices (e.g., Smartboard, document camera, LCD projector)	99 (0.5)
Robotics equipment	57 (3.3)
Probes for collecting data (e.g., motion sensors, temperature probes)	40 (3.9)

† Includes only those high school computer science teachers indicating the resource is always available in their classroom or available upon request.

Science teachers were also asked about the availability of laboratory facilities, using the same response options they used for instructional technologies. Electrical outlets and running water are widely available in all grade ranges (see Table 6.25). Fewer than a third of elementary classes have access to lab tables, but they are widespread in middle school and especially high school classrooms.

[21] The Mathematics Teacher Questionnaire did not include questions about instructional technologies.

Table 6.25
Availability† of Laboratory Facilities in Science Classes, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Electric outlets	93 (1.1)	98 (0.7)	98 (0.6)
Faucets and sinks	83 (2.0)	89 (1.5)	95 (0.9)
Lab tables	29 (3.1)	81 (2.0)	94 (1.1)
Gas for burners	n/a	n/a	85 (1.7)
Fume hoods	n/a	n/a	82 (1.8)

† Includes only those science teachers indicating the resource is either located in the classroom or available in another room.

The 2018 NSSME+ also asked science and mathematics program representatives how much money their schools spent during the most recently completed school 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 6.26). In science, per-pupil spending on equipment and supplies increases sharply from elementary school to high school, as does overall per-pupil spending. In mathematics, total per-pupil spending is substantially higher in elementary schools than in middle and high schools. Clearly, median per-pupil spending for software is the least of the three categories.

Table 6.26
Median Amount Schools Spent Per Pupil on Science and Mathematics Equipment, Consumable Supplies, and Software, by Grade Range

	MEDIAN AMOUNT		
	ELEMENTARY	MIDDLE	HIGH
Science			
Equipment	\$0.35 (0.1)	\$1.02 (0.2)	\$2.25 (0.3)
Consumable supplies	\$1.03 (0.2)	\$1.42 (0.2)	\$3.26 (0.3)
Software	\$0.00 ---†	\$0.00 ---†	\$0.00 ---†
Total	**\$1.98 (0.5)**	**\$3.27 (0.6)**	**\$6.88 (0.7)**
Mathematics			
Non-consumable items	\$0.92 (0.2)	\$0.80 (0.1)	\$0.93 (0.2)
Consumable supplies	\$1.46 (0.2)	\$0.97 (0.2)	\$0.56 (0.1)
Software	\$0.05 (0.4)‡	\$0.00 ---†	\$0.09 (0.2)‡
Total	**\$6.45 (1.1)**	**\$3.43 (0.5)**	**\$2.74 (0.4)**

† It was not possible to compute a standard error using either the Woodruff or the replication methods.
‡ 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.

Expenditures for science and mathematics are not distributed equally across all schools. For example, in science, schools with the lowest percentage of students who are eligible for free/reduced-price lunch spend considerably more per pupil on equipment and supplies than those with the highest percentage (see Table 6.27). Schools in the South spend considerably less than schools in the Northeast. In mathematics, the smallest schools spend more overall per pupil than the largest schools (see Table 6.28). Regional differences are also apparent, with schools in the Northeast spending the most overall per pupil.

Table 6.27
Equity Analyses of Median Amount Schools Spent Per Pupil on Science Equipment and Consumable Supplies

	MEDIAN AMOUNT		
	EQUIPMENT	CONSUMABLE SUPPLIES	TOTAL†
Percent of Students in School Eligible for FRL			
Lowest Quartile	$1.26 (0.3)	$2.24 (0.2)	$5.62 (0.8)
Second Quartile	$0.90 (0.2)	$1.59 (0.4)	$3.44 (0.7)
Third Quartile	$0.46 (0.3)	$1.14 (0.2)	$2.55 (0.6)
Highest Quartile	$0.42 (0.2)	$1.09 (0.2)	$2.05 (0.7)
School Size			
Smallest Schools	$0.90 (0.4)	$1.75 (0.4)	$4.61 (1.2)
Second Group	$0.98 (0.3)	$1.98 (0.3)	$3.62 (0.6)
Third Group	$0.66 (0.2)	$1.23 (0.2)	$2.48 (0.6)
Largest Schools	$0.65 (0.2)	$1.17 (0.2)	$2.34 (0.4)
Community Type			
Rural	$1.03 (0.2)	$1.85 (0.5)	$4.06 (0.7)
Suburban	$0.84 (0.2)	$1.49 (0.2)	$3.25 (0.5)
Urban	$0.48 (0.2)	$1.14 (0.3)	$2.06 (0.6)
Region			
Midwest	$1.06 (0.3)	$2.00 (0.6)	$4.41 (0.7)
Northeast	$1.41 (0.4)	$2.92 (0.7)	$6.62 (1.9)
South	$0.39 (0.1)	$1.06 (0.2)	$1.70 (0.3)
West	$0.98 (0.3)	$1.27 (0.3)	$3.11 (1.0)

† The "Total" column includes spending on software.

Table 6.28
Equity Analyses of Median Amount Schools Spent Per Pupil on Mathematics Equipment and Consumable Supplies

	MEDIAN AMOUNT		
	EQUIPMENT	CONSUMABLE SUPPLIES	TOTAL†
Percent of Students in School Eligible for FRL			
Lowest Quartile	\$0.68 (0.1)	\$1.10 (0.3)	\$4.20 (1.1)
Second Quartile	\$1.11 (0.2)	\$0.98 (0.4)	\$4.59 (1.2)
Third Quartile	\$1.03 (0.2)	\$1.13 (0.2)	\$4.87 (1.1)
Highest Quartile	\$1.16 (0.3)	\$0.95 (0.3)	\$5.38 (1.3)
School Size			
Smallest Schools	\$1.36 (0.3)	\$1.50 (0.5)	\$7.39 (1.5)
Second Group	\$0.93 (0.2)	\$0.79 (0.3)	\$4.79 (1.1)
Third Group	\$0.98 (0.2)	\$1.06 (0.3)	\$3.91 (0.9)
Largest Schools	\$0.76 (0.1)	\$0.75 (0.2)	\$3.85 (0.6)
Community Type			
Rural	\$0.98 (0.3)	\$0.69 (0.2)	\$4.68 (1.1)
Suburban	\$0.97 (0.2)	\$1.35 (0.2)	\$5.39 (0.8)
Urban	\$0.83 (0.3)	\$0.75 (0.3)	\$3.94 (1.0)
Region			
Midwest	\$0.95 (0.2)	\$0.86 (0.3)	\$4.22 (1.2)
Northeast	\$1.23 (0.6)	\$1.90 (0.5)	\$7.16 (1.4)
South	\$0.82 (0.2)	\$0.81 (0.2)	\$4.94 (0.8)
West	\$0.86 (0.2)	\$0.92 (0.2)	\$2.93 (1.1)

† 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 can be seen in Table 6.29, the overall pattern is that teachers of classes in the higher grade ranges are generally more likely than those in lower ones to rate the availability of resources as adequate. In elementary grades, teachers of fewer than half of classes rate the availability of resources as adequate, compared to two-thirds or more at the high school level.

Table 6.29
Adequacy† of Resources for Science Instruction, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Equipment (e.g., thermometers, magnifying glasses, microscopes, beakers, photogate timers, Bunsen burners)	39 (2.5)	58 (2.9)	73 (1.9)
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	38 (2.6)	62 (2.7)	72 (2.0)
Instructional technology (e.g., calculators, computers, probes/sensors)	49 (2.8)	57 (2.5)	70 (2.1)
Consumable supplies (e.g., chemicals, living organisms, batteries)	30 (2.8)	45 (2.7)	67 (2.1)

† Includes science teachers indicating 4 or 5 on a five-point scale ranging from 1 "not adequate" to 5 "adequate."

In mathematics, the patterns are much more varied (see Table 6.30). Teachers of high school classes are more likely than their elementary counterparts to rate the availability of instructional technology as adequate, but the pattern is reversed for manipulatives. These data suggest that substantial proportions of secondary mathematics teachers want to use manipulative materials but do not have adequate access to them. Ratings of the availability of measurement tools are similar, and high, across grade ranges.

Table 6.30
Adequacy† of Resources for Mathematics Instruction, by Grade Range

	PERCENT OF CLASSES		
	ELEMENTARY	MIDDLE	HIGH
Instructional technology (e.g., calculators, computers, probes/ sensors)	67 (2.0)	79 (2.3)	85 (1.6)
Measurement tools (e.g., protractors, rulers)	79 (1.7)	82 (2.1)	80 (1.6)
Consumable supplies (e.g., graphing paper, batteries)	65 (2.5)	75 (2.4)	77 (1.6)
Manipulatives (e.g., pattern blocks, algebra tiles)	87 (1.8)	63 (2.8)	51 (2.3)

† Includes mathematics teachers indicating 4 or 5 on a five-point scale ranging from 1 "not adequate" to 5 "adequate."

These items were combined into a composite variable named Adequacy of Resources for Instruction. As shown in Table 6.31, 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 aggregate view reflects other findings reported in this section, suggesting that science instruction in the earlier grades is under resourced from teachers' point of view.

Table 6.31
Class Mean Scores for the
Adequacy of Resources for Instruction Composite, by Subject

	MEAN SCORE	
	SCIENCE	MATHEMATICS
Elementary	52 (1.7)	80 (1.0)
Middle	65 (1.4)	80 (1.0)
High	76 (1.1)	78 (0.9)

In science, teachers of classes with mostly high-achieving students have the most positive views about their resources, compared to classes with average/mixed prior achievers and those with mostly low-achieving students (see Table 6.32). Similarly, teachers of classes with the lowest percentage of students from race/ethnicity groups historically underrepresented in STEM have more positive views than those with the highest percentage, as do teachers of classes with the lowest percentage of students eligible for free/reduced-price lunch, compared to those with the highest percentage. Mathematics teachers' views of the adequacy of their resources do not tend to differ substantially by various equity factors.

Table 6.32
Equity Analyses of Class Mean Scores for the Adequacy of Resources for Instruction Composite, by Subject

	MEAN SCORE	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	74 (1.6)	82 (1.0)
Average/Mixed	60 (1.1)	79 (0.8)
Mostly Low	54 (2.5)	76 (1.4)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	65 (1.7)	81 (1.0)
Second Quartile	64 (1.7)	82 (1.0)
Third Quartile	60 (1.4)	78 (1.2)
Highest Quartile	56 (2.9)	76 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	66 (2.1)	81 (1.1)
Second Quartile	63 (2.0)	81 (0.9)
Third Quartile	61 (2.8)	79 (1.2)
Highest Quartile	54 (1.6)	76 (1.2)

High school computer science teachers were asked how great a problem each of several factors presents in their instruction (see Table 6.33). Given the extent to which high school computer science classes rely on web-based instructional materials, it is perhaps not surprising that one of the most frequently cited problems is school restrictions on Internet content (37 percent of classes). Lack of support to maintain technology is a similarly prominent problem. It is also surprising that teachers in almost 1 in 5 classes rate lack of reliable Internet access as a problem given the ubiquity of Internet in schools.

Table 6.33
Factors Perceived as Problems† in High School Computer Science Classes

	PERCENT OF CLASSES
School restrictions on Internet content that is allowed	37 (4.3)
Lack of support to maintain technology (e.g., repair broken devices, install software)	34 (4.4)
Lack of functioning computing devices (e.g., desktop computers, laptop computers, tablets, smartphones)	27 (4.5)
Lack of reliable access to the Internet	19 (4.4)
Insufficient power sources for devices (e.g., electrical outlets, charging stations)	14 (3.1)

† Includes high school computer science teachers indicating "somewhat of a problem" or "serious problem" on a three-point scale from 1 "not a significant problem" to 3 "serious problem."

Summary

Analysis of data on the textbooks and equipment teachers use with their classes reveals a great deal about the learning environment experienced by grade K–12 students in 2018. The majority of science and mathematics classes have instructional materials designated for them, and the textbook is still the most commonly designated material. In contrast, only about one-fourth of high school computer science classes have designated materials, and among them, free, web-based resources are just as common as commercially published materials. Commercially published materials and materials developed by the state, county, or district play a prominent role in unit-level planning; however, at the lesson level, regardless of whether materials have been designated, teacher-created units and lessons heavily influence instruction, especially in middle school and high school.

Across both science and mathematics, the same three publishers—Pearson, McGraw-Hill, and Houghton Mifflin Harcourt—dominate, accounting for more than two-thirds of the market at each level. Science classes are more likely than mathematics classes to use older textbooks.

Commercially published materials and materials developed by the state or district exert substantial influence on instruction, from the frequency with which instruction is based on them to the ways teachers use them to plan for and organize instruction. At the same time, it is clear that teachers modify their published materials substantially, skipping parts of the text (often because teachers know of something better), supplementing with other materials (most often to provide additional practice or to differentiate instruction), and modifying them in other ways (often because teachers did not have enough time).

Computer and Internet resources, including school-wide Wi-Fi and computers or tablets for students, are widespread. However, the amount of money schools spend on instructional resources more broadly 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 considerably less than that spent in middle schools and especially in high schools. The lack of spending is likely 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. No such disparity by grade level exists in mathematics. Analyses of spending and resource adequacy by equity factors point to disparities, particularly in relation to the prior achievement level of students, the percentage of students from race/ethnicity groups historically underrepresented in STEM, and the percentage of students eligible for free/reduced-price lunch.

Factors Affecting Instruction

Overview

Students' opportunities to learn science, mathematics, and computer science 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 2018 NSSME+ 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; science, mathematics, and computer science course requirements; the extent of influence of state standards; and the extent of various problems that may affect 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 elementary self-contained classrooms, such as 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 elementary science specialists, either in place of, or in addition to, the regular classroom teacher, is uncommon (7–15 percent of schools). Pull-out science instruction, whether for remediation or enrichment, is also quite rare (8–10 percent of schools). The picture is quite different in elementary school mathematics instruction. Students are pulled out for mathematics remediation in more than 60 percent of schools, and in just over one-third of schools, students are pulled out for mathematics 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 are pulled out for remedial instruction in science/mathematics.	8 (1.7)	62 (3.0)
Students in self-contained classes are pulled out for enrichment in science/mathematics.	10 (1.8)	36 (2.8)
Students in self-contained classes are pulled out from science/mathematics instruction for additional instruction in other content areas.	28 (2.9)	25 (2.5)
Students in self-contained classes receive instruction from a district/diocese/school science/ mathematics specialist *in addition* to their regular teacher.	15 (2.1)	23 (2.4)
Students in self-contained classes receive instruction from a district/diocese/school science/ mathematics specialist *instead of* their regular teacher.	7 (1.8)	8 (1.7)
Students in self-contained classes receive science instruction on a regular basis from someone outside of the school/district/diocese (e.g., museum staff).	3 (1.2)	n/a

The study asked high schools about the prevalence of several possible course policies, specifically, block scheduling, single courses resulting in credit for multiple subjects, and allowing engineering courses to count toward students' science graduation requirement. 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. One main downside of block scheduling is that there is less total instructional time available for each class. As shown in Table 7.2, one-third of all high schools use block scheduling. Additionally, 1 in 5 high schools allow students to earn credits in multiple subjects with a single course, perhaps because of the increasing prominence of STEM initiatives in schools. Finally, 21 percent of the schools that offer engineering courses allow these courses to count toward students' graduation requirement for science.

Table 7.2
Prevalence of Various High School Course Policies

	PERCENT OF SCHOOLS
Block Schedule	**33 (2.4)**
Dual Credit Courses	**19 (2.4)**
Mathematics and science	9 (2.2)
Mathematics and computer science	4 (1.2)
Science and computer science	2 (1.1)
None of these combinations	8 (1.4)
Engineering Courses Count Toward Science Graduation Requirement†	**21 (2.6)**

† Includes only schools offering engineering courses.

The study also asked if high schools allow students to demonstrate mastery of course content without the normal seat time requirement by, for example, taking a test or performing a task. Results are shown in Table 7.3. About a quarter of all high schools allow for this in mathematics and science, while 10 percent of schools allow students to demonstrate computer science mastery for credit.

Table 7.3
Subjects for Which Students May Demonstrate Mastery of Course Content for Credit Without Normal Seat Time Requirement

	PERCENT OF SCHOOLS
Science	24 (2.5)
Mathematics	27 (2.4)
Computer Science	10 (1.6)

High school program representatives were asked how many years of science, mathematics, and computer science students are required to take in order to graduate. As can be seen in Table 7.4, the vast majority of high schools require at least three years of science and mathematics; more than half require four years of mathematics. For most schools, graduation requirements are just as demanding as state university entrance requirements.[22] However, when there is a difference,

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

graduation requirements tend to be more rigorous; 40 percent of high schools require more science and 32 percent require more mathematics courses for graduation than state universities do for entrance.

Table 7.4
High School Graduation vs. State University Entrance Requirements, by Subject

	PERCENT OF SCHOOLS	
	SCIENCE	MATHEMATICS
Graduation Requirement		
1 Year	0 (0.0)	0 (0.5)
2 Years	14 (2.5)	4 (1.2)
3 Years	66 (2.9)	44 (3.1)
4 Years	20 (2.2)	52 (3.2)
State University Entrance Requirement		
1 Year	2 (0.5)	0 ---†
2 Years	39 (3.0)	1 (0.5)
3 Years	56 (3.0)	76 (3.1)
4 Years	3 (0.8)	23 (3.1)
Difference		
2 Years Fewer Required for Graduation	0 ---†	0 (0.5)
1 Year Fewer Required for Graduation	4 (1.9)	8 (2.3)
No Difference	56 (2.6)	60 (3.1)
1 Year More Required for Graduation	29 (2.5)	32 (2.7)
2 Years More Required for Graduation	11 (0.6)	0 ---†
3 Years More Required for Graduation	0 (0.1)	0 ---†

† No schools in the sample were in this category. Thus, it is not possible to compute the standard error of this estimate.

In contrast, nearly three-quarters of schools do not require any computer science in order to graduate; almost all that do require one year or less (see Table 7.5). Additionally, program representatives were asked if computer science counts toward graduation requirements in any other subjects. As can be seen in Table 7.6, only a small percentage of high schools allow computer science to count toward graduation requirements in mathematics, science, or foreign language.

Table 7.5
High School Computer Science Graduation Requirements

	PERCENT OF SCHOOLS
0 Years	74 (3.1)
½ Year	8 (1.9)
1 Year	17 (2.9)
2–4 Years	1 (0.4)

Table 7.6
High School Computer Science Counting for Graduation Requirements in Other Subject Areas

	PERCENT OF SCHOOLS
Mathematics	15 (2.0)
Science	12 (2.0)
Foreign language	7 (2.0)

Finally, program representatives were asked to indicate which of several practices their school employs to enhance student interest and/or achievement in science, mathematics, and computer science. The results are shown in Tables 7.7–7.9. Especially in science, such programs tend to be more prevalent as grade range increases. For example, more than three-quarters of high schools offer after-school help in science and engineering, compared to about a third of elementary schools. Similarly, 47 percent of high schools have one or more teams participating in engineering competitions, whereas only 24 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 about one-third of high schools have mathematics clubs, and fewer than 20 percent of all schools participate in local or regional math fairs. Computer science enhancement programs are rare at all grade levels. With the exception of encouraging students to participate in computer science-based summer programs, the majority of all schools do not provide opportunities intended to promote interest and achievement in computer science. For example, 15 percent or fewer of all schools have teams participating in computer science competitions, coordinate internships in computer science, and participate in local or regional computer science fairs.

Table 7.7
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)	51 (2.9)	79 (2.9)
Encourages students to participate in science and/or engineering summer programs or camps (e.g., offered by community colleges, universities, museums, or science centers)	68 (2.8)	73 (2.9)	78 (3.3)
Coordinates visits to business, industry, and/or research sites related to science and/or engineering	39 (2.9)	45 (3.7)	55 (3.0)
Offers one or more science clubs	36 (3.2)	45 (3.7)	54 (3.5)
Has one or more teams participating in engineering competitions (e.g., Robotics)	24 (2.4)	35 (2.9)	47 (3.0)
Participates in a local or regional science and/or engineering fair	40 (2.8)	48 (3.2)	46 (3.6)
Has one or more teams participating in science competitions (e.g., Science Olympiad)	17 (2.0)	29 (2.9)	43 (3.0)
Coordinates meetings with adult mentors who work in science and/or engineering fields	26 (2.8)	34 (3.0)	39 (2.9)
Offers one or more engineering clubs	28 (2.5)	36 (2.9)	35 (2.6)
Offers formal after-school programs for enrichment in science and/or engineering	32 (2.7)	39 (2.9)	32 (2.5)
Coordinates internships in science and/or engineering fields	n/a	n/a	24 (2.4)
Holds family science and/or engineering nights	44 (3.0)	34 (3.0)	19 (2.3)

Table 7.8
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 (2.7)	79 (2.9)	85 (2.9)
Encourages students to participate in mathematics summer programs or camps (e.g., offered by community colleges, universities, museums or mathematics centers)	47 (2.9)	49 (2.9)	51 (3.1)
Has one or more teams participating in mathematics competitions (e.g., Math Counts)	27 (2.5)	37 (3.1)	43 (3.0)
Offers one or more mathematics clubs	20 (2.3)	29 (2.9)	36 (2.6)
Participates in a local or regional mathematics fair	16 (2.4)	19 (2.6)	19 (1.9)
Coordinates visits to business, industry, and/or research sites related to mathematics	17 (2.2)	14 (2.4)	19 (2.4)
Offers formal after-school programs for enrichment in mathematics	27 (2.8)	35 (3.1)	18 (1.8)
Coordinates meetings with adult mentors who work in mathematics fields	14 (2.0)	15 (2.2)	13 (2.0)
Holds family math nights	38 (2.8)	21 (2.6)	6 (1.2)
Coordinates internships in mathematics fields	n/a	n/a	6 (1.2)

Table 7.9
School Programs/Practices to Enhance Students' Interest and/or Achievement in Computer Science, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Encourages students to participate in computer science summer programs or camps offered by community colleges, universities, museums or computer science centers	38 (2.9)	44 (3.3)	51 (2.6)
Offers after-school help in computer science (e.g., tutoring)	14 (1.8)	20 (2.1)	31 (2.8)
Coordinates visits to business, industry, and/or research sites related to computer science	14 (2.3)	22 (2.8)	30 (3.0)
Offers one or more computer science clubs	22 (2.4)	25 (2.3)	29 (2.2)
Participates in Hour of Code	38 (2.8)	34 (2.8)	27 (2.6)
Coordinates meetings with adult mentors who work in computer science fields	14 (2.0)	18 (2.1)	22 (1.9)
Offers formal after-school programs for enrichment in computer science	21 (2.3)	21 (2.6)	15 (1.8)
Has one or more teams participating in computer science competitions (e.g., USA Computer Science Olympiad)	6 (1.3)	10 (1.5)	15 (1.6)
Coordinates internships in computer science fields	n/a	n/a	15 (1.7)
Participates in a local or regional computer science fair	11 (1.9)	13 (2.1)	12 (1.5)
Holds family computer science nights	15 (2.0)	8 (1.5)	5 (1.0)

Interestingly, these programs are not distributed equally across all types of schools. Some differences are particularly evident by percentage of students eligible for free/reduced-price lunch and school size. Large schools are more likely than small schools to offer many of these programs (see Table 7.10). For example, 45 percent of the largest schools offer opportunities for students to participate in engineering clubs, compared to only 19 percent of the smallest schools, and 53 percent of the largest schools have science clubs, compared to 27 percent of the smallest schools. Results are more varied when looking at these programs by the percentage of students in the school eligible for free/reduced-price lunch. Schools with the fewest students eligible for free/reduced-price lunch are more likely to offer enrichment programs (for example, 39 percent of schools in the lowest quartile have students participating in engineering clubs, compared to 26 percent of schools in the highest quartile). In contrast, 55 percent of schools in the highest quartile offer after-school help in science and/or engineering, compared to 39 percent of schools in the lowest quartile. Similar patterns exist to a lesser degree for schools' mathematics programs and practices (see Table 7.11) and computer science programs and practices (see Table 7.12).

Table 7.10
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Science/Engineering

	PERCENT OF SCHOOLS			
	PERCENT OF STUDENTS IN SCHOOL ELIGIBLE FOR FRL		SCHOOL SIZE	
	Lowest Quartile	Highest Quartile	Smallest Schools	Largest Schools
Encourage students to participate in summer programs/camps	70 (4.0)	70 (4.4)	68 (4.7)	71 (3.5)
Science clubs	47 (3.9)	38 (4.9)	27 (4.3)	53 (3.6)
After-school help	39 (3.6)	55 (4.4)	40 (5.6)	52 (3.3)
Participation in local or regional science/engineering fair	39 (4.3)	44 (4.8)	34 (5.1)	51 (3.3)
Visits to business, industry, and/or research sites	36 (3.9)	45 (5.4)	36 (4.8)	46 (3.7)
Family science and/or engineering nights	35 (3.9)	43 (4.9)	25 (4.9)	45 (3.6)
Participation in engineering competitions	36 (3.6)	25 (3.7)	20 (4.2)	45 (3.6)
Engineering clubs	39 (3.6)	26 (3.5)	19 (3.6)	45 (3.3)
After-school programs for enrichment	38 (4.5)	39 (4.2)	26 (4.5)	43 (3.0)
Meetings with mentors who work in science/engineering fields	26 (3.5)	28 (4.3)	24 (4.5)	34 (3.4)
Internships in science/engineering fields†	28 (4.8)	19 (4.3)	6 (3.1)	34 (3.6)
Participation in science competitions	25 (2.8)	20 (3.9)	13 (3.0)	32 (3.3)

† Includes only those schools with high school students.

Table 7.11
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Mathematics

	PERCENT OF SCHOOLS			
	PERCENT OF STUDENTS IN SCHOOL ELIGIBLE FOR FRL		SCHOOL SIZE	
	Lowest Quartile	Highest Quartile	Smallest Schools	Largest Schools
After-school help	65 (4.1)	81 (3.6)	67 (5.0)	76 (3.4)
Encourage students to participate in summer programs/camps	49 (4.2)	64 (4.2)	45 (5.5)	53 (3.3)
Participation in mathematics competitions	39 (4.3)	26 (3.7)	23 (4.5)	44 (3.6)
Mathematics clubs	30 (3.8)	24 (3.4)	13 (3.6)	41 (3.5)
Family math nights	20 (3.9)	45 (4.1)	23 (4.8)	34 (3.6)
After-school programs for enrichment	30 (3.8)	36 (4.1)	26 (5.2)	31 (3.5)
Participation in local or regional mathematics fair	20 (3.2)	19 (3.2)	8 (3.1)	24 (2.8)
Meetings with mentors who work in mathematics fields	11 (2.5)	22 (3.8)	14 (3.5)	18 (2.6)
Visits to business, industry, and/or research sites	16 (3.1)	23 (4.4)	16 (4.1)	15 (2.2)
Internships in mathematics fields†	11 (3.3)	7 (2.3)	4 (2.1)	9 (1.8)

† Includes only those schools with high school students.

Table 7.12
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Computer Science

	PERCENT OF SCHOOLS			
	PERCENT OF STUDENTS IN SCHOOL ELIGIBLE FOR FRL		SCHOOL SIZE	
	Lowest Quartile	Highest Quartile	Smallest Schools	Largest Schools
Participation in Hour of Code	46 (3.7)	30 (4.2)	23 (4.2)	51 (3.8)
Encourage students to participate in summer programs/camps	42 (3.9)	49 (4.5)	35 (5.5)	49 (2.8)
Computer science clubs	34 (3.5)	27 (3.7)	15 (4.3)	38 (3.0)
After-school help	21 (2.9)	24 (3.2)	20 (4.2)	25 (2.6)
After-school programs for enrichment	24 (3.8)	23 (4.1)	15 (3.9)	25 (2.7)
Visits to business, industry, and/or research sites	18 (3.0)	27 (4.1)	14 (4.3)	22 (2.4)
Internships in computer science fields†	15 (3.1)	17 (3.9)	6 (2.6)	21 (3.2)
Meetings with mentors who work in computer science fields	21 (2.8)	20 (4.1)	15 (3.3)	17 (2.0)
Participation in local or regional computer science fair	11 (2.6)	15 (3.0)	8 (2.9)	16 (2.3)
Participation in computer science competitions	11 (2.4)	7 (2.0)	5 (2.0)	14 (1.9)
Family computer science nights	9 (2.6)	20 (3.9)	11 (3.5)	12 (2.1)

† Includes only those schools with high school students.

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 Table 7.13. It is clear that state standards have a major influence at the school level. For example, 79 percent or more of program representatives agree that teachers in the school teach to science and mathematics standards. Similarly, a large majority of representatives agree that science and mathematics standards have been thoroughly discussed by teachers in the school and that there is a school-wide effort to align instruction to standards. Both practices are especially prevalent in mathematics, with 83–90 percent of representatives agreeing across the grade levels. It is somewhat surprising that only about half of high schools are in districts that organize professional development based on science and mathematics standards.

Table 7.13
Influence† of State Science and Mathematics Standards in Schools, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Science			
Most science teachers in this school teach to the state standards.	79 (2.6)	84 (2.5)	84 (2.7)
There is a school-wide effort to align science instruction with the state science standards.	71 (2.8)	79 (3.1)	78 (3.2)
State science standards have been thoroughly discussed by science teachers in this school.	65 (3.1)	76 (3.1)	78 (3.0)
The school/district/diocese organizes science professional development based on state standards.	54 (3.2)	61 (3.0)	57 (3.4)
Mathematics			
Most mathematics teachers in this school teach to the state standards.	93 (1.5)	93 (1.8)	87 (2.3)
There is a school-wide effort to align mathematics instruction with the state mathematics standards.	90 (1.7)	90 (2.2)	87 (2.1)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.	87 (2.4)	87 (2.7)	83 (2.9)
The school/district/diocese organizes mathematics professional development based on state standards.	73 (2.6)	67 (3.2)	53 (3.2)

† Includes schools indicating “strongly agree” or “agree” on a five-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 7.14, attention to standards is generally greater in mathematics than in science, particularly in elementary and middle schools. The greater weight given to mathematics in school accountability probably contributes to these results. In addition, high schools’ attention to state mathematics standards may be lower than elementary and middle schools’ because they are only held accountable in a few mathematics subjects.

Table 7.14
School Mean Scores for the Focus on State Standards Composite, by Subject

	MEAN SCORE	
	SCIENCE	MATHEMATICS
Elementary	66 (1.6)	81 (1.2)
Middle	73 (1.6)	81 (1.5)
High	73 (1.4)	75 (1.6)

Factors That Promote and Inhibit Instruction

Program representatives were asked about a number of factors that might affect science and mathematics instruction in their school. Schools were asked whether teachers travel among different classrooms, for example, using rooms available during other teachers’ planning periods, due to a shortage of classrooms within the school.[23] Table 7.15 displays the percentage of schools at each grade level that employ this strategy. High schools are the most likely to have

[23] Dubois, S. L., & Luft, J. A. (2014). Science teachers without classrooms of their own: A study of the phenomenon of floating. *Journal of Science Teacher Education*, *25*(1), 5-23.

teachers travel among classrooms (39 percent). Schools were also asked whether first-year teachers were purposefully given a classroom of their own. Fewer than 10 percent of all schools, including those that currently do not have teachers traveling, have policies in place to ensure first-year teachers do not have to travel among classrooms.

Table 7.15
School Policies Related to Teachers Traveling Among Rooms Due to a Shortage of Classrooms, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Teachers currently traveling among classrooms	16 (2.3)	24 (2.5)	39 (2.6)
Policy that first-year teachers do not travel among classrooms	6 (1.6)	9 (2.1)	8 (1.6)

Program representatives were also given a list of factors and asked to indicate their influence on science and mathematics instruction. Results for science instruction are presented in Table 7.16, and those for mathematics instruction are in Table 7.17. As there is little variation by grade range, the results are presented for schools overall. Two factors are perceived by a majority of schools as promoting effective science instruction: school/district science professional development policies and practices and the importance that the school places on science. Additionally, fewer than one-fourth of schools see either of these factors as inhibiting science instruction.

Table 7.16
Effect† of Various Factors on Science Instruction

	PERCENT OF SCHOOLS		
	INHIBITS	NEUTRAL	PROMOTES
The school/district/diocese science professional development policies and practices	14 (1.6)	34 (2.1)	52 (2.4)
The importance that the school places on science	21 (1.9)	27 (2.2)	51 (2.5)
How science instructional resources are managed (e.g., distributing and refurbishing materials)	22 (1.8)	30 (2.1)	49 (2.5)
The amount of time provided by the school/district/diocese for teacher professional development in science	32 (2.3)	32 (2.4)	36 (2.2)
The amount of time provided by the school/district/diocese for teachers to share ideas about science instruction	35 (2.3)	29 (1.9)	36 (2.2)
Other school and/or district/diocese initiatives	23 (2.1)	42 (1.9)	35 (2.3)

† Schools rated the effect of each factor on a five-point scale ranging from 1 “inhibits effective instruction” to 5 “promotes effective instruction.” The “Inhibits” column includes those indicating 1 or 2. The “Promotes” column includes those indicating 4 or 5.

The climate for mathematics instruction seems generally more supportive than that for science. For example, 78 percent of schools indicate that the importance the school places on the subject promotes effective mathematics instruction (compared to 51 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 than science instruction.

Table 7.17
Effect† of Various Factors on Mathematics Instruction

	PERCENT OF SCHOOLS		
	INHIBITS	NEUTRAL	PROMOTES
The importance that the school places on mathematics	7 (1.0)	15 (1.6)	78 (1.7)
The school/district/diocese mathematics professional development policies and practices	7 (1.0)	28 (2.0)	66 (2.3)
How mathematics instructional resources are managed (e.g., distributing and replacing materials)	13 (1.5)	28 (2.0)	59 (2.2)
The amount of time provided by the school/district/diocese for teacher professional development in mathematics	17 (1.7)	30 (2.2)	52 (2.4)
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction	20 (1.8)	28 (2.1)	52 (2.1)
Other school and/or district/diocese initiatives	10 (1.2)	44 (2.0)	46 (2.1)

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

These items were combined into a composite variable in order to look at the effects of the factors on science and mathematics instruction more holistically. As Table 7.18 displays, elementary schools generally provide a less supportive context for science instruction than middle or high schools. In addition, elementary and middle schools tend to be more supportive for mathematics teaching than science teaching.

Table 7.18
School Mean Scores for the Supportive Context for Science/Mathematics Instruction Composites, by Subject

	MEAN SCORE	
	SCIENCE	MATHEMATICS
Elementary	54 (1.5)	68 (1.3)
Middle	59 (1.5)	66 (1.3)
High	61 (1.4)	63 (1.2)

Program representatives were also asked to rate whether each of several factors is a problem for instruction in their school. In science, low student prior knowledge and skills is perceived as a problem across grade levels (64–75 percent of schools), particularly high school, as can be seen in Table 7.19. Inadequate science-related professional development opportunities is perceived as a problem by 61–76 percent of the schools, inadequate materials for differentiating instruction by 54–67 percent, and inadequate funds for purchasing science equipment and supplies by 54–62 percent. In high schools, low student interest is seen as a problem by 61 percent of schools, compared to 44 percent of middle schools and 29 percent of elementary schools. Lack of teacher interest in science is more likely to be seen as a problem in elementary schools (46 percent) than in high schools (13 percent).

Table 7.19
Science Program Representatives Viewing Each of a Number of Factors as a Problem† for Science Instruction in Their School, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Low student prior knowledge and skills	64 (2.5)	64 (3.2)	75 (3.0)
Lack of parent/guardian support and involvement	45 (2.8)	51 (2.5)	63 (3.0)
Inadequate science-related professional development opportunities	76 (2.5)	64 (3.3)	61 (3.5)
Low student interest in science	29 (2.7)	44 (3.0)	61 (3.3)
High student absenteeism	33 (2.3)	39 (2.8)	56 (3.5)
Inadequate funds for purchasing science equipment and supplies	62 (2.7)	60 (3.2)	54 (2.9)
Inadequate materials for differentiating science instruction	67 (2.6)	59 (3.4)	54 (3.0)
Large class sizes	42 (2.7)	46 (2.6)	46 (3.3)
Insufficient instructional time to teach science	71 (2.9)	50 (3.3)	45 (3.5)
Poor quality of science textbooks/modules	49 (2.6)	48 (2.9)	44 (3.2)
Inappropriate student behavior	43 (2.4)	46 (2.4)	42 (3.7)
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)	58 (3.1)	53 (3.0)	41 (3.4)
Lack of science textbooks/modules	46 (2.7)	43 (3.5)	37 (3.2)
High teacher turnover	31 (2.8)	36 (3.0)	37 (3.2)
Inadequate teacher preparation to teach science	59 (2.7)	39 (3.0)	27 (3.5)
Community resistance to the teaching of "controversial" issues in science (e.g., evolution, climate change)	16 (2.3)	19 (2.8)	21 (3.1)
Lack of teacher interest in science	46 (2.8)	25 (3.3)	13 (2.7)

† Includes schools indicating "somewhat of a problem" or "serious problem" on a three-point scale from 1 "not a significant problem" to 3 "serious problem."

In mathematics, three factors are seen as a problem in a substantial proportion of schools: low student interest in the subject, low student prior knowledge and skills, and lack of parent/guardian support and involvement (see Table 7.20). Low student interest and low student prior knowledge are both more likely to be seen as problems in high schools than in elementary schools.

Table 7.20
Mathematics Program Representatives Viewing Each of a Number of Factors as a Problem† for Mathematics Instruction in Their School, by Grade Range

	PERCENT OF SCHOOLS		
	ELEMENTARY	MIDDLE	HIGH
Low student prior knowledge and skills	71 (2.8)	77 (3.0)	87 (1.5)
Low student interest in mathematics	56 (3.5)	67 (3.9)	82 (2.2)
Lack of parent/guardian support and involvement	60 (3.0)	63 (3.7)	67 (2.8)
High student absenteeism	44 (2.9)	51 (3.4)	59 (3.0)
Inadequate mathematics-related professional development opportunities	52 (3.0)	51 (3.5)	53 (3.1)
Inadequate materials for differentiating mathematics instruction	54 (3.0)	53 (3.0)	50 (2.8)
Community attitudes toward mathematics instruction	37 (3.0)	43 (3.4)	49 (3.3)
Inappropriate student behavior	46 (2.8)	51 (3.1)	46 (2.9)
Inadequate funds for purchasing mathematics equipment and supplies	35 (2.4)	43 (3.5)	45 (3.2)
Insufficient instructional time to teach mathematics	36 (3.0)	36 (3.0)	44 (3.3)
Large class sizes	35 (3.3)	38 (2.9)	41 (3.2)
Poor quality mathematics textbooks	27 (2.5)	28 (2.7)	40 (3.2)
Lack of equipment and supplies and/or manipulatives for teaching mathematics (e.g., materials for students to draw, cut, and build in order to make sense of problems)	26 (3.0)	34 (3.5)	39 (3.5)
High teacher turnover	29 (2.8)	34 (3.1)	38 (3.1)
Lack of mathematics textbooks	17 (2.3)	19 (2.7)	29 (3.0)
Inadequate teacher preparation to teach mathematics	39 (3.2)	29 (3.2)	19 (2.6)
Lack of teacher interest in mathematics	25 (2.8)	19 (2.7)	15 (2.4)

† Includes schools indicating "somewhat of a problem" or "serious problem" on a three-point scale from 1 "not a significant problem" to 3 "serious problem."

Composite variables created from these items allow for a summary of the factors affecting science and mathematics instruction. One striking difference is that the extent to which student issues are seen as problematic is more pronounced in mathematics instruction compared to science instruction (see Table 7.21). Some differences across grade ranges are also apparent, particularly in science. Specifically, lack of resources and teacher-related issues are more notable at the elementary level than at the high school level.

Table 7.21
School Mean Scores for Factors Affecting Instruction Composites, by Grade Range

	MEAN SCORE		
	ELEMENTARY	MIDDLE	HIGH
Science			
Extent to Which Student Issues are Problematic	24 (1.0)	28 (1.3)	33 (1.6)
Extent to Which a Lack of Resources is Problematic	37 (1.5)	34 (1.6)	29 (1.8)
Extent to Which Teacher Issues are Problematic	42 (1.5)	28 (1.7)	22 (1.6)
Mathematics			
Extent to Which Student Issues are Problematic	33 (1.6)	39 (1.9)	43 (1.5)
Extent to Which a Lack of Resources is Problematic	19 (1.1)	21 (1.5)	24 (1.6)
Extent to Which Teacher Issues are Problematic	22 (1.4)	19 (1.4)	19 (1.3)

When disaggregated by the percentage of students eligible for free/reduced-price lunch, some differences in composite means emerge (see Table 7.22). 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 both science and mathematics by the percentage of students eligible for free/reduced-price lunch (ranging from 16 for the lowest quartile to 38 for the highest in science, and from 23 to 48 in mathematics). Though not as pronounced, similar gaps are seen in science for the Extent to Which a Lack of Resources is Problematic composite, which includes items about a lack of equipment and textbooks, and the Extent to Which Teacher Issues are Problematic composite, which includes items about teacher interest in the subject and teacher preparation to teach the subject.

Table 7.22
Equity Analyses of School Mean Scores for Factors Affecting Instruction Composites by Percentage of Students in School Eligible for Free/Reduced-Price Lunch

	MEAN SCORE		
	EXTENT TO WHICH A LACK OF RESOURCES IS PROBLEMATIC	EXTENT TO WHICH STUDENT ISSUES ARE PROBLEMATIC	EXTENT TO WHICH TEACHER ISSUES ARE PROBLEMATIC
Science			
Lowest Quartile	32 (2.5)	16 (1.5)	33 (2.1)
Second Quartile	31 (2.3)	24 (1.6)	30 (2.2)
Third Quartile	38 (2.8)	33 (1.8)	35 (2.3)
Highest Quartile	40 (2.1)	38 (2.1)	41 (2.5)
Mathematics			
Lowest Quartile	20 (1.5)	23 (2.1)	21 (2.0)
Second Quartile	18 (1.8)	32 (2.3)	18 (1.9)
Third Quartile	20 (1.7)	46 (1.9)	20 (1.6)
Highest Quartile	26 (2.3)	48 (2.3)	25 (2.0)

Teachers were asked about factors that affect instruction in their randomly selected class. Elementary science teacher results are shown in Table 7.23. Similar to findings from the program questionnaires, teachers indicate that students' motivation, interest, and effort in science tend to promote science instruction in elementary classes (75 percent). However, instructional time available for science instruction is seen as one of the biggest inhibitors of science instruction (28 percent).

Table 7.23
Effect† of Various Factors on Instruction in Elementary Science Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Students' motivation, interest, and effort in science	9 (1.6)	16 (1.8)	75 (2.2)
Principal support	6 (1.4)	29 (2.3)	65 (2.5)
Current state standards	5 (1.0)	31 (2.2)	64 (2.3)
Students' prior knowledge and skills	15 (2.0)	25 (2.0)	60 (2.3)
Amount of time for you to plan, individually and with colleagues	21 (1.8)	22 (2.3)	57 (2.8)
Pacing guides	11 (1.5)	34 (2.5)	55 (2.7)
Amount of instructional time devoted to science	28 (2.3)	22 (2.4)	49 (2.7)
Amount of time available for your professional development	26 (1.8)	30 (2.3)	44 (2.7)
Teacher evaluation policies	14 (1.7)	48 (2.8)	38 (3.1)
Parent/guardian expectations and involvement	18 (1.8)	45 (2.0)	37 (2.3)
State/district/diocese testing/accountability policies‡	19 (2.0)	45 (2.6)	36 (2.5)
Textbook/module selection policies	26 (2.9)	42 (3.2)	32 (2.5)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

In middle school science classes, principal support, current state standards, and the amount of time provided to plan individually and with colleagues are seen as promoting effective instruction in two-thirds or more of classes (see Table 7.24). Conversely, teachers of about a quarter of middle school science classes see students' prior knowledge and skills, parent/guardian expectations and involvement, and state/district testing/accountability policies as inhibiting science instruction.

Table 7.24
Effect† of Various Factors on Instruction in Middle School Science Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Principal support	10 (2.1)	19 (1.9)	71 (2.5)
Current state standards	8 (1.7)	25 (2.3)	68 (2.5)
Amount of time for you to plan, individually and with colleagues	20 (2.5)	14 (1.5)	66 (2.6)
Students' motivation, interest, and effort in science	24 (1.9)	18 (1.8)	58 (2.4)
Students' prior knowledge and skills	27 (2.4)	19 (1.5)	55 (2.5)
Pacing guides	11 (1.7)	35 (2.9)	54 (2.8)
Amount of time available for your professional development	20 (2.4)	29 (2.6)	51 (2.8)
Teacher evaluation policies	15 (1.7)	44 (2.5)	40 (2.7)
Parent/guardian expectations and involvement	27 (2.4)	33 (2.3)	40 (2.4)
Textbook/module selection policies	20 (2.6)	43 (2.8)	37 (2.8)
State/district/diocese testing/accountability policies‡	27 (2.9)	39 (2.6)	35 (2.8)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

Similar to middle school classes, the amount of time for teachers to plan individually and with colleagues, as well as principal support, are both seen as promoting science instruction in two-thirds or more of high school science classes (see Table 7.25). State testing/accountability policies are seen as inhibiting science instruction in one-fourth of high school science classes. In addition, high school teachers were asked how college entrance requirements affect science instruction. In about half of classes, teachers see these requirements as promoting effective instruction; in only 4 percent of high school science classes do teachers consider them as inhibiting instruction.

Table 7.25
Effect† of Various Factors on Instruction in High School Science Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Amount of time for you to plan, individually and with colleagues	15 (1.6)	17 (1.7)	69 (2.2)
Principal support	7 (1.2)	27 (1.8)	66 (1.9)
Students' motivation, interest, and effort in science	21 (1.5)	19 (1.8)	60 (1.9)
Students' prior knowledge and skills	20 (1.5)	21 (2.4)	59 (2.2)
Current state standards	8 (0.9)	37 (1.9)	55 (2.2)
College entrance requirements	4 (0.9)	43 (2.1)	53 (2.1)
Amount of time available for your professional development	20 (1.7)	28 (1.6)	52 (2.2)
Pacing guides	11 (1.5)	41 (2.4)	48 (2.3)
Parent/guardian expectations and involvement	18 (1.2)	39 (2.5)	43 (2.6)
Teacher evaluation policies	13 (1.3)	44 (2.0)	42 (2.3)
Textbook/module selection policies	15 (1.5)	47 (2.3)	38 (2.5)
State/district/diocese testing/accountability policies‡	25 (1.9)	46 (2.2)	29 (1.8)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

Table 7.26 displays the results for elementary mathematics. In stark contrast to the results about time available for elementary science instruction, the amount of time available for elementary mathematics instruction was rated as the greatest promoter of effective instruction. Students' motivation, interest, and effort in mathematics, as well as their prior knowledge and skills, are seen as promoting mathematics instruction in 70 percent or more elementary classes.

Table 7.26
Effect† of Various Factors on
Instruction in Elementary Mathematics Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Amount of instructional time devoted to mathematics	5 (0.9)	12 (1.5)	84 (1.8)
Current state standards	4 (0.9)	17 (1.8)	79 (1.9)
Principal support	5 (1.1)	17 (1.7)	78 (2.0)
Amount of time for you to plan, individually and with colleagues	14 (1.9)	16 (1.7)	71 (2.3)
Students' motivation, interest, and effort in mathematics	14 (1.7)	15 (1.9)	71 (2.2)
Students' prior knowledge and skills	14 (1.8)	16 (1.8)	70 (2.3)
District/Diocese/School pacing guides	13 (1.7)	21 (1.9)	65 (2.0)
Amount of time available for your professional development	16 (1.6`)	25 (2.0)	59 (2.3)
Parent/guardian expectations and involvement	23 (1.9)	24 (1.8)	53 (2.1)
Teacher evaluation policies	11 (1.6)	40 (2.2)	49 (2.6)
State/district/diocese testing/accountability policies‡	21 (2.1)	34 (2.7)	44 (2.2)
Textbook selection policies	18 (2.2)	39 (2.5)	42 (2.3)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

As in middle school science, principal support, amount of time for planning, and current state standards are all seen as the top factors for promoting instruction in middle school mathematics classes (see Table 7.27). Students' motivation, interest, and effort in mathematics as well as parent/guardian expectations and involvement are seen as inhibiting instruction in more than a quarter of middle school mathematics classes.

Table 7.27
Effect† of Various Factors on
Instruction in Middle School Mathematics Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Principal support	5 (1.4)	21 (1.8)	74 (2.2)
Amount of time for you to plan, individually and with colleagues	12 (1.6)	16 (2.0)	73 (2.2)
Current state standards	6 (1.0)	24 (2.8)	69 (2.9)
District/Diocese/School pacing guides	10 (1.7)	30 (2.7)	60 (2.9)
Students' prior knowledge and skills	27 (2.3)	15 (1.6)	58 (2.6)
Students' motivation, interest, and effort in mathematics	28 (2.5)	16 (1.8)	55 (2.6)
Amount of time available for your professional development	14 (2.1)	32 (2.9)	54 (2.9)
Parent/guardian expectations and involvement	27 (2.3)	28 (2.0)	45 (2.2)
Teacher evaluation policies	13 (1.6)	43 (2.6)	43 (2.6)
State/district/diocese testing/accountability policies‡	25 (2.6)	35 (3.0)	40 (3.0)
Textbook selection policies	23 (2.6)	44 (3.1)	33 (2.7)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

Table 7.28 shows that in high school mathematics, principal support and the amount of time for planning promote effective instruction in more than two-thirds of classes. Like with middle school mathematics, students' motivation, interest, and effort in mathematics are the biggest inhibitors of instruction in high school mathematics classes. College entrance requirements are seen as promoting or have a neutral effect on high school mathematics instruction in nearly all classes.

Table 7.28
Effect† of Various Factors on Instruction in High School Mathematics Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Principal support	6 (1.0)	23 (2.0)	70 (2.0)
Amount of time for you to plan, individually and with colleagues	14 (1.4)	18 (1.4)	69 (1.6)
Current state standards	8 (1.0)	31 (1.6)	62 (1.6)
College entrance requirements	5 (0.8)	35 (2.3)	60 (2.3)
District/Diocese/School pacing guides	10 (1.5)	31 (1.8)	59 (2.0)
Students' prior knowledge and skills	27 (2.1)	16 (1.4)	57 (2.1)
Amount of time available for your professional development	16 (1.6)	30 (1.8)	55 (2.0)
Students' motivation, interest, and effort in mathematics	30 (1.7)	18 (1.6)	52 (1.8)
Teacher evaluation policies	12 (1.1)	40 (2.3)	47 (2.3)
Textbook selection policies	16 (1.7)	41 (2.3)	43 (2.2)
Parent/guardian expectations and involvement	24 (1.8)	36 (1.9)	40 (1.9)
State/district/diocese testing/accountability policies‡	22 (2.0)	39 (2.4)	39 (1.9)

† Teachers rated the effect of each factor on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction." The "Inhibits" column includes those indicating 1 or 2. The "Promotes" column includes those indicating 4 or 5.
‡ This item was presented only to teachers in public and Catholic schools.

Table 7.29 displays the results for high school computer science. Unlike high school science and mathematics, students' motivation, interest, and effort in computer science are seen by teachers in the large majority of classes as promoting effective instruction. Principal support, time to plan, and the amount of time for professional development are also seen as promoters of effective instruction in two-thirds or more of classes. Current state standards and textbook selection policies have a neutral or mixed effect on computer science instruction in approximately half of the classes, likely because these standards and policies are absent from most schools.

Table 7.29
Effect† of Various Factors on
Instruction in High School Computer Science Classes

	PERCENT OF CLASSES		
	INHIBITS	NEUTRAL	PROMOTES
Principal support	3 (1.1)	18 (2.7)	79 (2.9)
Students' motivation, interest, and effort in computer science	10 (2.6)	14 (3.3)	76 (4.0)
Amount of time for you to plan, individually and with colleagues	11 (2.1)	19 (3.6)	70 (3.8)
Amount of time available for your professional development	12 (2.3)	21 (3.5)	67 (3.8)
Students' prior knowledge and skills	15 (3.1)	25 (3.5)	60 (4.0)
College entrance requirements	5 (1.3)	49 (4.7)	47 (4.9)
Teacher evaluation policies	9 (2.0)	46 (4.9)	45 (5.0)
Parent/guardian expectations and involvement	9 (2.1)	48 (3.9)	43 (4.1)
Current state standards	11 (2.6)	49 (4.5)	40 (4.7)
Textbook selection policies	13 (2.5)	60 (4.9)	27 (4.5)

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

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 7.30. Several patterns are apparent in the results. The extent to which the policy environment promotes effective instruction is about the same across grade levels in science. Similarly, the extent to which school support promotes effective instruction varies little across grade levels in mathematics. In addition, stakeholders are seen to be the most supportive in the elementary grades for both science and mathematics. Finally, in high school computer science, school and stakeholder support is generally high (mean scores of 74 and 70, respectively) compared with the policy environment (mean score of 59).

Table 7.30
Class Mean Scores for Factors
Affecting Instruction Composites, by Grade Range

	MEAN SCORE		
	ELEMENTARY	MIDDLE	HIGH
Science			
Extent to Which School Support Promotes Effective Instruction	62 (1.6)	67 (2.0)	69 (1.5)
Extent to Which Stakeholders Promote Effective Instruction	68 (1.4)	60 (1.6)	64 (1.0)
Extent to Which the Policy Environment Promotes Effective Instruction	62 (1.0)	63 (1.1)	61 (0.8)
Mathematics			
Extent to Which School Support Promotes Effective Instruction	72 (1.4)	71 (1.4)	69 (1.0)
Extent to Which Stakeholders Promote Effective Instruction	71 (1.2)	60 (1.7)	60 (1.2)
Extent to Which the Policy Environment Promotes Effective Instruction	68 (1.0)	63 (1.2)	64 (0.9)
Computer Science			
Extent to Which School Support Promotes Effective Instruction	n/a	n/a	74 (1.9)
Extent to Which Stakeholders Promote Effective Instruction	n/a	n/a	70 (1.7)
Extent to Which the Policy Environment Promotes Effective Instruction	n/a	n/a	59 (2.1)

The means for some of these factors vary substantially by equity factors. As can be seen in Tables 7.31–7.33, the mean for the stakeholder composite is substantially higher when classes are composed of mostly high-achieving students, compared to classes with mostly low-achieving students in both science and mathematics. There is also a large gap for this variable in both subjects 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. These patterns do not tend to exist in computer science, perhaps because far fewer schools offer computer science programs.

Table 7.31
Equity Analyses of Class Mean Scores for Factors Affecting Science Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	63 (1.2)	73 (1.3)	72 (1.9)
Average/Mixed	63 (0.8)	66 (0.9)	65 (1.2)
Mostly Low	58 (1.4)	52 (2.9)	58 (3.1)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	62 (1.4)	68 (1.1)	64 (1.8)
Second Quartile	61 (1.2)	68 (1.5)	64 (2.0)
Third Quartile	63 (1.3)	65 (1.9)	66 (2.1)
Highest Quartile	61 (1.5)	61 (2.6)	66 (2.6)
Percent of Students in School Eligible for FRL			
Lowest Quartile	63 (1.2)	71 (1.4)	68 (1.8)
Second Quartile	62 (1.4)	68 (1.2)	63 (1.9)
Third Quartile	62 (1.3)	63 (1.4)	63 (1.5)
Highest Quartile	60 (1.2)	60 (2.4)	65 (2.6)

Table 7.32
Equity Analyses of Class Mean Scores for Factors Affecting Mathematics Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	66 (1.6)	71 (2.1)	71 (1.9)
Average/Mixed	67 (0.8)	67 (1.0)	71 (1.0)
Mostly Low	62 (1.4)	55 (2.2)	69 (2.1)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	67 (1.2)	69 (1.6)	70 (1.6)
Second Quartile	67 (1.0)	69 (1.4)	71 (1.6)
Third Quartile	64 (1.4)	65 (1.7)	71 (1.8)
Highest Quartile	64 (1.5)	59 (2.1)	71 (1.7)
Percent of Students in School Eligible for FRL			
Lowest Quartile	66 (1.0)	72 (1.4)	72 (1.7)
Second Quartile	65 (1.2)	66 (1.4)	71 (1.0)
Third Quartile	66 (1.2)	63 (1.5)	70 (1.6)
Highest Quartile	65 (1.3)	60 (1.7)	71 (1.5)

Table 7.33
Equity Analyses of Class Mean Scores for Factors Affecting Computer Science Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	57 (2.4)	73 (2.0)	71 (2.9)
Average/Mixed	59 (3.0)	68 (2.2)	75 (2.3)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	56 (3.7)	67 (3.7)	64 (4.6)
Second Quartile	52 (4.8)	68 (3.1)	79 (3.9)
Third Quartile	56 (3.3)	67 (3.6)	75 (3.8)
Highest Quartile	66 (3.8)	75 (3.0)	76 (4.3)
Percent of Students in School Eligible for FRL			
Lowest Quartile	53 (2.9)	69 (2.6)	70 (2.5)
Second Quartile	58 (3.2)	69 (2.8)	75 (4.3)
Third Quartile	63 (2.9)	68 (5.4)	79 (4.6)
Highest Quartile	66 (6.6)	74 (4.4)	75 (4.1)

Summary

The 2018 NSSME+ data indicate 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, fewer than 20 percent of schools have students compete in mathematics competitions. Such practices are more common in science and engineering and tend to be more prevalent in higher grades. All schools tend to offer more enhancement opportunities in science and mathematics than computer science. Further, in all three subjects, the opportunities are not distributed evenly across types of schools, as they are more likely to occur in large schools than small ones. There are also differences in opportunities related to the percentage of students in schools eligible for free/reduced-prince lunch, with similar patterns within science, mathematics, and computer science. For example, opportunities such as after-school help, family nights, and visits to industry are more prevalent in schools with a high percentage of eligible students, whereas subject-specific clubs and opportunities to participate in academic competitions are more likely to be available in schools with a low percentage of eligible students.

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

Overall, the climate for mathematics instruction is generally seen as more supportive than that for science. For example, in 78 percent of schools, the importance that the school places on mathematics is seen as supporting instruction, compared to only 51 percent of schools for science. Lack of time and materials for science instruction, especially in the elementary grades, is particularly problematic. Programs to support students in computer science are relatively uncommon, with only 26 percent of high schools requiring any amount of computer science for graduation and fewer than one-third of all schools offering programs or practices to enhance interest in computer science beyond encouraging students to participate in camps.

Sampling and Weighting for 2018 NSSME+

Sampling

Weighting and Variances

Sampling and Weighting for 2018 NSSME+

Sampling

The 2018 NSSME+ used a stratified two-stage probability sample of science, mathematics, and computer science teachers in grades K–12 in the United States. At the first stage, 2,000 elementary and secondary schools were selected within strata with probability proportional to size (PPS). Although the final sampling plan projected 1,200 schools to participate in the survey, about 1,300 participated (65 percent response rate). At the second stage, approximately 10,000 science and mathematics teachers were sampled at predetermined rates to ensure a sufficient sample size for domain estimates, such as region or community type. Computer science teachers were sampled with certainty to allow for national estimates, as their prevalence in secondary schools is much lower than science and mathematics teachers. About 7,000 teachers were projected to complete the survey (70 percent response rate).

School Sampling Frame

The target population for the school sample includes all regular public and private schools in the 50 states and the District of Columbia. The school sampling frame was created from the final 2014–15 Common Core of Data (CCD) and the 2011–12 Private School Survey (PSS) public use file. The following types of school were excluded from the frame:

- Schools in Puerto Rico and the territories;
- Schools run by the Department of Defense;
- Schools run by the Bureau of Indian Education;
- Schools that are special education, vocational, technical, alternative, adult, career, virtual schools, or early childhood/child care centers;
- Schools that were closed or not yet open;
- Schools that are ungraded; and
- Schools that offer only Pre–K.

School Stratification

Schools on the frame were stratified by three primary strata using the CCD and PSS information on grade span: (1) school has any of grades 10–12, (2) school does not have any of grades 10–12 and has no grade lower than 5, and (3) all other schools. Within primary strata, schools were further stratified by Census region (Northeast, North Central, South, West), school metro status (urban, suburban/town, rural), and school type (public, private), resulting in a total of 72 strata.

Allocation of School Sample Size

The allocation of the 2,000 school sample size among the primary strata was based on the minimum sample size desired by stratum and the desired sample sizes for teachers of advanced mathematics and physics/chemistry. As in the 2012 National Survey of Science and Mathematics Education, 52 percent were allocated to primary stratum 1 and 24 percent were allocated to each primary stratum 2 and 3. Within primary strata, school sample sizes were secondary stratum. Sample sizes for each secondary stratum are displayed in Table A-1. The distribution of the sample across primary and secondary strata can be seen in Table A-2.

Table A-1
School Sample by Census Region, Metro Status, and School Type

REGION	SAMPLE SIZE	METRO STATUS	SAMPLE SIZE	SCHOOL TYPE	SAMPLE SIZE
Midwest	427	Urban	595	Public	1,770
Northeast	397	Suburban	995	Private	230
South	812	Rural	410		
West	364				
Total	**2,000**	**Total**	**2,000**	**Total**	**2,000**

Table A-2
Distribution of School Sample, by Stratum

	SECONDARY STRATUM			PRIMARY STRATUM			
	REGION	**METRO STATUS**	**PUBLIC/ PRIVATE**	**1 GRADE 10–12**	**2 GRADE 5–9**	**3 OTHER**	**ALL GRADES**
1	Midwest	Urban	Public	45	19	25	89
2			Private	12	0	5	17
3		Suburban	Public	92	61	45	198
4			Private	14	0	6	20
5		Rural	Public	54	19	22	95
6			Private	5	0	2	7
7	Northeast	Urban	Public	41	18	22	81
8			Private	18	1	4	23
9		Suburban	Public	100	61	44	205
10			Private	20	0	6	26
11		Rural	Public	30	12	12	54
12			Private	7	0	3	10
13	South	Urban	Public	89	58	53	200
14			Private	30	1	5	36
15		Suburban	Public	148	103	83	334
16			Private	26	0	6	32
17		Rural	Public	99	46	41	186
18			Private	18	0	3	21
19	West	Urban	Public	63	31	33	127
20			Private	15	0	5	20
21		Suburban	Public	76	42	42	160
22			Private	10	0	5	15
23		Rural	Public	22	8	9	39
24			Private	4	0	1	5
	TOTAL			**1,038**	**480**	**482**	**2,000**

Sample Selection of Schools

Prior to sampling, schools were sorted by the first three digits of zip code (ZIP3) and total number of teachers within secondary strata. A serpentine sort was employed to sort schools from smallest to largest within ZIP3, then largest to smallest within the next ZIP3.

Schools were sampled within strata using PPS systematic sampling, with measure of size equal to the total number of FTE teachers (public schools) or the total number of teachers (private schools) in the school. Schools with measure of size less than the 20th percentile for their stratum were assigned the 20th percentile as a measure of size to avoid large weights. In 7.1 percent of the schools on the school frame, the total number of teachers was imputed using the average pupil-teacher ratio for the stratum (1–72) by school locale (see Table A-3 for definitions), by school type (public, Catholic, non-Catholic religious, other private), and the school's reported enrollment:

Total teachers = Total enrollment / average (pupil-teacher ratio).

Table A-3
Definition of School Locale Code, Based on School's Address

LOCALE CODE	DEFINITION
11	City, Large Territory inside an urbanized area and inside a principal city with pop >= 250,000
12	City, Mid-size Territory inside an urbanized area and inside a principal city with pop < 250,000 and >= 100,000
13	City, Small Territory inside an urbanized area and inside a principal city with a population < 100,000
21	Suburban, Large Territory outside a principal city and inside an urbanized area with pop >= 250,000
22	Suburban, Mid-Size Territory outside a principal city and inside an urbanized area with a pop < 250,000 and >= 100,000
23	Suburb, Small Territory outside a principal city and inside an urbanized area with a pop < 100,000
31	Town, Fringe Territory inside an urban cluster <= 10 miles from an urbanized area
32	Town, Distant Territory inside an urban cluster > 10 miles and <= 35 miles from an urbanized area
33	Town, Remote Territory inside an urban cluster > 35 miles from an urbanized area
41	Rural, Fringe Census-defined rural territory <= 5 miles from an urban area; also rural territory <= 2.5 miles from an urban cluster
42	Rural, Distant Census-defined rural territory > 5 miles and <= 25 miles from an urbanized area; also rural territory > 2.5 miles and < 10 miles from an urban cluster
43	Rural, Remote Census-defined rural territory > 25 miles from an urbanized area and > 10 miles from an urban cluster

Replacement Schools

Four replacement schools were designated for each sampled school in case of nonresponse for the originally sampled school. The four replacement schools were usually the two or three schools listed just before and just after the sampled school on the frame, after sorting as described above. The replacement schools were ranked by similarity with the sampled school with respect to number of teachers and assigned an "order of use" number so that the closest matching school within the same stratum/ZIP3 would be used first.

Target Population for Teacher Sampling

The target population for the teacher sample consists of teachers in eligible schools (see School Sampling Frame section) who teach science and/or mathematics, or computer science.

Teacher Sampling Frame

The sampling frame for the teacher sample was constructed by requesting that principals in all sample schools appoint a study coordinator to provide a list of eligible teachers and identify the courses taught by each teacher. To assist the school in providing the information necessary to build the frame, an online form was provided to collect teaching categories depending on the school's primary stratum. For schools in primary stratum 1 the following categories were listed:

- High school physics or chemistry;
- Other science;
- High school calculus or advanced mathematics;
- Other mathematics; and
- Computer science.

For primary strata 2 and 3 the categories listed were:

- Science; and
- Mathematics

Teacher Stratification

Based on the course information provided for teachers on the school list, each teacher was assigned to one of the following six teacher strata:

- Physics/chemistry with or without other science, no mathematics or computer science;
- Advanced mathematics with or without other mathematics, no science or computer science;
- Other science only;
- Other mathematics only;
- Any combination of mathematics and science, but no computer science; and
- Computer science regardless of other subjects taught.

Teacher Sample Selection

The goal was to sample about 10,000 teachers and get completed teacher questionnaires for 7,000 teachers. The target sample sizes were nine teachers per Grade 10–12 school, eight teachers per Grade 5–9 school, and seven teachers per Other school. If the number of teachers in the school was less than or equal to the target, all teachers were selected. All computer science teachers were selected with certainty in Grade 10–12 schools. For the remaining subjects, teachers were sampled with probability proportional to a measure of size that was designed to oversample advanced mathematics and physics/chemistry teachers at a rate of 3. Prior to sampling, teachers were sorted by teacher stratum. The resulting sample sizes were:

- Primary school stratum 1: 5,517 teachers;
- Primary school stratum 2: 2,356 teachers; and
- Primary school stratum 3: 2,066 teachers.

The sampling fraction for teachers in teacher stratum l (l = 1–6) was computed as follows:

$$f_l = \frac{n_l}{N_l}$$

where:

f_l = Overall stratum sampling fraction in teacher stratum l

n_l = Number of teachers sampled in stratum l

N_l = Number of listed teachers in stratum l

Table A-4 shows the number of teachers selected in the cooperating schools for each of the three primary school strata, and the overall sampling fraction in each teacher stratum. The sample sizes do not include 35 teachers who were sampled but later dropped because their school or district refused to participate after data collection began.

Table A-4
Teachers Selected in Each School Stratum

	SAMPLE SIZE (N_1)	SAMPLING FRACTION (F_1)
School Stratum 1: Grades 10–12	**5,517**	**0.4165**
1. Physics/chemistry with or without other science, no mathematics	1,428	0.5689
2. Advanced mathematics with or without other mathematics, no science	1,406	0.5871
3. Other science only	897	0.2752
4. Other mathematics only	1,060	0.2767
5. Any combination of science and mathematics	331	0.3899
6. Computer science	395	0.9850
School Stratum 2: Grades 5–9	**2,356**	**0.5672**
1. Physics/chemistry with or without other science, no mathematics	0	0
2. Advanced mathematics with or without other mathematics, no science	0	0
3. Other science only	1,021	0.5688
4. Other mathematics only	1,217	0.5671
5. Any combination of science and mathematics	116	0.5498
6. Computer science	2	1.0000
School Stratum 3: Other	**2,066**	**0.3561**
1. Physics/chemistry with or without other science, no mathematics	0	0
2. Advanced mathematics with or without other mathematics, no science	0	0
3. Other science only	118	0.3806
4. Other mathematics only	199	0.4243
5. Any combination of science and mathematics	1,749	0.3483

Selection of Science or Mathematics Classes

Sampled teachers were mailed invitations to complete an online questionnaire. As part of the sampling process, teachers in sub-stratum five in each stratum were randomly assigned to receive either a science or a mathematics questionnaire. This represented an additional stage of sampling since only half of the sampled teachers in this stratum were assigned to report on science and the other half on mathematics. This one-in-two sub-sampling must be reflected in producing science- or mathematics-specific estimates.

Some of the items on the questionnaire apply to individual classes. Teachers with multiple science or mathematics classes each day were asked to report on only one of these classes. Teachers were asked to list all of their science and mathematics classes in order by class period. The web questionnaire used a pre-generated sampling table to make a selection from among the classes listed. The sampling table was randomly generated so that a random selection of classes would be achieved overall.

Weighting and Variances

In surveys involving complex, multistage designs such as this national survey, weighting is necessary to reflect the differential probabilities of selection among sample units at each stage of selection. Weights were developed to produce unbiased estimates for school and teacher characteristics. Weighting is also used to adjust for different rates of participation in the survey by different types of schools and teachers. The final adjusted weights permit the respondents from the sample to represent the population of schools and teachers.

Three school weights were developed corresponding to the School Coordinator Questionnaire, Science Program Questionnaire, and the Mathematics Program Questionnaire. A fourth school weight was developed for schools that completed teacher sampling and agreed to participate with the study, which was used in creating teacher weights. Three separate teacher weights were also developed for the Mathematics, Science, and Computer Science Teacher Questionnaires.

Variance computation must also take into account the survey design using a method such as jackknife or BRR replication or Taylor series linearization. Statistical software packages that assume simple random sampling are not appropriate because they will underestimate the standard errors. To accommodate the sample design used in this study, a set of 75 jackknife (JK2) replicate weights was created for each full-sample school and teacher weight.[24]

School Weights

The base weight associated with a school is the reciprocal of the school's probability of selection and is calculated as follows:

$$W_{hi} = \frac{\sum_{i=1}^{N_h} MOS_{hi}}{n_h MOS_{hi}}$$

where:

MOS_{hi} = measure of size for school *i* in stratum *h*
N_h = total number of schools on the frame in stratum *h*
n_h = number of schools sampled in stratum *h*
$h = 1, 2, \ldots 72$.

[24] Rust, K. and Rao, J.N.K. (1996). Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research: Special Issue on the Analysis of Complex Surveys, 5,* 283–310.

Replacement schools were used to substitute for non-cooperating schools, and for these the probability of selection of the originally sampled school was used to calculate the base weight. Of the 2,008 schools in the final sample (including 9 newly merged schools discovered after sampling), 750 were replacement schools. The probability of selection for the new schools was calculated to take into account their increased chance of selection. If the schools were from the same stratum, the probabilities of selection for the two schools that merged were summed. If they were from different strata, the probability of selection was calculated as:

1 - (1 - p(school 1)) * (1 - p(school 2))

because sampling was independent across strata.

To adjust for different rates of participation in the survey by different types of schools, school nonresponse adjustments were developed and applied to the base.[25]

Schools that did not allow teacher sampling were treated as nonresponding schools. In some schools, the School Coordinator Questionnaire was not completed. In addition, the person designated to answer questions about the school science or mathematics program may have failed to participate. Accordingly, four distinct school nonresponse adjustments were developed:

- NR1: To produce school estimates from the School Coordinator Questionnaire
- NR2: To produce mathematics program level estimates
- NR3: To produce science program level estimates
- NR4: To produce a school weight for calculating teacher weights

For nonresponse adjustment cell c, the general form of the nonresponse adjustment (NRA) is given by:

$$NRA_c = \frac{\sum_{\mathrm{i \in elig\ in\ c}} w_i}{\sum_{\mathrm{i \in resp\ in\ c}} w_i}$$

where w_i is the base weight of the ith school in cell c. The numerator of the three adjustment factors is the same—all eligible schools. The denominator (respondents) for NR1 includes all schools that completed the School Coordinator Questionnaire; respondents for NR2 and NR3 include only schools that completed a program questionnaire in science or mathematics, respectively. The denominator for NR4 includes all schools that completed teacher sampling and agreed to cooperate. Since the replacement schools already compensate for nonresponse, the weights for these schools are included in the denominators of the adjustments.

Because nonresponse adjustment through weighting assumes that response patterns of nonrespondents are similar to that of respondents, c corresponds to cells formed from school

[25] Brick, J.M. and Kalton, G. (1996). Handling missing data in survey research. *Statistical Methods in Medical Research, 5*, 215 (http://smm.sagepub.com/cgi/content/abstract/5/3/215)

Kalton, G. and Kasprzyk, D. (1986). The treatment of missing survey data. *Survey Methodology, 12*(1), pp. 1–16.

characteristics that were determined to be correlated with nonresponse. These characteristics were identified through a tree classification program (SAS Proc HPSPLIT) that classified schools into cells ("leaves") defined by school characteristics, based on their response rates. The characteristics identified as correlated with response rates were school type (public, catholic, other private), high minority enrollment (> 25 percent), and metro status (urban, suburban, rural). Primary stratum (grades 10–12 , grades 5–9, other) was also used for public schools, since their larger numbers in the sample allowed four variables to be used to form nonresponse adjustment cells.

The four school weights adjusted for nonresponse are given by:

$$W_{1i,\,nr} = w_i * NR1_c$$
$$W_{2i,\,nr} = w_i * NR2_c$$
$$W_{3i,\,nr} = w_i * NR3_c$$
$$W_{4i,\,nr} = w_i * NR4_c$$

where:

w_i = Base weight associated with school *i*

$NR1_c$ = Nonresponse adjustment factor for School Coordinator Questionnaire for schools in cell *c*

$NR2_c$ = Nonresponse adjustment factor for Mathematics Program Questionnaire for schools in cell *c*

$NR3_c$ = Nonresponse adjustment factor for Science Program Questionnaires for schools in cell *c*

$NR4_c$ = Nonresponse adjustment factor for school teacher sampling in cell *c*.

The nonresponse adjusted school weights were trimmed to the 99^{th} percentile of the weight distribution to reduce the effect of a few extremely large weights. These outlier weights arose from a few very small private schools that had a very small probability of selection. The weights that were not trimmed received a small adjustment so that the sum of the final school weights would equal the total of the school weights before trimming.

Teacher Weights

The teacher base weight is equal to the inverse of the overall probability of selection of the teacher, including the school's probability of selection. The teacher base weight was calculated as:

Teacher base weight = final school weight * (1/teacher probability of selection)

where the final school weight was adjusted for schools that refused to allow sampling of their teachers. Each teacher responded to only one of the mathematics, science, or computer science teacher questionnaires. For teachers sampled in the 5^{th} teacher stratum (both math and science taught), the teacher probability of selection includes a factor of 2 to reflect the random assignment of these teachers to math or science with a probability of 1/2.

The teacher base weight was adjusted separately for nonresponse to the mathematics, science, and computer science teacher questionnaires, because separate weights were planned for mathematics, science, and computer science teachers. That is,

$$W_{ijk,\,nr} = \text{final school weight}_i * \text{teacher base weight}_{ij} * NRT_{jk}$$

where:

$W_{ijk,\,nr}$	= nonresponse-adjusted weight teacher j in school i, subject k,
NRT_{jjk}	= nonresponse adjustment factor for teacher j in school i, subject k,
k	= mathematics, science, or computer science.

NRT_{ijk} was calculated within adjustment cell c for each subject k as:

$$NRT_c = \frac{\sum_{\text{j} \in \text{elig in c}} w_{ij}}{\sum_{\text{j} \in \text{resp in c}} w_{ij}}$$

where w_{ij} is the base weight for teacher j in school i.

The nonresponse adjustment factor was calculated within adjustment cells formed using variables that were determined to be correlated with teacher nonresponse. These variables were identified using a classification tree program (SAS Proc HPSPLIT) that classified teachers into cells defined by school characteristics based on their response status to the math, science, and computer science questionnaires. The variables identified by the program as correlated with teacher response rates were school level (grades 10–12, grades 5–9, other), school type (public, catholic, other private), high minority enrollment (>25 percent), metro status (urban, suburban, rural) and region (Northeast, Midwest, South, West). The unweighted response rate for both the mathematics and science questionnaires was 78 percent; for the computer science questionnaire the unweighted response rate was 79 percent.

The nonresponse-adjusted teacher weights were trimmed to a threshold of 5*average teacher weight to prevent extremely large weights from having undue influence on the estimates and variances, and the remaining teacher weights received a small adjustment factor to preserve the sum of the nonresponse-adjusted teacher weights prior to trimming. The percentage of responding teacher weights that were trimmed was 3.6 percent for mathematics teachers, 3.4 percent for science teachers, and 1.4 percent for computer science teachers.

Calculating Standard Errors

Estimates obtained from a sample of teachers will differ from the true population parameters because they are based on a randomly chosen subset of the population, rather than on a complete census of all mathematics, science, and computer science teachers. This type of error is known as sampling error. The differences between the estimates and the true population values can also be caused by nonsampling error. Nonsampling errors can result from many causes, such as measurement error, nonresponse, sampling frame errors, and respondent error. The precision of an estimate is measured by the standard error (defined as the square root of the variance due to sampling). The calculation of the standard error must reflect the manner in which the sample was drawn, otherwise the standard errors can be misleading and result in incorrect confidence intervals and p-values in hypothesis testing. The study's sampling involved stratification, clustering, and unequal probabilities of selection, all of which must be reflected in the standard error calculations.

Replication methods such as the jackknife are commonly used to estimate variances for complex surveys involving multi-stage sampling. Replication methods work by dividing the sample into subsample replicates that mirror the design of the sample. A weight is calculated for each replicate using the same procedures as for the full-sample weight. This process produces a set of replicate weights for each sampled school and teacher. To calculate the standard error of a survey estimate, the estimate is first calculated for each replicate using the replicate weight and the same form of estimator as for the full sample. The variation among the replicates is then used to estimate the variance for the full sample estimate, as given below in the formula for jackknife replicates formed with two variance units or pseudo-PSUs (primary sampling units) per stratum (JK2)[26]:

$$\text{var}(\hat{\theta}) = \sum_{g=1}^{G} (\hat{\theta}_{(g)} - \hat{\theta})^2$$

where G is the total number of replicates $\hat{\theta}_{(\text{g})}$ and is the estimate of $\hat{\theta}$ based on the observations included in the g[th] replicate.

For the current study, a set of 75 jackknife replicate weights was created for each school and teacher weight for calculating standard errors for school and teacher estimates. These may be used with packages that accommodate replication methods, such as SAS, Stata, R, SUDAAN or WesVar.

[26] Rust, K. and Rao, J.N.K. (1996). Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research: Special Issue on the Analysis of Complex Surveys, 5,* 283–310.

Description of Data Collection

Study Endorsements

Advance Notification

School Recruitment

Teacher and Program Survey Administration

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Copies of Materials Referenced in Appendix B

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District Superintendent Letter
Principal Letter
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E-mail Message to School Coordinator
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Program Questionnaire Cover Letter
Instructions Page for Accessing the Program Questionnaire
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Instructions Page for Accessing the Teacher Questionnaire
E-mail Message Alerting Coordinators to Expect Package
Reminder E-mail to Coordinators with Response Rates < 100 Percent
Teacher Listing Form Instruction
Teacher Listing Form

Description of Data Collection

Study Endorsements

Prior to school recruitment, study endorsements were solicited from many national professional organizations in an effort to encourage participation. In the fall of 2016, each organization was sent a letter briefly describing the study and asking for input on the survey instruments. The letter included a link to a website where representatives could view the 2012 versions of the surveys (the 2018 versions were still being revised). The following organizations provided letters of endorsement, and their names were included on the study stationery.

American Association of Chemistry Teachers
American Association of Physics Teachers
American Federation of Teachers
American Society for Engineering Education
Association of Mathematics Teacher Educators
Association of Science Teacher Educators
Association of State Supervisors of Mathematics
Computer Science Teachers Association
Council of State Science Supervisors
National Association of Biology Teachers
National Association of Elementary School Principals
National Association of Secondary School Principals
National Council of Supervisors of Mathematics
National Council of Teachers of Mathematics
National Earth Science Teachers Association
National Education Association
National Science Education Leadership Association
National Science Teachers Association

Advance Notification

In February 2017, notification letters were mailed to the Chief State School Officers, advising them of the format and schedule of the study. Three days later, similar information letters were mailed to superintendents of districts in which sampled public schools were located. District officials were asked to contact the project team if they had any questions or concerns. (Copies of the state and district letters are included at the end of this appendix.)

Westat identified 135 school districts in the sample that had a formal research approval process. Westat prepared and submitted research applications according to each district's requirements and then followed up with research coordinators throughout the approval process. Of the 135 districts, 61 approved the study. Those that declined cited lack of time and misalignment with the district's own research priorities as reasons.

School Recruitment

In February 2017, a pre-survey packet was sent to the principal of each sampled school that had not refused participation at the district level. The pre-survey packet consisted of a cover letter from HRI describing the school's involvement, a one-page description of the study, and instructions for logging on to the study website and designating a school contact person or "school coordinator." (Copies of the packet materials are included at the end of this appendix.) The school coordinator designation page was designed to confirm the principal's contact information as well as to obtain the name, title, position, phone number, and email address of the coordinator. (The mailing also included a printed copy of the form and postage-paid return envelope.) As an incentive, school coordinators were offered honoraria of $100 for completing a teacher list and school questionnaire, $15 for completing each program questionnaire (optional), and $10 for each completed program and teacher questionnaire. Teachers were offered a $25 honorarium for completing the teacher questionnaire.

A small percentage of schools responded to the letter by going to the study website and designating a coordinator or by completing the printed copy and returning it by mail. If a principal had not responded within two weeks of receiving the letter, Westat began calling the school. Generally, a series of telephone calls was needed to determine whether anyone had received the letter, to whom the task had been delegated, and whether or not that person was planning to complete it. In many cases, schools requested a re-mailing of the survey materials.

A few school officials directly refused to participate at this stage, generally citing competing priorities and overburdened teachers. When this occurred, telephone prompters attempted to change the principal's mind. Although this method was effective in some cases, most direct refusers did not change their mind.

Beginning in September 2017, each school's coordinator was sent an email indicating that s/he had been designated by their principal as the survey contact and detailing the coordinator role in the study. If the coordinator was someone other than the principal, the principal was copied on the email. Each coordinator was asked to complete three initial tasks online: (1) submit a list of science, mathematics, and computer science teachers; (2) designate individuals to complete program-level questionnaires; and (3) respond to the School Coordinator Questionnaire (included in Appendix C). (Copies of the email, the teacher listing form and accompanying instructions are included at the end of this appendix.) Coordinators were asked to complete these tasks within a two-week period and were sent the first installment of their honorarium ($100) within four weeks of completion.

Coordinators received a phone call one business day after being sent the email to confirm that the email was received. A second phone call was placed later in the week if the coordinator had not responded. Non-responding coordinators received an email reminder (included at the end of this appendix) one week after the initial email was sent. Two more phone calls were placed following this reminder email. Following an additional week of non-response, a second reminder email was sent to each coordinator. Three days later, if a coordinator had still not responded, the school principal was contacted and asked to either encourage the current coordinator to respond or to consider designating someone new to serve in this capacity.

Table B-1 summarizes the slot response rate by stratum. A total of 41 slots were closed because the primary school in the slot was ineligible, due to either being closed, not having the appropriate grade levels, or being merged with another school to create a new school. In total, 1,273 schools chose to participate, filling 65 percent of the remaining 1,959 slots.

Table B-1
Percentage of Slots Filled, by Stratum

	STRATUM 1	STRATUM 2	STRATUM 3	TOTAL
Response Rate	66%	65%	64%	65%
Participated	661	311	301	1,273
Non-Response	348	166	172	686
Ineligible	29	3	9	41
TOTAL	**1,038**	**480**	**482**	**2,000**

The School Coordinator Questionnaire was programmed to check for the accuracy of certain information as it was submitted. For instance, the survey checked whether student enrollment overall matched student enrollment by race/ethnicity. Coordinators were asked to correct any mismatches before proceeding with the survey.

The teacher lists resulted in a file of 23,020 teachers. From this frame, a sample of 9,939 science, mathematics, and computer science teachers was drawn. For Stratum 1 schools, nine science and mathematics teachers were sampled. In Stratum 2 schools, eight science and mathematics teachers were sampled. In Stratum 3 schools, seven science and mathematics teachers were sampled. In all schools containing any grade 9–12, all computer science teachers were sampled, as their prevalence much lower than science and mathematics teachers. The number of teachers sampled per school ranged from 1 to 9, with a mean of 7.8 teachers and a median of 8. Teachers were sampled on a rolling basis so that late responders to the pre-survey would not delay the main data collection effort.

Teacher and Program Survey Administration

In February 2018, HRI staff mailed program and teacher questionnaire invitations to 30 schools in the sample. (Copies of the surveys are included in Appendix C.) This first small group served as a "soft launch" to test survey administration procedures and the functionality of the data collection website. After two weeks, additional mailings were sent to batches of schools each week as they were recruited until recruitment closed at the beginning of April 2018. The packets contained:

- A personalized cover letter from HRI; and
- A "how to" page explaining how to access the online survey using unique login information.

(Copies of packet materials are included at the end of this appendix.)

Many of the individuals designated to respond for the program questionnaires were teachers and, consequently, had been randomly sampled to complete the teacher questionnaire as well. These individuals received both the teacher questionnaire invitation and the program questionnaire packet (mailed in separate envelopes). Because the program questionnaire requested information that the respondent was not likely to know, the mailing included a paper copy of the survey, so that respondents could gather data before completing the on-line version.

Prompting Respondents

A series of steps was taken to increase the response rate, primarily through email follow-up with school coordinators. The day the packet left HRI, coordinators received an email letting them know to expect the packet. Reminder emails were sent to coordinators at schools with less than 100 percent response at one, two, three, four, five, six, and eight weeks following the survey invitation mailing. (Copies of these emails are included at the end of this appendix.) Two and three weeks after the initial mailing, schools with no respondents received a phone call in addition to the reminder email. At four and at five weeks, any school with less than 50 percent completion received a phone call in addition to the reminder email. In some instances, schools indicated that they had not received survey invitations, in which case materials were re-mailed or re-sent via email.

During the survey administration phase, school coordinators were given access to a real-time, web-based completion status report, which summarized survey response for their school. The report listed the surveys to be completed at the school, the name of the person designated and/or sampled to complete each one, and whether the survey was "Not started," "Partial," or "Complete." Coordinators were asked to use the report to follow up with non-respondents to encourage them to complete their questionnaires.

Response Rates

A total of 3,303 completed school/program questionnaires were received out of the 3,819 possible, for a response rate of 86 percent. A total of 7,600 out of 9,702 eligible teachers[27] completed a teacher questionnaire, for a response rate of 78 percent. Tables B-2 and B-3 provide response rate breakdowns for program heads and teachers, respectively.

Table B-2
School/Program Questionnaire Response Rates

	SAMPLED	NON-RESPONSE	COMPLETED	RESPONSE RATE (PERCENT)
Stratum 1	**1,983**	**288**	**1,695**	**85**
Science	661	131	530	80
Mathematics	661	133	528	80
School Coordinator	661	24	637	96
Stratum 2	**933**	**138**	**795**	**85**
Science	311	56	255	82
Mathematics	311	64	247	79
School Coordinator	311	18	293	94
Stratum 3	**903**	**90**	**813**	**90**
Science	301	39	262	87
Mathematics	301	43	258	86
School Coordinator	301	8	293	97
TOTAL	**3,819**	**516**	**3,303**	**86**

[27] During data collection, it was determined that a small number of teachers were not eligible to participate in the study (e.g., after the school submitted its teacher list, the teacher retired, went on maternity leave, changed teaching assignment). These teachers are not included in the denominator when calculating response rates.

Table B-3
Teacher Questionnaire Response Rates

	SAMPLED	NON-RESPONSE	INELIGIBLE	COMPLETED	RESPONSE RATE (PERCENT)
Stratum 1	**5,517**	**1,194**	**122**	**4,201**	**0.78**
Science	2,496	569	40	1,887	0.77
Mathematics	2,626	554	45	2,027	0.79
Computer Science	395	71	37	287	0.80
Stratum 2	**2,356**	**522**	**68**	**1,766**	**0.77**
Science	1,079	237	34	808	0.77
Mathematics	1,275	285	34	956	0.77
Computer Science	2	0	0	2	1.00
Stratum 3	**2,066**	**377**	**56**	**1,633**	**0.81**
Science	1,004	167	35	802	0.83
Mathematics	1,062	210	21	831	0.80
Computer Science	---	---	---	---	---
TOTAL	**9,939**	**2,093**	**246**	**7,600**	**0.78**

Data Retrieval

The web-based survey format minimized the need for data retrieval. Critical items were identified during questionnaire development, and the surveys were programmed such that respondents could not proceed without answering these questions. In addition, the surveys were programmed with a number of "soft checks" for potentially incorrect responses. For example, on the School Coordinator Questionnaire, if the number of students in the various demographic categories did not sum to the total enrollment reported, the survey prompted coordinators to double check their numbers.

Data Cleaning

Questionnaire responses were captured through a commercial survey administration website. Data were screened by researchers for missing data, out-of-range answers, and logical inconsistencies. After data-cleaning decisions regarding these issues were made, the data were updated to reflect the decisions. Additional variables needed for analysis were created using data from survey answers and other sources.

The data about instructional materials used (e.g., titles, ISBNs) were used to mine additional information about textbooks (e.g., the publisher) and to resolve inconsistencies in title and author information.

Copies of Materials Referenced in Appendix B

Copies of materials referenced in this appendix follow.

State Chief Letter

[Month and Year]

[State Chief Name]
[Title]
[Address]

Dear [Dr./Mr./Ms.] [State Chief Last Name]:

I am writing to let you know about the 2018 National Survey of Science and Mathematics Education (2018 NSSME+) being conducted by Horizon Research, Inc. The plus symbol reflects the study's added emphasis on computer science and engineering, two disciplines that are increasingly prominent in discussions about K–12 STEM education and college and career readiness. This study is the sixth in a series dating back to a 1977 study commissioned by the National Science Foundation. The 2018 NSSME+ will assess changes over time and provide current national estimates on essential elements of the STEM education system, which will inform future education policy and practice. A one-page summary of the study is enclosed. The survey has been endorsed by a number of professional organizations, including the American Federation of Teachers, American Society for Engineering Education, the Computer Science Teachers Association, the National Council of Teachers of Mathematics, the National Education Association, and the National Science Teachers Association. These groups are providing input into the content of the questionnaires and will be involved in the dissemination of the study results.

A nationally representative sample of 2,000 schools has been selected to participate. We will begin contacting district superintendents and principals in January 2017 and compiling lists of computer science, engineering, mathematics, and science teachers in the sampled schools in September 2017. Questionnaire administration will begin in November 2017; an average of eight teachers in each sampled school will be asked to complete a 30-minute web-based survey focused on one of the fields of computer science, science, or mathematics instruction. Each teacher will receive a $25 honorarium. *No data will be collected from students, and there will be no intrusion on the instructional day.* The information collected through the survey will be used only for statistical purposes, and individual districts, schools, and teachers will not be identified.

We are excited to begin this important national study and look forward to working with the sampled schools in [State Name]. If you have any questions about the study, I hope you will not hesitate to contact me by phone (toll free, 877-297-6829) or by email at nssme18@horizon-research.com.

Best regards,

Eric Banilower
Vice President
Principal Investigator for the 2018 NSSME+

Enc.

horizon RESEARCH, INC.
Westat

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326 CLOISTER CT., CHAPEL HILL, NC 27514-2296
WWW.HORIZON-RESEARCH.COM
NSSME18@HORIZON-RESEARCH.COM
P: (877) 297-6829 (TOLL FREE) | F: (919) 493-7589

WESTAT, INC.
1600 RESEARCH BLVD., ROCKVILLE, MD 20850-3129
WWW.WESTAT.COM
2018NSSME@WESTAT.COM
P: (855) 462-5831 (TOLL FREE) | F: (800) 254-0984 (TOLL FREE)

District Superintendent Letter

[Month and Year]

Superintendent
[District name]
[District address]

Dear Superintendent:

I am writing to let you know about the 2018 National Survey of Science and Mathematics Education (2018 NSSME+) being conducted by Horizon Research, Inc. The plus symbol reflects the study's added emphasis on computer science and engineering, two disciplines that are increasingly prominent in discussions about K–12 STEM education and college and career readiness. This study is the sixth in a series dating back to a 1977 study commissioned by the National Science Foundation. The 2018 NSSME+ will assess changes over time and provide current data on essential elements of the STEM education system, which will inform future education policy and practice. A one-page summary of the study is enclosed. The survey has been endorsed by a number of professional organizations, including the American Federation of Teachers, the American Society for Engineering Education, the Computer Science Teachers Association, the National Council of Teachers of Mathematics, the National Education Association, and the National Science Teachers Association.

A nationally representative sample of approximately 2,000 schools has been selected to participate, including the school(s) in [District Name] listed on the enclosed page. We plan to begin contacting school principals in the coming weeks to request their participation. In September 2017, we will compile lists of computer science, engineering, mathematics, and science teachers in the sampled schools. We will randomly sample an average of eight teachers from each school. Survey administration will begin in November 2017.

We want to assure you that *no data will be collected from students, and there will be no intrusion on the instructional day*. The information collected through the survey will be used only for statistical purposes, and individual districts, schools, and teachers will not be identified. Each teacher will receive a $25 honorarium for completing the questionnaire.

Horizon Research, Inc. has contracted with the survey research firm Westat to contact districts and schools for the survey. We are excited to begin this important national study and look forward to working with the sampled schools in [District Name]. If you have any questions about the study, please call Roberta Pike (toll free, 855-462-5831) or email 2018nssme@westat.com.

Best regards,

Eric Banilower
Vice President
Principal Investigator for the 2018 NSSME+

Enc.

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Principal Letter

[Month and Year]

Principal
[school name]
[school address]

Dear Principal:

I am writing to let you know that [school name] has been randomly selected to participate in the 2018 National Survey of Science and Mathematics Education (NSSME+). The plus symbol reflects the study's added emphasis on computer science and engineering, two disciplines that are increasingly prominent in discussions about K–12 STEM education and college and career readiness. A total of 2,000 public and private schools and selected K–12 teachers throughout the United States will be involved in the study. The 2018 NSSME+ is the sixth in a series of surveys dating back to a 1977 study commissioned by the National Science Foundation. Conducted by Horizon Research, Inc., the study will assess changes over time and provide current data on essential elements of the STEM education system, which will inform future education policy and practice. A one-page summary of the study is enclosed.

Your district has been informed about this study, which is designed to strictly avoid intrusions on the instructional day and to place minimal burden on principals and teachers. In addition, ***no data will be collected from students***. The information collected through the survey will be used only for statistical purposes, and individual districts, schools, and teachers will not be identified.

At this time, we are asking that you designate a school coordinator within the next three weeks. The coordinator will receive a stipend of at least $100, and up to $200, to facilitate the study within the school. In September 2017, we will ask the coordinator to provide a list of teachers at the school whose assignment includes computer science, engineering, mathematics, or science. Using this list, we will randomly select an average of eight teachers per school to complete the survey. In November 2017, we will begin administering the school and teacher questionnaires and ask the coordinator to facilitate communication with sampled teachers. Teachers will have the option of completing a web or paper version of the questionnaire, which is expected to take about 30 minutes to complete. Each teacher will receive a $25 honorarium for completing the survey. (**See the enclosed page for instructions on designating a coordinator.**)

Your participation is voluntary but very important and greatly appreciated. Because your school is one of a small sample selected for this survey, your cooperation is critical to make the results of the survey comprehensive, accurate, and timely. Horizon Research, Inc. has contracted with the survey research firm Westat to contact districts and schools for the survey. If you have any questions about the study, please call Roberta Pike (toll free, 855-462-5831) or email 2018nssme@westat.com.

Best regards,

Eric Banilower
Vice President
Principal Investigator for the 2018 NSSME+

Enc.

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NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

Study Description

In response to numerous requests for information regarding the status of K–12 STEM education in the United States, Horizon Research, Inc. is conducting the 2018 National Survey of Science and Mathematics Education (NSSME+). The plus symbol reflects the study's added emphasis on computer science and engineering, two disciplines that are increasingly prominent in discussions about K–12 STEM education and college and career readiness. This study is the sixth in a series of surveys dating back to a 1977 study commissioned by the National Science Foundation. The 2018 NSSME+ will assess changes over time and provide current data on essential elements of the STEM education system, data that will inform future education policy and practice.

Focus of the Study

The study will address the following research questions:

1. To what extent do computer science, engineering, mathematics, and science instruction reflect what is known about effective teaching?
2. What are the characteristics of the computer science/engineering/mathematics/science teaching force in terms of race, gender, age, content background, beliefs about teaching and learning, and perceptions of preparedness?
3. What are the most commonly used textbooks/programs, and how are they used?
4. What influences teachers' decisions about content and pedagogy?
5. What formal and informal opportunities do computer science/engineering/mathematics/ science teachers have for ongoing development of their knowledge and skills?
6. How are resources for computer science/engineering/mathematics/science education, including well-prepared teachers and course offerings, distributed among schools in different types of communities and different socioeconomic levels?

Minimal Burden on Schools

We have designed the study to avoid intrusions on the instructional day and to place minimal burden on principals and teachers. *No data will be collected from students.* The information collected through the survey will be used only for statistical purposes, and individual districts, schools, and teachers will not be identified. Principals will be asked to designate a school coordinator, and the coordinator will receive a stipend to provide lists of teachers and facilitate communication during the data collection phase of the study. Teachers will be asked to fill out a web-based questionnaire, which is expected to take approximately 30 minutes to complete. Each teacher will receive a $25 stipend for completing the survey.

Timeline

Contact with states, districts, and schools will begin in January 2017, and data collection will take place from September 2017 to May 2018.

Benefit to STEM Education

The 2018 NSSME+ will help monitor trends in key areas, collect data on emerging policy issues, determine how computer science/engineering/mathematics/science teachers compare to teachers overall, and delve deeper in selected areas such as the nature of instruction. The results of the study will inform policy, programmatic decisions, and future education research. In order to reach a broad audience, survey findings will be disseminated through technical reports, research journals, social media, and publications aimed at education practitioner and policymaker audiences.

NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

Coordinator Designation Form

[school ID]
[School Name]
[School Street Address]

We ask that you identify a school coordinator for the NSSME study. The coordinator will receive a stipend of at least $100 and up to $200 to facilitate the study within the school.

Please complete and mail this form in the postage-paid envelope provided or submit the information online using the instructions in the box at the bottom of the form. You are welcome to designate yourself or someone else. The contact information you provide will be kept **private and confidential** and will only be used in connection with this study.

1. Enter coordinator information below.

Coordinator's Personal Title: (e.g., Ms. Mrs. Mr. Dr.) ______________

Coordinator's Name (*First):* ________________________________ *(Last):*_______________________________

Coordinator's Position at school (e.g., Math Dept. Chair, Secretary): _____________________________________

Coordinator's Email: ____

Coordinator's Phone: _______________________Ext. ________

2. Principal Name: *(First)*:_______________________________ *(Last)*:____________________________________

3. Please verify your school name printed at the top of this form.
School names are from Department of Education files; please consider abbreviations/deviations from the official school name as correct.

☐ Correct *(Skip to Question 4)*

☐ Incorrect *(Please answer Questions 3a and 3b below)*

3a. What is the correct school name: ____

3b. Please check the reason(s) for the name change: (*Check all that apply*.)

☐ School merger or reconfiguration

☐ New school

☐ Name change

☐ Other (specify) ____

4. Please verify your school mailing address printed at the top of this form and enter any corrections below.

Correct street address *(if different than above):* ____

Correct mailing city: ___________________________________ State: ______ ZIP: ___________

TO RETURN COMPLETED FORM BY MAIL OR FAX:	OR	TO DESIGNATE COORDINATOR ON THE WEB:
By Mail **use enclosed envelope** **or send to:** Westat 1600 Research Blvd, RB 3103 Rockville, Maryland 20850-3129 **By Fax:** 800-254-0984		**Use the URL, Username, and Password below:** URL: http://tiny.cc/CoordForm Username: [username] Password: [password]

For Questions: Call Rene Walker at 855-462-5831 or email 2018nssme@westat.com

E-mail Message to School Coordinator

Dear [title] [lastname]:

Welcome to the 2018 National Survey of Science and Mathematics Education (NSSME+)!

Thank you in advance for serving as the school coordinator for [school name]. [IF COORD IS NOT PRINCIPAL: Our records show that your principal, [principal name], designated you for this role.] C**oordinators will receive up to $220** for providing information about the school and for facilitating communication with teachers. You can read a brief description of the coordinator role here.

Within the next week, please:
1) Complete the Teacher Listing Form for your school (Link to instructions); and
2) Complete a questionnaire about the school (Link to preview).

We will send you a check for $100 (the first installment of your honorarium) after you complete these two tasks.

I will follow up with you by phone to make sure you received this email and to see if you have any questions.

Please don't hesitate to contact me by email ([staff email]) or by phone Monday through Friday between 8:30 AM and 5:00 PM Eastern (toll free, 877-297-6829 ext. [staff extension]). I look forward to working with you on this important national study of STEM education.

[staff name]
Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514
877-297-6829 (toll-free) ext. [staff extension]
www.horizon-research.com

Reminder E-mail Message to School Coordinator

Dear [title] [last name]:

I recently contacted you about providing information for your school, [school name], for the 2018 National Survey of Science and Mathematics Education. This is a gentle reminder to please visit the links below and complete the following tasks:

1) Complete an online form (see below) listing all the teachers in your school who teach computer science, mathematics, science, and/or engineering (we will use this list to randomly sample an average of eight teachers per school to complete the teacher questionnaire later in the school year); and designate individuals to complete the Mathematics Program Questionnaire and the Science Program Questionnaire; and

2) Complete a questionnaire about the school.

Please use these links to complete the tasks. If you have started but not yet completed these tasks, the links should take you to where you left off.
1) [unique link to Teacher Listing Form]
You may find it useful to have a staff directory or roster on hand.

2) [unique link to School Coordinator Questionnaire]
We recommend that you first download the preview version so that you can gather the necessary information: Link to preview

We ask that you provide this information within the next week. You will receive a check for $100 within four weeks of completion.

Please don't hesitate to contact me by email (nssme18@horizon-research.com) or by phone Monday through Friday between 8:30 AM and 5:00 PM EST (toll free, 877-297-6829). I look forward to working with you on this important national study.

[staff name]
Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514
877-297-6829 (toll-free) ext. [staff extension]
www.horizon-research.com

Program Questionnaire Letter

[Month and Year]

[first and last name]
[school name]
[school address]

Re: NSSME+ [Mathematics/Science] **Program** Questionnaire

Dear Colleague:

As you may know, [school name] has agreed to participate in the **2018 National Survey of Science and Mathematics Education (NSSME+)**, the sixth in a series of studies initiated in 1977. Your school has designated you as someone able to answer questions about the **[mathematics/science] program** at your school. You will receive a $15 honorarium for completing the survey.

The NSSME+ is being conducted by Horizon Research, Inc. and Westat, Inc. and is endorsed by numerous organizations, including the [National Council of Teachers of Mathematics, the Association of State Supervisors of Mathematics/ National Science Teachers Association, the Council of State Science Supervisors], the American Federation of Teachers, and the National Education Association. Your responses, combined with those from approximately 1,500 other schools throughout the United States, will be used to inform policymakers about issues affecting computer science, mathematics, and science teachers. All respondent identities will be kept strictly confidential; data will be reported only in aggregate form, such as by grade level or region of the country, and no information identifying individual states, districts, schools, or teachers will be released. You can visit https://tinyurl.com/NSSME2018 for more information about the study.

The [Mathematics/Science] Program questionnaire has general questions about the instructional objectives and course offerings at your school. Because of the study's importance, we ask that you complete the survey in the next two weeks. ***The [Mathematics/Science] Program questionnaire is web-based; please follow the instructions on the enclosed page to access it.*** It should take only about 20–30 minutes to complete.

If you have any questions about the study, please email [staff name] at [staff email] or call (toll free) [staff phone number and extension] Monday - Friday, between 8:30 a.m. and 5:00 p.m. Eastern Time.

Sincerely,

Eric Banilower
Vice President
Principal Investigator for the 2018 NSSME+

THE NSSME IS ENDORSED BY

American Association of Chemistry Teachers

American Association of Physics Teachers

American Federation of Teachers

American Society for Engineering Education

Association of Mathematics Teacher Educators

Association of Science Teacher Educators

Association of State Supervisors of Mathematics

Computer Science Teachers Association

Council of State Science Supervisors

National Association of Biology Teachers

National Association of Elementary School Principals

National Association of Secondary School Principals

National Council of Supervisors of Mathematics

National Council of Teachers of Mathematics

National Earth Science Teachers Association

National Education Association

National Science Education Leadership Association

National Science Teachers Association

Instructions Page for Accessing the Program Questionnaire

HOW TO COMPLETE THE 2018 NSSME+ [MATHEMATICS/SCIENCE] PROGRAM QUESTIONNAIRE

[first and last name]

1. We have enclosed a preview of the web-based questionnaire. We recommend that you review it and gather the needed information prior to accessing the web-based questionnaire.

2. Please visit the following website to begin the questionnaire:

   Website: www.2018nssme.org

   Username: [unique username]

   Password: [unique password]

If you have problems accessing the questionnaire or experience technical difficulties completing it, please email [staff name] at [staff email] or call (toll free, [staff phone number and extension]) between 8:30 a.m. and 5:00 p.m. Eastern Time.

Thank you for participating in the 2018 NSSME+!

Teacher Questionnaire Letter

[Month and Year]

[first and last name]
[school name]
[school address]

Re: NSSME+ [Computer Science/Mathematics/Science] **Teacher** Questionnaire

Dear Colleague:

As you may know, [school name] has agreed to participate in the **2018 National Survey of Science and Mathematics Education (NSSME+)**, the sixth in a series of studies initiated in 1977. Working with [school coordinator first and last name], we compiled a list of all teachers of computer science, mathematics, and science at your school. You were randomly selected from this list to respond about your **[computer science/mathematics/science] instruction**. You will receive a $25 honorarium for completing the survey.

The NSSME+ is being conducted by Horizon Research, Inc. and Westat, Inc. and is endorsed by numerous organizations, including the [Computer Science Teachers Association/National Council of Teachers of Mathematics, the Association of State Supervisors of Mathematics/ National Science Teachers Association, the Council of State Science Supervisors], the American Federation of Teachers, and the National Education Association. Your responses, combined with those from approximately 1,500 other schools throughout the United States, will be used to inform policymakers about issues affecting computer science, mathematics, and science teachers. All respondent identities will be kept strictly confidential; data will be reported only in aggregate form, such as by grade level or region of the country, and no information identifying individual states, districts, schools, or teachers will be released. You can visit https://tinyurl.com/NSSME2018 for more information about the study.

We realize that you are very busy, and we have tried to minimize the burden of responding by asking only the most important questions. Because of the study's importance, we ask that you complete the survey in the next two weeks. ***The 2018 NSSME+ is a web-based questionnaire; please follow the instructions on the enclosed page to access it.*** We anticipate most teachers will need 30–40 minutes to complete the questionnaire.

If you have any questions about the study, please email [staff name] at [staff email] or call (toll free) [staff phone number and extension] Monday - Friday, between 8:30 a.m. and 5:00 p.m. Eastern Time.

Sincerely,

Eric Banilower
Vice President
Principal Investigator for the 2018 NSSME+

horizon RESEARCH, INC.

Westat

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Instructions Page for Accessing the Teacher Questionnaire

HOW TO COMPLETE THE 2018 NSSME+ [COMPUTER SCIENCE/MATHEMATICS/SCIENCE] TEACHER QUESTIONNAIRE

[first and last name]

NOTE: If possible, please complete the questionnaire where you have access to the instructional materials you use in your computer science class(es).

1. Please visit the following website to begin the questionnaire:

   Website: www.2018nssme.org

   Username: [unique username]

   Password: [unique password]

2. The first few questions ask for information to verify that you are eligible to complete the questionnaire. If you are not eligible, the questionnaire will let you know immediately and not ask you to continue answering questions. (Please note that we cannot provide an honorarium to teachers who are not eligible to complete the questionnaire.)

If you have problems accessing the questionnaire or experience technical difficulties completing it, please email [staff name] at [staff email] or call (toll free, [staff phone number and extension]) between 8:30 a.m. and 5:00 p.m. Eastern Time.

Thank you for participating in the 2018 NSSME+!

E-mail Message Alerting School Coordinator to Expect Package

Dear [title] [last name]:

Thank you again for participating in the 2018 National Survey of Science and Mathematics Education (NSSME+). This email is to let you know that we have sent invitation letters (via US mail) to the individuals that you selected to complete the program questionnaires and to the teachers who have been randomly sampled to complete a teacher questionnaire. (The envelopes look like the image below my name.) These letters should arrive at [school name] within the next week. In addition, we will be sending you a packet containing duplicate letters. Please keep these letters and distribute if a teacher does not receive or misplaces his or her letter.

When you click here, you will be prompted to enter a username and password unique to you:

Username: [unique username]
Password: [unique password]

Logging in will take you to a coordinator menu that lists everyone who has been selected to complete a questionnaire and their completion status. **Please tell these individuals to expect a letter from NSSME so they don't throw the letter away.**

We have asked individuals to complete questionnaires within two weeks. We will ask that you follow up with non-responders to encourage them to complete their survey.

The questionnaire invitation letters we sent include unique usernames and passwords for each of the selected individuals. Please note that individuals participating in more than one survey will receive multiple letters, with unique login information for each survey. If respondents lose their login information, you can find their username and password on your coordinator menu.

Please do **not** reassign login information to another teacher. If you do, we will not be able to use the data, and the individual will not be eligible for an honorarium.

As you may recall, you will receive $10 for each completed questionnaire (including both program and teacher). Individuals who complete the teacher questionnaire will receive a $25 honorarium, and those who complete the program questionnaire will receive a $15 honorarium. Checks will be mailed within four weeks of completing the questionnaire.

I hope you will not hesitate to contact me by email [staff email] or by phone Monday through Friday between 8:30 AM and 5:00 PM EST (toll free, staff phone number and extension). I look forward to working with you on this important national study.

[staff name]

NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

326 CLOISTER COURT, CHAPEL HILL, NC 27514-2296

Horizon Research, Inc.
326 Cloister Court
Chapel Hill, NC 27514
877-297-6829 (toll-free)
www.horizon-research.com

Reminder E-mail to Coordinators with Response Rates < 100 Percent

Dear [title] [last name]:

Recently, we emailed to let you know that we've started administering surveys for the 2018 National Survey of Science and Mathematics Education. On [mailing date], we sent a letter (via US mail) to each sampled teacher, inviting them to complete the surveys within two weeks. The letters should have arrived by now. (The envelopes look like the image below my name.) If they haven't arrived, would you please let me know in case we need to re-mail them.

Please log on to http://www.2018nssme.org/ with your coordinator login credentials to see which individuals should have received the letter.

Username: [unique username]
Password: [unique password]

When you log on, you will see a "completion status report" listing all individuals and their survey completion status. **Please encourage those who have not completed the survey to log on and respond as soon as possible.**

Please do **not** reassign login information to another teacher. If you do, we will not be able to use the data, and the individual will not be eligible for an honorarium.

You will receive $10 for each completed questionnaire (including both program and teacher). Individuals who complete the teacher questionnaire will receive a $25 honorarium; those who complete the program questionnaire will receive $15. We will mail checks within four weeks of receiving an individual's responses.

Please do not hesitate to contact me with any questions or concerns. Thank you very much for your help.

[staff name]

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877-297-6829 (toll-free)
www.horizon-research.com

Teacher Listing Form Instructions

On this form, you will enter all K–12 teachers in this school who are expected to teach computer science, mathematics, science, and/or engineering in the spring of 2018, regardless of how much instructional time they will devote to these subjects—only these teachers are *eligible* for this study. You will also designate what subjects/courses they will be teaching.

1. *Do not include* pre-Kindergarten teachers, teacher assistants, or teachers responsible only for special education or "pull-out" classes for remediation or enrichment of students who also receive science/mathematics instruction from the regular classroom teacher. These teachers are *ineligible* for the study.
2. For the purposes of this study, *the following are not considered computer science, mathematics, science or engineering courses*: Health, Hygiene, Technology Education, Business, Career-technical education (CTE) courses that cover such things as automotive repair or audio/video production.

The following table shows the type of information you will be asked to provide (see the following page for definitions of these categories):

			SELF-CONTAINED				NOT SELF-CONTAINED					
TEACHER	FIRST	LAST	COMPUTER SCIENCE	ENGINEERING	MATHEMATICS	SCIENCE	HIGH SCHOOL PHYSICS OR CHEMISTRY	OTHER SCIENCE	ENGINEERING	HIGH SCHOOL CALCULUS OR ADVANCED MATHEMATICS	OTHER MATHEMATICS	COMPUTER SCIENCE
1	John	Smith			X	X						
2	Maria	Lopez					X	X				
3	Sarah	Baker							X	X		
....												
N												

If you are not sure which teachers to include on this form, please email nssme18@horizon-research.com or call 877-297-6829 (toll free) 8:30 AM to 5:00 PM Eastern before proceeding.

Important Terms

Self-contained vs. Not Self-contained

A *self-contained* teacher teaches multiple subjects to a single class of students all or most of the day. Elementary teachers often are self-contained. A teacher who is *not self-contained* (sometimes called "departmentalized") teaches computer science, mathematics, science and/or engineering (and perhaps other subjects) to multiple classes of students all or most of the day. Middle and high school teachers typically are *not self-contained*.

High School Calculus or Advanced Mathematics

This category includes such courses as: Pre-Calculus, Calculus, Algebra 3, Analytic Geometry, Trigonometry, Math IV, and any other College Prep Senior Math with Algebra 2/Math 3 as a prerequisite.

Other Mathematic

This category includes such courses as: General Math, Basic Math, Algebra 1, Algebra 2, Geometry, Math 1-3, Integrated/Unified Math 1-3, and 7^{th} grade math.

High School Physics or Chemistry

This category includes such courses as: First-year Chemistry, Advanced Chemistry, Advanced Placement Chemistry, Conceptual Physics, Physics I, Advanced Physics, and IB Physics.

Other Science

This category includes such courses as: Biology, AP Biology, Earth Science, Physical Science, Integrated Science, General Science, and 7^{th} grade science.

Engineering

This category includes such courses as: Engineering, Engineering Design, Principles of Engineering, Technological Systems, and Technology and Society.

Computer Science

This category includes such courses as: Computer Literacy, Computer Science Discoveries, Exploring computer science, Computer Science Essentials, Introductory Programming, AP/IB Computer Science.

Teacher Listing Form

On the next several screens, you will be asked to enter the names of all computer science, mathematics, science, and engineering teachers in your school. Additionally, you will indicate if each person is a self-contained teacher[1] and the subjects s/he teaches. We will use this teacher list to randomly select a sample of teachers to receive a questionnaire.

Before clicking "Next", it is important that you view and print these instructions (The instructions are in PDF format, which requires Adobe Acrobat Reader. If you don't already have Acrobat Reader, you can download it for free from Adobe's website.)

1. What grades are included in this school?
   (Select all grades served by this school, regardless of whether any students are currently enrolled in each grade.)

☐ This school is ungraded

☐ Pre-K
☐ K
☐ 1st
☐ 2nd
☐ 3rd
☐ 4th
☐ 5th
☐ 6th
☐ 7th
☐ 8th
☐ 9th
☐ 10th
☐ 11th
☐ 12th

1 Self-contained teachers are typically elementary teachers. A self-contained teacher teaches multiple subjects to a single class of students all or most of the day.

2. *[High schools only]* Do students in this school take courses on a semester-block schedule (meaning students enroll in one set of courses in the fall semester and another set in the spring semester)?

○	Yes
○	No

3. *[If Q2=Yes]* When does the spring semester start? (For example, 07/25/2017)

On this form, you will enter all K–12 teachers **at this school** who are expected to teach computer science, mathematics, science, and/or engineering in the spring of 2018 regardless of how much instructional time they devote to these subjects. Do **not** include pre-Kindergarten teachers, teacher assistants, or teachers responsible only for special education or "pull-out" classes for remediation or enrichment of students who also receive instruction in one or more of these subjects from the regular classroom teacher.

For the purposes of this survey, the following are ***not*** considered computer science, mathematics, science, or engineering courses: Health, Hygiene, Technology Education, Business, Career-Technical Education (CTE) courses that cover such things as automotive repair or audio/video production.

4. How many teachers in your school will teach computer science, mathematics, science, and/or engineering in the spring of 2018? (Maximum 100) ___________

5. Please list each teacher and enter the following information below.

			SELF-CONTAINED				NOT SELF-CONTAINED					
TEACHER	FIRST	LAST	COMPUTER SCIENCE	ENGINEERING	MATHEMATICS	SCIENCE	HIGH SCHOOL PHYSICS OR CHEMISTRY	OTHER SCIENCE	ENGINEERING	HIGH SCHOOL CALCULUS OR ADVANCED MATHEMATICS	OTHER MATHEMATICS	COMPUTER SCIENCE
1												
….												
N												

6. ***[If a teacher teaches CS, either self-contained or not self-contained]***
You indicated that ***[First and Last Name]*** will teach computer science.

At what grade level are the computer science classes s/he will teach in spring 2018?

☐	K-5
☐	6-8
☐	9-12

7. Do any of the computer science classes s/he will teach in spring 2018 teach programming ***[or have programming as a prerequisite (Shown if school includes grades 6-12)]***?

○	Yes
○	No

Mathematics Program Questionnaire
Please designate someone to complete the Mathematics Program Questionnaire. If possible, this questionnaire should be completed by the mathematics department chair or a mathematics lead teacher. The person completing this questionnaire should have a broad understanding of mathematics instruction within your school. You may select someone from the list below, or select "other" and enter a new name.

8. **MATHEMATICS** Program Questionnaire Designee:
[List of all teachers and coordinator, principal]
   - o [Coordinator Name]
   - o [Principal Name]
   - o [Teacher 1]
   - o …..
   - o [Teacher X]
   - o Other (please specify below):

Title (Dr., Mr., Mrs., etc.): ________________
First name: ________________
Last name: ________________

Science Program Questionnaire
Please designate someone to complete the Science Program Questionnaire. If possible, this questionnaire should be completed by the science department chair or a science lead teacher. The person completing this questionnaire should have a broad understanding of science instruction within your school. You may select someone from the list below, or select "other" and enter a new name.

9. **SCIENCE** Program Questionnaire Designee:
   [List of all teachers and coordinator, principal]
   - o [Coordinator Name]
   - o [Principal Name]
   - o [Teacher 1]
   - o …..
   - o [Teacher X]
   - o Other (please specify below):

Title (Dr., Mr., Mrs., etc.): ________________
First name: ________________
Last name: ________________

Thank you for completing the Teacher Listing Form. Your responses have been successfully submitted. **Please remember to complete the School Questionnaire as soon as possible if you have not already** (the link is in the email we sent previously).

If you have any questions, please contact us by email at nssme18@horizon-research.com.
You should receive a confirmation email verifying your responses were received (check your spam folder if you do not see it).

Survey Questionnaires

School Coordinator Questionnaire

Science Program Questionnaire

Mathematics Program Questionnaire

Science Teacher Questionnaire

Mathematics Teacher Questionnaire

High School Computer Science Teacher Questionnaire

2018 NSSME+
School Coordinator Questionnaire

1. How many students are currently enrolled in each of the following grades in your school?

	NUMBER OF STUDENTS
Pre-Kindergarten	
Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	
Ungraded	

2. Please indicate the number of students in this school in each of the following categories: (Please count each student only once.)

	NUMBER OF STUDENTS
American Indian or Alaska Native	
Asian	
Black or African American	
Hispanic/Latino	
Native Hawaiian or Other Pacific Islander	
White	
Two or more races	

3. Of the students in this school, how many…

	NUMBER OF STUDENTS
a. are eligible for free or reduced-price lunch?	
b. have an Individualized Education Plan (IEP)?	
c. are classified as English-language learners?	

4. ***[High schools only]***
Does your school use block scheduling (class periods scheduled to create extended blocks of instructional time) to organize most classes? *Select one.*

○	Yes
○	No

5. ***[High schools only]***
Does your school offer courses in which students can earn credit toward graduation in multiple subjects for the same course? *Select one.*

○	Yes
○	No ***[Skip to Question 7]***

6. ***[High schools only]***
For which of the following combinations of subjects does your school offer these courses? *Select all that apply.*

☐	a.	Mathematics and science
☐	b.	Mathematics and computer science
☐	c.	Science and computer science
☐	d.	None of these combinations

7. ***[High schools only]***
In each of the following subjects, does your school allow students to demonstrate mastery of course content for credit in a course without the normal seat-time requirement? *Select one on each row.*

		YES	NO
a.	Computer science	○	○
b.	Mathematics	○	○
c.	Science	○	○

8. Does your school have… *Select one on each row.*

		YES	NO
a.	One or more computer labs available for teachers to schedule for their classes?	○	○
b.	Laptop/tablet carts available for teachers to use with their classes?	○	○
c.	A 1-to-1 initiative (every student is provided with a laptop or tablet)?	○	○
d.	School-wide Wi-Fi?	○	○

9. Which of the following best describes your school's policy about students using their own computing devices in classes? *Select one.*

○	Students are required to provide their own laptops or tablets for use in classes.
○	Students are not required but are allowed to bring their own laptops or tablets for use in classes.
○	Students are not allowed to use their own laptops or tablets in classes.

10. Do any teachers in your school travel among different rooms because of a shortage of classrooms? *Select one.*

○	Yes
○	No *[Skip to Question 12]*

11. Does your school ensure that teachers in their first year of teaching do not have to travel among different classrooms? *Select one.*

○	Yes
○	No

12. Does your school/district/diocese have a formal induction program for teachers new to the profession (support that is not offered to other teachers in the school)? *Select one.*

○	Yes
○	No *[Skip to Question 17]*

13. How long does a teacher typically receive support from the induction program? *Select one.*

○	One year or less
○	2 years
○	3 or more years

14. Which of the following organizations are involved in developing and implementing the induction program? *Select all that apply.*

☐	a.	School
☐	b.	District/Diocese (if applicable)
☐	c.	Regional or county educational service
☐	d.	Local university
☐	e.	Other; please specify __________

15. Which of the following supports are provided as part of the formal induction program? *Select all that apply.*

☐	a.	Release time to attend national, state, or local teacher conferences
☐	b.	Financial support to attend national, state, or local teacher conferences
☐	c.	Common planning time with experienced teachers who teach the same subject or grade level
☐	d.	Release time to observe other teachers in their grade/subject area
☐	e.	Formally assigned school-based mentor teachers
☐	f.	District/diocese-based or university-based mentors
☐	g.	Reduced course load
☐	h.	Reduced class size
☐	i.	Reduced number of teaching preps
☐	j.	A meeting to orient them to school/district/diocese policies and practices
☐	k.	Professional development opportunities on teaching their subject
☐	l.	Professional development opportunities on providing instruction that meets the needs of students from the cultural backgrounds represented in your school
☐	m.	Classroom aides/teaching assistants
☐	n.	Supplemental funding for classroom supplies

16. ***[For schools that select Question 15e only]***
Are formally assigned school-based mentor teachers in your school's induction program… *Select one on each row.*

		YES	NO
a.	given extra compensation for being a mentor?	○	○
b.	intentionally given release time or a reduced course load to work with their mentee?	○	○
c.	given training on effective mentoring practices?	○	○
d.	required to attend workshops with their mentees?	○	○
e.	when feasible, intentionally assigned to beginning teachers who teach the same subject or grade level?	○	○
f.	when feasible, intentionally given common planning time with their mentees?	○	○

Computer Science Programs and Practices

17. Indicate whether your school does each of the following to enhance students' interest and/or achievement in computer science. *Select one on each row.*

		YES	NO
a.	Holds family computer science nights	○	○
b.	Offers after-school help in computer science (for example: tutoring)	○	○
c.	Offers formal after-school programs for enrichment in computer science	○	○
d.	Offers one or more computer science clubs	○	○
e.	Participates in Hour of Code	○	○
f.	Participates in a local or regional computer science fair	○	○
g.	Has one or more teams participating in computer science competitions (for example: USA Computer Science Olympiad)	○	○
h.	Encourages students to participate in computer science summer programs or camps offered by community colleges, universities, museums or computer science centers	○	○
i.	Coordinates visits to business, industry, and/or research sites related to computer science	○	○
j.	Coordinates meetings with adult mentors who work in computer science fields	○	○
k.	*[High schools only]* Coordinates internships in computer science fields	○	○

18. *[Elementary and middle schools only]*
Does your school provide computer programming (for example: LOGO, Python, Scratch, Snap!) instruction to any or all students during the regular school day? *Select one.*

○	Yes
○	No *[Skip to Question 30]*

19. Omitted – Item did not function properly.

20. Omitted – Item did not function properly.

21. *[Elementary schools only]*
Who provides computer programming (for example: LOGO, Python, Scratch, Snap!) instruction to grades K–5 students during the regular school day? *Select all that apply.*

☐	a.	Regular classroom teachers
☐	b.	A school/district/diocese specialist
☐	c.	Someone from outside of the school/district/diocese (for example: volunteers, university personnel)

22. ***[High schools only]***
In which of the following ways can grades 9–12 students in this school take a computer science course that teaches programming or requires programming as a prerequisite? *Select all that apply.*

☐	a.	From a teacher in this school
☐	b.	Through virtual courses offered by other schools/institutions (for example: online, videoconference)
☐	c.	By going to a Career and Technical Education (CTE) center
☐	d.	By going to another high school
☐	e.	By going to a college or university
☐	f.	Grades 9-12 students in this school cannot take a computer science course that teaches programming or requires programming as a prerequisite ***[If selected, skip to Question 30]***

23. ***[High schools only]***
Does your school offer each of the following types of computer science courses that might qualify for college credit? Include both courses that are offered every year and those offered in alternating years. *Select one on each row.*

	YES	NO
a. Advanced Placement (AP) computer science courses	○	○
b. International Baccalaureate (IB) computer science courses	○	○
c. Concurrent college and high school credit/dual enrollment computer science courses ***[If no, skip to Question 25]***	○	○

24. ***[High schools only]***
When are concurrent college and high school credit/dual enrollment computer science courses offered in this school? *Select one.*

○	Offered this school year
○	Not offered this school year, but offered in alternating years

25. ***[High schools only]***
Which of the following computer science courses are available to students in this school? For each course that is available, indicate where and when it is offered. *Select one on each row in each section, if applicable.*

		AVAILABLE?		[IF AVAILABLE] WHERE OFFERED		[IF AVAILABLE] WHEN OFFERED	
		YES	NO	AT THIS SCHOOL	ELSEWHERE (OFFSITE OR ONLINE)	THIS YEAR	NOT THIS YEAR, BUT IN ALTERNATING YEARS
a.	AP Computer Science A	○	○	○	○	○	○
b.	AP Computer Science Principles	○	○	○	○	○	○
c.	IB Computer science standard level	○	○	○	○	○	○
d.	IB Computer science higher level	○	○	○	○	○	○
e.	Other IB computer science course	○	○	○	○	○	○

26. ***[High schools only]***
Is your school offering any computer science courses in the following categories this school year for students in any grades 9–12? *Select one on each row.*

	GRADES 9–12 COURSE TYPE	EXAMPLE COURSES	YES	NO
a.	**Computer technology courses that do <u>not</u> include programming**	Computer literacy, Keyboarding, Media technology (digital video/audio, multimedia presentations, digital arts), Desktop publishing, Computer applications (word processing, spreadsheets, slide presentations), Computer repair and computer networking, Web design, Computer-aided design (architectural drawing, fashion design), Other technology courses that do not teach or require programming	○	○
b.	**Introductory high school computer science courses <u>that include programming but do not qualify for college credit</u>**	Computer Science Discoveries on code.org, Exploring computer science, PLTW's Computer Science Essentials, introductory programming course, IB Computer Science–Standard Level, Computer science elective that includes introductory programming	○	○
c.	**Specialized/elective computer science courses with programming as a prerequisite <u>that do not qualify for college credit</u>**	Advanced Computer science electives such as Robotics, Game or mobile app development, or other advanced computer science elective with programming as a prerequisite	○	○

27. ***[High schools only; skip if no computer science courses that teach programming or have programming as a prerequisite are offered this year]***
Approximately how many students in grades 9–12 in this school will take a computer science course this year that includes programming or has programming as a prerequisite?

NUMBER OF STUDENTS

Computer Science Requirements

28. *[High schools only]*
In order to graduate from this high school, how many years of computer science are grades 9–12 students required to take? *Select one.*

○	0 years
○	½ year
○	1 year
○	2 years
○	3 years
○	4 years

29. *[High schools only]*
Can computer science courses count towards students' high school graduation requirements in each of the following subject areas? *Select one on each row.*

	YES	NO
a. Mathematics	○	○
b. Science	○	○
c. Foreign language	○	○

Computer Science Professional Development

30. **In the last three years**, has your school and/or district/diocese offered **workshops** specifically focused on computer science or computer science teaching, possibly in conjunction with other organizations (for example: other school districts/dioceses, colleges or universities, museums, professional associations, commercial vendors)? *Select one.*

○	Yes
○	No

31. **In the last three years**, has your school and/or district/diocese offered **teacher study groups** where teachers meet on a regular basis to discuss teaching and learning of computer science, and possibly other content areas as well (sometimes referred to as Professional Learning Communities, PLCs, or lesson study)? *Select one.*

○	Yes
○	No

32. Do any teachers in your school have access to **one-on-one coaching** focused on improving their computer science instruction (include voluntary and/or required coaching)? *Select one.*

○	Yes
○	No

Thank you!

2018 NSSME+
Science Program Questionnaire

This questionnaire asks a number of questions about teachers of science. In responding, unless otherwise specified, consider ALL teachers of science in your school, including self-contained teachers who teach science and other subjects to the same group of students all or most of the day.

1. Which of the following describe your position? [Select all that apply.]

□	Science department chair
□	Science lead teacher or coach
□	Science/STEM specialist
□	Regular classroom teacher
□	Principal
□	Assistant principal
□	Other (please specify: ______________)

School Programs and Practices

2. *[Presented only to schools that include self-contained teachers]*
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		YES	NO
a.	Students in self-contained classes receive science instruction from a district/diocese/school science specialist instead of their regular teacher.	○	○
b.	Students in self-contained classes receive science instruction from a district/diocese/school science specialist in addition to their regular teacher.	○	○
c.	Students in self-contained classes receive science instruction on a regular basis from someone outside of the school district/diocese (for example: museum staff).	○	○
d.	Students in self-contained classes pulled out for remedial instruction in science.	○	○
e.	Students in self-contained classes pulled out for enrichment in science.	○	○
f.	Students in self-contained classes pulled out from science instruction for additional instruction in other content areas.	○	○

3. *[Presented only to schools that include any grades 9–12]*
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		YES	NO
a.	Physics courses offered this school year or in alternating years, on or off site.	○	○
b.	Students can go to a Career and Technical Education (CTE) Center for science and/or engineering instruction.	○	○
c.	This school provides students access to virtual science and/or engineering courses offered by other schools/institutions (for example: online, videoconference).	○	○
d.	This school provides its own science and/or engineering courses virtually (for example: online, videoconference).	○	○
e.	Students can go to another K–12 school for science and/or engineering courses.	○	○
f.	Students can go to a college or university for science and/or engineering courses.	○	○

4. Indicate whether your school does each of the following to enhance students' interest and/or achievement in science and/or engineering. [Select one on each row.]

		YES	NO
a.	Holds family science and/or engineering nights	○	○
b.	Offers after-school help in science and/or engineering (for example: tutoring)	○	○
c.	Offers formal after-school programs for enrichment in science and/or engineering	○	○
d.	Offers one or more science clubs	○	○
e.	Offers one or more engineering clubs	○	○
f.	Participates in a local or regional science and/or engineering fair	○	○
g.	Has one or more teams participating in science competitions (for example: Science Olympiad)	○	○
h.	Has one or more teams participating in engineering competitions (for example: Robotics)	○	○
i.	Encourages students to participate in science and/or engineering summer programs or camps (for example: offered by community colleges, universities, museums, or science centers)	○	○
j.	Coordinates visits to business, industry, and/or research sites related to science and/or engineering	○	○
k.	Coordinates meetings with adult mentors who work in science and/or engineering fields	○	○
l.	Coordinates internships in science and/or engineering fields	○	○

Your State Standards

5. Please provide your opinion about each of the following statements in regard to your current state standards for science. [Select one on each row.]

		STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
a.	State science standards have been thoroughly discussed by science teachers in this school.	①	②	③	④	⑤
b.	There is a school-wide effort to align science instruction with the state science standards.	①	②	③	④	⑤
c.	Most science teachers in this school teach to the state standards.	①	②	③	④	⑤
d.	This school/district/diocese organizes science professional development based on state standards.	①	②	③	④	⑤

Science Courses Offered in Your School

6. *[Presented only to schools that include any grades 6–8]*
What types of science courses are offered to students in the following grades? [Select one on each row.]

	SINGLE-DISCIPLINE SCIENCE COURSES (FOR EXAMPLE: LIFE SCIENCE)	MULTI-DISCIPLINE SCIENCE COURSES (FOR EXAMPLE: GENERAL SCIENCE, INTEGRATED SCIENCE)	BOTH SINGLE-DISCIPLINE AND MULTI-DISCIPLINE SCIENCE COURSES
6th Grade	○	○	○
7th Grade	○	○	○
8th Grade	○	○	○

7. *[Presented only to schools that include any grades 9–12]*
Approximately how many students in grades 9–12 in this school will **not** take a science course this year? [Enter your response as a whole number (for example: 1500).]
____

[Questions 8–13 presented only to schools that include any grades 9–12; schools that do not include any of these grades skip to Q14]

8. Is your school offering any courses in each of the following categories **this year** for students in grades 9–12? [Select one on each row.]

	YES	NO
a. Coordinated/Integrated/Interdisciplinary science (including General Science and Physical Science)		
i. Non-college prep	○	○
ii. College prep, including honors	○	○
b. Earth/Space Science		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including concurrent college and high school credit/dual enrollment courses	○	○
c. Life Science/Biology		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses	○	○
d. Environmental Science/Ecology		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses	○	○
e. Chemistry		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses	○	○
f. Physics		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment courses	○	○
g. Engineering—Include courses that address the nature of engineering, engineering design processes, technological systems, or technology and society. Do not include career-technical education (CTE) courses that cover such things as automotive repair, audio/video production, etc.		
i. Non-college prep	○	○
ii. 1st year college prep, including honors	○	○
iii. 2nd year advanced, including concurrent college and high school credit/dual enrollment courses	○	○

9. Does your school offer each of the following types of science courses that might qualify for college credit? (Include both courses that are offered every year and those offered in alternating years.) [Select one on each row.]

		YES	NO
a.	Advanced Placement (AP) science courses	○	○
b.	International Baccalaureate (IB) science courses	○	○
c.	Concurrent college and high school credit/dual enrollment science courses	○	○

10. *[Presented only to schools that selected "Yes" for Q9c]*
When are concurrent college and high school credit/dual enrollment science courses offered?

○	Offered this school year
○	Not offered this school year, but offered in alternating years

11. Which of the following science courses are available to students in this school, either on site, at other locations, or online? [Select one on each row.]

		AVAILABLE		*[IF AVAILABLE]* WHERE OFFERED		*[IF AVAILABLE]* WHEN OFFERED	
		YES	NO	AT THIS SCHOOL	ELSEWHERE (OFFSITE OR ONLINE)	THIS YEAR	NOT THIS YEAR, BUT IN ALTERNATING YEARS
a.	*[Skip if Q9a was "No"]* AP Biology	○	○	○	○	○	○
b.	*[Skip if Q9a was "No"]* AP Chemistry	○	○	○	○	○	○
c.	*[Skip if Q9a was "No"]* AP Physics 1	○	○	○	○	○	○
d.	*[Skip if Q9a was "No"]* AP Physics 2	○	○	○	○	○	○
e.	*[Skip if Q9a was "No"]* AP Physics C: Electricity and Magnetism	○	○	○	○	○	○
f.	*[Skip if Q9a was "No"]* AP Physics C: Mechanics	○	○	○	○	○	○
g.	*[Skip if Q9a was "No"]* AP Environmental Science	○	○	○	○	○	○
h.	*[Skip if Q9b was "No"]* IB Biology	○	○	○	○	○	○
i.	*[Skip if Q9b was "No"]* IB Chemistry	○	○	○	○	○	○
j.	*[Skip if Q9b was "No"]* IB Physics	○	○	○	○	○	○
k.	*[Skip if Q9b was "No"]* IB Physics	○	○	○	○	○	○

Science Requirements

12. *[Presented only to schools that include grade 12]*
    In order to graduate from this high school, how many years of grades 9–12 science are students required to take?

1 YEAR	2 YEARS	3 YEARS	4 YEARS
○	○	○	○

13. *[Presented only to schools that include grade 12]*
    Does participation in Engineering courses count towards students' high school graduation requirements for science?

○	Yes
○	No

Influences on Science Instruction

14. For this school, how much money was spent on each of the following during the most recently completed budget year? (If you don't know the exact amounts, please provide your best estimates.) [Enter each response as a whole dollar amount without special characters such as dollar signs (for example: 1500).]

a.	Consumable supplies for science instruction (for example: chemicals, living organisms, batteries)	
b.	Science equipment (non-consumable, non-perishable items such as microscopes, scales, etc., but not computers)	
c.	Software for science instruction	

15. Which of the following best describes how the science instructional materials used in your school are selected?
    [Select one.]

○	At the district/diocese level (for example: by a science supervisor or district/diocese-wide committee) ***[Not presented to non-Catholic private schools]***
○	At the school level (for example: by the principal, department chair, or teacher committee/grade-level team)
○	By individual teachers

16. Please rate the effect of each of the following on the quality of science instruction in your school. [Select one on each row.]

		INHIBITS EFFECTIVE INSTRUCTION		NEUTRAL OR MIXED		PROMOTES EFFECTIVE INSTRUCTION
a.	The school/district/diocese science professional development policies and practices	①	②	③	④	⑤
b.	The amount of time provided by the school/district/diocese for teacher professional development in science	①	②	③	④	⑤
c.	The importance that the school places on science	①	②	③	④	⑤
d.	Other school and/or district/diocese initiatives	①	②	③	④	⑤
e.	The amount of time provided by the school/district/diocese for teachers to share ideas about science instruction	①	②	③	④	⑤
f.	How science instructional resources are managed (for example: distributing and refurbishing materials)	①	②	③	④	⑤

17. In your opinion, how great a problem is each of the following for science instruction **in your school as a whole**? [Select one on each row.]

		NOT A SIGNIFICANT PROBLEM	SOMEWHAT OF A PROBLEM	SERIOUS PROBLEM
a.	Lack of science facilities (for example: lab tables, electric outlets, faucets and sinks in classrooms)	①	②	③
b.	Inadequate funds for purchasing science equipment and supplies	①	②	③
c.	Lack of science textbooks/modules	①	②	③
d.	Poor quality science textbooks/modules	①	②	③
e.	Inadequate materials for differentiating science instruction	①	②	③
f.	Low student interest in science	①	②	③
g.	Low student prior knowledge and skills	①	②	③
h.	Lack of teacher interest in science	①	②	③
i.	Inadequate teacher preparation to teach science	①	②	③
j.	High teacher turnover	①	②	③
k.	Insufficient instructional time to teach science	①	②	③
l.	Inadequate science-related professional development opportunities	①	②	③
m.	Large class sizes	①	②	③
n.	High student absenteeism	①	②	③
o.	Inappropriate student behavior	①	②	③
p.	Lack of parent/guardian support and involvement	①	②	③
q.	Community resistance to the teaching of "controversial" issues in science (for example: evolution, climate change)	①	②	③

Science Professional Development Opportunities

18. **In the last 3 years**, has your school and/or district/diocese offered **workshops** specifically focused on science/engineering or science/engineering teaching, possibly in conjunction with other organizations (for example: other schools/districts/dioceses, colleges or universities, museums, professional associations, commercial vendors)?

○	Yes
○	No *[Skip to Q20]*

19. Please indicate the extent to which **workshops** offered by your school and/or district/diocese **in the last 3 years** emphasized each of the following: [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	Deepening teachers' understanding of science concepts	①	②	③	④	⑤
b.	Deepening teachers' understanding of how science is done (for example: developing scientific questions, developing and using models, engaging in argumentation)	①	②	③	④	⑤
c.	Deepening teachers' understanding of how engineering is done (for example: identifying criteria and constraints, designing solutions, optimizing solutions)	①	②	③	④	⑤
d.	Deepening teachers' understanding of the state science standards	①	②	③	④	⑤
e.	Deepening teachers' understanding of how students think about various science ideas	①	②	③	④	⑤
f.	How to use particular science/engineering instructional materials (for example: textbooks or modules)	①	②	③	④	⑤
g.	How to monitor student understanding during science instruction	①	②	③	④	⑤
h.	How to adapt science instruction to address student misconceptions	①	②	③	④	⑤
i.	How to use technology in science instruction	①	②	③	④	⑤
j.	How to develop students' confidence that they can successfully pursue careers in science/engineering	①	②	③	④	⑤
k.	How to incorporate real-world issues (for example: current events, community concerns) into science instruction	①	②	③	④	⑤
l.	How to connect instruction to science/engineering career opportunities	①	②	③	④	⑤
m.	How to integrate science, engineering, mathematics, and/or computer science	①	②	③	④	⑤
n.	How to engage students in doing science (for example: developing scientific questions, developing and using models, engaging in argumentation)	①	②	③	④	⑤
o.	How to engage students in doing engineering (for example: identifying criteria and constraints, designing solutions, optimizing solutions)	①	②	③	④	⑤
p.	How to incorporate students' cultural backgrounds into science instruction	①	②	③	④	⑤
q.	How to differentiate science instruction to meet the needs of diverse learners	①	②	③	④	⑤

20. **In the last 3 years**, has your school offered **teacher study groups** where teachers meet on a regular basis to discuss teaching and learning of science/engineering, and possibly other content areas as well (sometimes referred to as Professional Learning Communities, PLCs, or lesson study)?

○	Yes
○	No *[Skip to Q32]*

21. *[Presented only to schools that include any grades K–5]*
Typically, are teachers of grades K–5 science required to participate in these science/engineering-focused **teacher study groups**?

○	Yes, all teachers of grades K–5 science
○	Yes, but only science/STEM specialists
○	No

22. *[Presented only to schools that include any grades 6–8]*
Typically, are teachers of grades 6–8 science classes required to participate in these science/engineering-focused **teacher study groups**?

○	Yes
○	No

23. *[Presented only to schools that include any grades 9–12]*
Typically, are teachers of grades 9–12 science classes required to participate in these science/engineering-focused **teacher study groups**?

○	Yes
○	No

24. Has your school specified a schedule for when these science/engineering-focused **teacher study groups** are expected to meet?

○	Yes
○	No *[Skip to Q27]*

25. Over what period of time have these science/engineering-focused **teacher study groups** typically been expected to meet?

○	The entire school year
○	One semester
○	Less than one semester

26. How often have these science/engineering-focused teacher study groups typically been expected to meet?

○	Less than once a month
○	Once a month
○	Twice a month
○	More than twice a month

27. Which of the following describe the typical science/engineering-focused **teacher study groups** in this school? [Select all that apply.]

□	Organized by grade level
□	Include teachers from multiple grade levels
□	Include teachers who teach different science/engineering subjects
□	Include parents/guardians or other community members
□	Include higher education faculty or other “consultants”
□	Include school and/or district/diocese administrators
□	Limited to teachers from this school
□	Include teachers from other schools in the district/diocese *[Not presented to non-Catholic private schools]*
□	Include teachers from other schools outside of your district/diocese

28. Which of the following describe the typical science/engineering-focused **teacher study groups** in this school? [Select all that apply.]

□	Teachers engage in science investigations.
□	Teachers engage in engineering design challenges.
□	Teachers analyze student science assessment results.
□	Teachers analyze science/engineering instructional materials (for example: textbooks or modules).
□	Teachers plan science/engineering lessons together.
□	Teachers rehearse instructional practices (meaning: try out, receive feedback, and reflect on those practices).
□	Teachers observe each other's science/engineering instruction (either in-person or through video recording).
□	Teachers provide feedback on each other's science/engineering instruction.
□	Teachers examine classroom artifacts (for example: student work samples, videos of classroom instruction).

29. To what extent have these science/engineering-focused **teacher study groups** emphasized each of the following? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	Deepening teachers' understanding of science concepts	①	②	③	④	⑤
b.	Deepening teachers' understanding of how science is done (for example: developing scientific questions, developing and using models, engaging in argumentation)	①	②	③	④	⑤
c.	Deepening teachers' understanding of how engineering is done (for example: identifying criteria and constraints, designing solutions, optimizing solutions)	①	②	③	④	⑤
d.	Deepening teachers' understanding of the state science standards	①	②	③	④	⑤
e.	Deepening teachers' understanding of how students think about various science ideas	①	②	③	④	⑤
f.	How to use particular science/engineering instructional materials (for example: textbooks or modules)	①	②	③	④	⑤
g.	How to monitor student understanding during science/engineering instruction	①	②	③	④	⑤
h.	How to adapt science instruction to address student misconceptions	①	②	③	④	⑤
i.	How to use technology in science instruction	①	②	③	④	⑤
j.	How to develop students' confidence that they can successfully pursue careers in science/engineering	①	②	③	④	⑤
k.	How to incorporate real-world issues (for example: current events, community concerns) into science instruction	①	②	③	④	⑤
l.	How to connect instruction to science/engineering career opportunities	①	②	③	④	⑤
m.	How to integrate science, engineering, mathematics, and/or computer science	①	②	③	④	⑤
n.	How to engage students in doing science (for example: developing scientific questions, developing and using models, engaging in argumentation)	①	②	③	④	⑤
o.	How to engage students in doing engineering (for example: identifying criteria and constraints, designing solutions, optimizing solutions)	①	②	③	④	⑤
p.	How to incorporate students' cultural backgrounds into science instruction	①	②	③	④	⑤
q.	How to differentiate science instruction to meet the needs of diverse learners	①	②	③	④	⑤

30. Have there been designated leaders for these science/engineering-focused **teacher study groups**?

○	Yes
○	No *[Skip to Q32]*

31. The designated leaders of these science/engineering-focused **teacher study groups** were from: [Select all that apply.]

☐	This school
☐	Elsewhere in this district/diocese *[Not presented to non-Catholic private schools]*
☐	College/University
☐	External consultants
☐	Other (please specify: ________________)

32. Thinking about last school year, which of the following were used to provide teachers in this school with time for professional development workshops/teacher study groups that included a focus on science/engineering and/or science/engineering teaching, regardless of whether they were offered by your school and/or district/diocese? [Select all that apply.]

☐	Early dismissal and/or late start for students
☐	Professional days/teacher work days during the students' school year
☐	Professional days/teacher work days before and/or after the students' school year
☐	Common planning time for teachers
☐	Substitute teachers to cover teachers' classes while they attend professional development
☐	None of the above

33. Do any teachers in your school have access to **one-on-one coaching** focused on improving their science instruction (include voluntary and required coaching)?

○	Yes
○	No *[Skip to Q36]*

34. This school year, how many teachers in this school have received one-on-one coaching focused on improving their science instruction (include voluntary and required coaching)? [Enter response as a whole number (for example: 15)] ______________________

35. To what extent is one-on-one coaching focused on improving science instruction provided by each of the following? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	The principal of your school	①	②	③	④	⑤
b.	An assistant principal at your school	①	②	③	④	⑤
c.	District/Diocese administrators including science supervisors/coordinators *[Not presented to non-Catholic private schools]*	①	②	③	④	⑤
d.	Teachers/coaches who do not have classroom teaching responsibilities	①	②	③	④	⑤
e.	Teachers/coaches who have part-time classroom teaching responsibilities	①	②	③	④	⑤
f.	Teachers/coaches who have full-time classroom teaching responsibilities	①	②	③	④	⑤

36. Which of the following are provided to teachers considered in need of special assistance in science teaching? [Select all that apply.]

□	Seminars, classes, and/or study groups
□	Guidance from a formally designated mentor or coach
□	A higher level of supervision than for other teachers
□	None of the above

Thank you!

2018 NSSME+
Mathematics Program Questionnaire

This questionnaire asks a number of questions about teachers of mathematics. In responding, unless otherwise specified, consider ALL teachers of mathematics in your school, including self-contained teachers who teach mathematics and other subjects to the same group of students all or most of the day.

1. Which of the following describe your position? [Select all that apply.]

☐	Mathematics department chair
☐	Mathematics lead teacher or coach
☐	Mathematics/STEM specialist
☐	Regular classroom teacher
☐	Principal
☐	Assistant principal
☐	Other (please specify: _______________)

School Programs and Practices

2. ***[Presented only to schools that include self-contained teachers]***
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		YES	NO
a.	Students in self-contained classes receive mathematics instruction from a district/diocese/school mathematics specialist **instead of** their regular teacher.	○	○
b.	Students in self-contained classes receive mathematics instruction from a district/diocese/school mathematics specialist **in addition** to their regular teacher.	○	○
c.	Students in self-contained classes pulled out for remedial instruction in mathematics.	○	○
d.	Students in self-contained classes pulled out for enrichment in mathematics.	○	○
e.	Students in self-contained classes pulled out from mathematics instruction for additional instruction in other content areas.	○	○

3. *[Presented only to schools that include any grades 9–12]*
Indicate whether each of the following programs and/or practices is currently being implemented in your school. [Select one on each row.]

		YES	NO
a.	Algebra 1 course, or its equivalent, offered over two years or as two separate block courses (for example: Algebra A and Algebra B, or Integrated Math A and Integrated Math B).	○	○
b.	Calculus courses (beyond pre-Calculus) offered this school year or in alternating years, on or off site.	○	○
c.	Students can go to a Career and Technical Education (CTE) center for mathematics instruction.	○	○
d.	This school provides students access to virtual mathematics courses offered by other schools/institutions (for example: online, videoconference).	○	○
e.	This school provides its own mathematics courses virtually (for example: online, videoconference).	○	○
f.	Students can go to another K–12 school for mathematics courses.	○	○
g.	Students can go to a college or university for mathematics courses.	○	○

4. Indicate whether your school does each of the following to enhance students' interest and/or achievement in mathematics. [Select one on each row.]

		YES	NO
a.	Holds family math nights	○	○
b.	Offers after-school help in mathematics (for example: tutoring)	○	○
c.	Offers formal after-school programs for enrichment in mathematics	○	○
d.	Offers one or more mathematics clubs	○	○
e.	Participates in a local or regional mathematics fair	○	○
f.	Has one or more teams participating in mathematics competitions (for example: Math Counts)	○	○
g.	Encourages students to participate in mathematics summer programs or camps (for example: offered by community colleges, universities, museums or mathematics centers)	○	○
h.	Coordinates visits to business, industry, and/or research sites related to mathematics	○	○
i.	Coordinates meetings with adult mentors who work in mathematics fields	○	○
j.	Coordinates internships in mathematics fields	○	○

Your State Standards

5. Please provide your opinion about each of the following statements in regard to your current state standards for mathematics. [Select one on each row.]

	STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
a. State mathematics standards have been thoroughly discussed by mathematics teachers in this school.	①	②	③	④	⑤
b. There is a school-wide effort to align mathematics instruction with the state mathematics standards.	①	②	③	④	⑤
c. Most mathematics teachers in this school teach to the state standards.	①	②	③	④	⑤
d. The school/district/diocese organizes mathematics professional development based on state standards.	①	②	③	④	⑤

Student Enrollment in Mathematics Courses

6. *[Presented only to schools that include grade 8]*
Approximately how many of this year's 8th grade students will have completed Algebra 1 or its equivalent (for example: Integrated Math 1) prior to 9th grade? [Enter your response as a whole number (for example: 15).] ____________________

7. *[Presented only to schools that include grade 8]*
Approximately how many of this year's 8th grade students will have completed Geometry or its equivalent (for example Integrated Math 2) prior to 9th grade? [Enter your response as a whole number (for example: 15).] ____________________

8. *[Presented only to schools that include any grades 9–12]*
Approximately how many students in grades 9–12 in this school will **not** take a mathematics course this year? [Enter your response as a whole number (for example: 1500)] __________

Mathematics Courses Offered in Your School

[Questions 9–16 presented only to schools that include any grades 9–12; schools that do not include any of these grades skip to Q17]

9. What types of mathematics courses are offered to grades 9–12 students in your school **this year**? [Select all that apply.]

☐	Single-subject mathematics courses (for example: Algebra, Geometry)
☐	Integrated mathematics courses

10. Is your school offering any courses in each of the following categories **this year** for students in grades 9–12? [Select one on each row.]

	YES	NO
a. **Non-college prep mathematics courses** *Example courses*: Developmental Math; High School Arithmetic; Remedial Math; General Math; Vocational Math; Consumer Math; Basic Math; Business Math; Career Math; Practical Math; Essential Math; Pre-Algebra; Introductory Algebra; Algebra 1 Part 1; Algebra 1A; Math A; Basic Geometry; Informal Geometry; Practical Geometry	○	○
b. **Formal/College prep mathematics level 1 courses** *Example courses:* Algebra 1; Integrated Math 1; Unified Math I; Algebra 1 Part 2; Algebra 1B; Math B	○	○
c. **Formal/College prep mathematics level 2 courses** *Example courses:* Geometry; Plane Geometry; Solid Geometry; Integrated Math 2; Unified Math II; Math C	○	○
d. **Formal/College prep mathematics level 3 courses** *Example courses:* Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra; Integrated Math 3; Unified Math III	○	○
e. **Formal/College prep mathematics level 4 courses** *Example courses:* Algebra 3; Trigonometry; Pre-Calculus; Analytic/Advanced Geometry; Elementary Functions; Integrated Math 4, Unified Math IV; Calculus (not including college level/AP); any other College Prep Senior Math with Algebra 2 as a prerequisite	○	○
f. **Mathematics courses that might qualify for college credit** *Example courses:* Advanced Placement Calculus (AB, BC); Advanced Placement Statistics; IB Mathematics Standard Level; IB Mathematics Higher Level; concurrent college and high school credit/ dual enrollment	○	○

11. Does this school offer one or more courses focused specifically on probability and/or statistics? (Include both courses that are offered every year and those offered in alternating years.)

○	Yes
○	No *[Skip to Q13]*

12. What probability and/or statistics courses does this school offer? [Select all that apply.]

☐	Probability and Statistics combined
☐	Probability
☐	Statistics

13. Does your school offer each of the following types of mathematics courses that might qualify for college credit? (Include both courses that are offered every year and those offered in alternating years.) [Select one on each row.]

	YES	NO
a. Advanced Placement (AP) mathematics courses	○	○
b. International Baccalaureate (IB) mathematics courses	○	○
c. Concurrent college and high school credit/dual enrollment mathematics courses	○	○

14. *[Presented only to schools that selected "Yes" for Q13c]*
When are concurrent college and high school credit/dual enrollment mathematics courses offered?

○	Offered this school year
○	Not offered this school year, but offered in alternating years

15. Which of the following mathematics courses are available to students in this school, either on site, at other locations, or online? [Select one on each row.]

	AVAILABLE		*[IF AVAILABLE]* WHERE OFFERED		*[IF AVAILABLE]* WHEN OFFERED	
	YES	NO	AT THIS SCHOOL	ELSEWHERE (OFFSITE OR ONLINE)	THIS YEAR	NOT THIS YEAR, BUT IN ALTERNATING YEARS
a. *[Skip if Q13a was "No"]* AP Calculus AB	○	○	○	○	○	○
b. *[Skip if Q13a was "No"]* AP Calculus BC	○	○	○	○	○	○
c. *[Skip if Q13a was "No"]* AP Statistics	○	○	○	○	○	○
d. *[Skip if Q13b was "No"]* IB Mathematical Studies Standard Level	○	○	○	○	○	○
e. *[Skip if Q13b was "No"]* IB Mathematics Standard Level	○	○	○	○	○	○
f. *[Skip if Q13b was "No"]* IB Mathematics Higher Level	○	○	○	○	○	○
g. *[Skip if Q13b was "No"]* IB Further Mathematics Standard Level	○	○	○	○	○	○

Mathematics Requirements

16. *[Presented only to schools that include grade 12]*
In order to graduate from this high school, how many years of grades 9–12 mathematics are students required to take?

1 YEAR	2 YEARS	3 YEARS	4 YEARS
○	○	○	○

Influences on Mathematics Instruction

17. For this school, how much money was spent on each of the following during the most recently completed budget year? (If you don't know the exact amounts, please provide your best estimates.) [Enter each response as a whole dollar amount without special characters such as dollar signs (for example: 1500).]

a.	Consumable supplies for mathematics instruction (for example: graph paper)	
b.	Non-consumable items for mathematics instruction such as calculators, protractors, manipulatives, etc. (Do not include computers)	
c.	Software specific to mathematics instruction (for example: dynamic geometry software)	

18. Which of the following best describes how the mathematics instructional materials used in your school are selected? [Select one.]

○	At the district/diocese level (for example: by a mathematics supervisor or district/diocese -wide committee) ***[Not presented to non-Catholic private schools]***
○	At the school level (for example: by the principal, department chair, or teacher committee/grade-level team)
○	By individual teachers

19. Please rate the effect of each of the following on the quality of mathematics instruction in your school. [Select one on each row.]

	INHIBITS EFFECTIVE INSTRUCTION		NEUTRAL OR MIXED		PROMOTES EFFECTIVE INSTRUCTION
a. The school/district/diocese mathematics professional development policies and practices	①	②	③	④	⑤
b. The amount of time provided by the school/district/ diocese for teacher professional development in mathematics	①	②	③	④	⑤
c. The importance that the school places on mathematics	①	②	③	④	⑤
d. Other school and/or district/diocese initiatives	①	②	③	④	⑤
e. The amount of time provided by the school/district/ diocese for teachers to share ideas about mathematics instruction	①	②	③	④	⑤
f. How mathematics instructional resources are managed (for example: distributing and replacing materials)	①	②	③	④	⑤

20. In your opinion, how great a problem is each of the following for mathematics instruction **in your school as a whole**? [Select one on each row.]

	NOT A SIGNIFICANT PROBLEM	SOMEWHAT OF A PROBLEM	SERIOUS PROBLEM
a. Lack of 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)	①	②	③
b. Inadequate funds for purchasing mathematics equipment and supplies	①	②	③
c. Lack of mathematics textbooks	①	②	③
d. Poor quality mathematics textbooks	①	②	③
e. Inadequate materials for differentiating mathematics instruction	①	②	③
f. Low student interest in mathematics	①	②	③
g. Low student prior knowledge and skills	①	②	③
h. Lack of teacher interest in mathematics	①	②	③
i. Inadequate teacher preparation to teach mathematics	①	②	③
j. High teacher turnover	①	②	③
k. Insufficient instructional time to teach mathematics	①	②	③
l. Inadequate mathematics-related professional development opportunities	①	②	③
m. Large class sizes	①	②	③
n. High student absenteeism	①	②	③
o. Inappropriate student behavior	①	②	③
p. Lack of parent/guardian support and involvement	①	②	③
q. Community attitudes toward mathematics instruction	①	②	③

Mathematics Professional Development Opportunities

21. **In the last 3 years,** has your school and/or district/diocese offered **workshops** specifically focused on mathematics or mathematics teaching, possibly in conjunction with other organizations (for example: other schools/districts/dioceses, colleges or universities, museums, professional associations, commercial vendors)?

○	Yes
○	No *[Skip to Q23]*

22. Please indicate the extent to which **workshops** offered by your school and/or district/diocese **in the last 3 years** emphasized each of the following: [Select one on each row.]

	NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a. Deepening teachers' understanding of mathematics concepts	①	②	③	④	⑤
b. Deepening teachers' understanding of how mathematics is done (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	①	②	③	④	⑤
c. Deepening teachers' understanding of the state mathematics standards	①	②	③	④	⑤
d. Deepening teachers' understanding of how students think about various mathematical ideas	①	②	③	④	⑤
e. How to use particular mathematics instructional materials (for example: textbooks)	①	②	③	④	⑤
f. How to monitor student understanding during mathematics instruction	①	②	③	④	⑤
g. How to adapt mathematics instruction to address student misconceptions	①	②	③	④	⑤
h. How to use technology in mathematics instruction	①	②	③	④	⑤
i. How to use investigation-oriented tasks in mathematics instruction	①	②	③	④	⑤
j. How to develop students' confidence that they can successfully pursue careers in mathematics	①	②	③	④	⑤
k. How to incorporate real-world issues (for example: current events, community concerns) into mathematics instruction	①	②	③	④	⑤
l. How to connect instruction to mathematics career opportunities	①	②	③	④	⑤
m. How to integrate science, engineering, mathematics, and/or computer science	①	②	③	④	⑤
n. How to engage students in doing mathematics (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	①	②	③	④	⑤
o. How to incorporate students' cultural backgrounds into mathematics instruction	①	②	③	④	⑤
p. How to differentiate mathematics instruction to meet the needs of diverse learners	①	②	③	④	⑤

23. **In the last 3 years,** has your school offered **teacher study groups** where teachers meet on a regular basis to discuss teaching and learning of mathematics, and possibly other content areas as well (sometimes referred to as Professional Learning Communities, PLCs, or lesson study)?

○	Yes
○	No *[Skip to Q35]*

24. *[Presented only to schools that include any grades K–5]*
Typically, are teachers of grades K–5 mathematics required to participate in these mathematics-focused **teacher study groups**?

○	Yes, all teachers of grades K–5 mathematics
○	Yes, but only mathematics/STEM specialists
○	No

25. *[Presented only to schools that include any grades 6–8]*
Typically, are teachers of grades 6–8 mathematics classes required to participate in these mathematics-focused **teacher study groups**?

○	Yes
○	No

26. *[Presented only to schools that include any grades 9–12]*
Typically, are teachers of grades 9–12 mathematics classes required to participate in these mathematics-focused **teacher study groups**?

○	Yes
○	No

27. Has your school specified a schedule for when these mathematics-focused **teacher study groups** are expected to meet?

○	Yes
○	No *[Skip to Q30]*

28. Over what period of time have these mathematics-focused **teacher study groups** typically been expected to meet?

○	The entire school year
○	One semester
○	Less than one semester

29. How often have these mathematics-focused **teacher study groups** typically been expected to meet?

○	Less than once a month
○	Once a month
○	Twice a month
○	More than twice a month

30. Which of the following describe the typical mathematics-focused **teacher study groups** in this school? [Select all that apply.]

☐	Organized by grade level
☐	Include teachers from multiple grade levels
☐	Include teachers who teach different mathematics subjects
☐	Include parents/guardians or other community members
☐	Include higher education faculty or other "consultants"
☐	Include school and/or district/diocese administrators
☐	Limited to teachers from this school
☐	Include teachers from other schools in the district/diocese ***[Not presented to non-Catholic private schools]***
☐	Include teachers from other schools outside of your district/diocese

31. Which of the following describe the typical mathematics-focused **teacher study groups** in this school? [Select all that apply.]

☐	Teachers engage in mathematics investigations.
☐	Teachers analyze student mathematics assessment results.
☐	Teachers analyze mathematics instructional materials (for example: textbooks).
☐	Teachers plan mathematics lessons together.
☐	Teachers rehearse instructional practices (meaning: try out, receive feedback, and reflect on those practices).
☐	Teachers observe each other's mathematics instruction (either in-person or through video recording).
☐	Teachers provide feedback on each other's mathematics instruction.
☐	Teachers examine classroom artifacts (for example: student work samples, videos of classroom instruction).

32. To what extent have these mathematics-focused **teacher study groups** emphasized each of the following? [Select one on each row.]

	NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a. Deepening teachers' understanding of mathematics concepts	①	②	③	④	⑤
b. Deepening teachers' understanding of how mathematics is done (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	①	②	③	④	⑤
c. Deepening teachers' understanding of the state mathematics standards	①	②	③	④	⑤
d. Deepening teachers' understanding of how students think about various mathematical ideas	①	②	③	④	⑤
e. How to use particular mathematics instructional materials (for example: textbooks)	①	②	③	④	⑤
f. How to monitor student understanding during mathematics instruction	①	②	③	④	⑤
g. How to adapt mathematics instruction to address student misconceptions	①	②	③	④	⑤
h. How to use technology in mathematics instruction	①	②	③	④	⑤
i. How to use investigation-oriented tasks in mathematics instruction	①	②	③	④	⑤
j. How to develop students' confidence that they can successfully pursue careers in mathematics	①	②	③	④	⑤
k. How to incorporate real-world issues (for example: current events, community concerns) into mathematics instruction	①	②	③	④	⑤
l. How to connect instruction to mathematics career opportunities	①	②	③	④	⑤
m. How to integrate science, engineering, mathematics, and/or computer science	①	②	③	④	⑤
n. How to engage students in doing mathematics (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	①	②	③	④	⑤
o. How to incorporate students' cultural backgrounds into mathematics instruction	①	②	③	④	⑤
p. How to differentiate mathematics instruction to meet the needs of diverse learners	①	②	③	④	⑤

33. Have there been designated leaders for these mathematics-focused **teacher study groups**?

○	Yes
○	No *[Skip to Q35]*

34. The designated leaders of these mathematics-focused **teacher study groups** were from: [Select all that apply.]

☐	This school
☐	Elsewhere in this district/diocese *[Not presented to non-Catholic private schools]*
☐	College/University
☐	External consultants
☐	Other (please specify: ________________)

35. Thinking about last school year, which of the following were used to provide teachers in this school with time for professional development workshops/teacher study groups that included a focus on mathematics and/or mathematics teaching, regardless of whether they were offered by your school and/or district/diocese? [Select all that apply.]

□	Early dismissal and/or late start for students
□	Professional days/teacher work days during the students' school year
□	Professional days/teacher work days before and/or after the students' school year
□	Common planning time for teachers
□	Substitute teachers to cover teachers' classes while they attend professional development
□	None of the above

36. Do any teachers in your school have access to **one-on-one coaching** focused on improving their mathematics instruction (include voluntary and required coaching)?

○	Yes
○	No *[Skip to Q39]*

37. This school year, how many teachers in this school have received one-on-one coaching focused on improving their mathematics instruction (include voluntary and required coaching)? [Enter response as a whole number (for example: 15)] ______________

38. To what extent is one-on-one coaching focused on improving mathematics instruction provided by each of the following? [Select one on each row.]

	NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a. The principal of your school	①	②	③	④	⑤
b. An assistant principal at your school	①	②	③	④	⑤
c. District/Diocese administrators including mathematics supervisors/coordinators *[Not presented to non-Catholic private schools]*	①	②	③	④	⑤
d. Teachers/coaches who do not have classroom teaching responsibilities	①	②	③	④	⑤
e. Teachers/coaches who have part-time classroom teaching responsibilities	①	②	③	④	⑤
f. Teachers/coaches who have full-time classroom teaching responsibilities	①	②	③	④	⑤

39. Which of the following are provided to teachers considered in need of special assistance in mathematics teaching? [Select all that apply.]

☐	Seminars, classes, and/or study groups
☐	Guidance from a formally designated mentor or coach
☐	A higher level of supervision than for other teachers
☐	None of the above

Thank you!

2018 NSSME+
Science Teacher Questionnaire

Teacher Background and Opinions

1. How many years have you taught prior to this school year: [Enter each response as a whole number (for example: 15).]

a.	any subject at the K–12 level?	
b.	science at the K–12 level?	
c.	at this school, any subject?	

2. At what grade levels do you currently teach science? [Select all that apply.]

□	K–5
□	6–8
□	9–12
□	I do not currently teach science.

3. *[Presented to self-contained teachers only]*
Which best describes the science instruction provided to the entire class?
   - Do not consider pull-out instruction that some students may receive for remediation or enrichment.
   - Do not consider instruction provided to individual or small groups of students, for example by an English-language specialist, special educator, or teacher assistant.

○	This class receives science instruction only from you. ***[Presented only to teachers who answered in Q2 that they teach science]***
○	This class receives science instruction from you and other teachers (for example: a science specialist or a teacher you team with). ***[Presented only to teachers who answered in Q2 that they teach science]***
○	This class receives science instruction only from another teacher (for example: a science specialist or a teacher you team with). ***[Presented only to teachers who answered in Q2 that they do not currently teach science] [Teacher ineligible, exit survey]***
○	This class does not receive science instruction this year. ***[Presented only to teachers who answered in Q2 that they do not currently teach science] [Teacher ineligible, exit survey]***

4. Omitted – Used only for survey routing.

5. *[Presented to self-contained teachers only]*
Which best describes your science teaching?

○	I teach science all or most days, every week of the year.
○	I teach science every week, but typically not every day of the week.
○	I teach science some weeks, but typically not every week. ***[Skip to Q7]***

6. *[Presented to self-contained teachers only]*
In a typical week, how many days do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 5, 150).]

	NUMBER OF DAYS PER WEEK	TOTAL NUMBER OF MINUTES PER WEEK
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

7. *[Presented only to self-contained teachers who did not answer Q6]*
In a typical year, how many weeks do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 36, 150).]

	NUMBER OF WEEKS PER YEAR	AVERAGE NUMBER OF MINUTES PER WEEK WHEN TAUGHT
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

8. *[Presented to non-self-contained teachers only]*
In a typical week, how many different classes (sections) of each of the following are you currently teaching? [Select one on each row.]
- If you meet with the *same class of students* multiple times per week, count that class only once.
- If you teach the *same science or engineering* course to multiple classes of students, count each class separately.

	0	1	2	3	4	5	6	7	8	9	10
Science (may include some engineering content)		○	○	○	○	○	○	○	○	○	○
Engineering	○	○	○	○	○	○	○	○	○	○	○

9. *[Presented to non-self-contained teachers only]*
For each science class you currently teach, select the course type and enter the number of students enrolled. Enter the classes in the order that you teach them. For teachers on an alternating day block schedule, please order your classes starting with the first class you teach this week. Select one course type on each row and enter the number of students as a whole number (for example: 25).]

CLASS	COURSE TYPE	NUMBER OF STUDENTS ENROLLED
Your 1st science class:		
Your 2nd science class:		
…		
Your 10th science class:		

COURSE TYPE LIST	
1	Science (Grades K–5)
2	Life Science (Grades 6–8)
3	Earth/Space Science (Grades 6–8)
4	Physical Science (Grades 6–8)
5	General or Integrated Science (Grades 6–8)
6	Multi-discipline science courses (for example: General Science, Integrated Science, Physical Science) (Grades 9–12)
7	Earth/Space Science (Grades 9–12)
8	Life Science/Biology (Grades 9–12)
9	Environmental Science/Ecology (Grades 9–12)
10	Chemistry (Grades 9–12)
11	Physics (Grades 9–12)

10. *[Presented to non-self-contained grades 9–12 teachers only]*
Use the descriptions below to select the level that best describes the content addressed in each grades 9–12 science class you teach. [Select one on each row.]

LEVEL	DESCRIPTION
Non-college Prep	A course that does not count towards the entrance requirements of a 4-year college. For example: Life Science.
1st Year College Prep, Including Honors	The first course in a discipline that counts towards the entrance requirements of a 4-year college. For example: Biology, Chemistry I.
2nd Year Advanced	A course typically taken after a 1st year college prep course. For example: Anatomy and Physiology, Advanced Chemistry, Physics II. Include Advanced Placement, International Baccalaureate, and concurrent college and high school credit/dual enrollment.

CLASS	COURSE TYPE	NON-COLLEGE PREP	1ST YEAR COLLEGE PREP, INCLUDING HONORS	2ND YEAR ADVANCED
Your 1st science class:	*[course type(s) teacher selected in Q9]*	○	○	○
Your 2nd science class:		○	○	○
…				
Your 10th science class:		○	○	○

11. ***[Presented to non-self-contained teachers only]***
Later in this questionnaire, we will ask you questions about your *[[xth]]* science class, which you indicated was *[[level indicated in Q10]] [[course type indicated in Q9]]*. What is your school's title for this course? ____

12. Have you been awarded one or more bachelor's and/or graduate degrees in the following fields? (With regard to bachelor's degrees, count only areas in which you majored. Do not include endorsements or certificates.) [Select one on each row.]

		YES	NO
a.	Education (general or subject specific such as science education)	○	○
b.	Engineering	○	○
c.	Natural Sciences (for example: biology, chemistry, physics, Earth sciences)	○	○
d.	Other, including social sciences; please specify ____________________	○	○

13. ***[Presented only to teachers that selected "Yes" for Q12a]***
What type of education degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Elementary Education
□	Mathematics Education
□	Science Education
□	Other education, please specify. ___________

14. ***[Presented only to teachers that selected "Yes" for Q12b]***
What type of engineering degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Aerospace/Aeronautical/Astronautical Engineering
□	Bioengineering/Biomedical Engineering
□	Chemical Engineering
□	Civil Engineering
□	Computer Engineering
□	Electrical/Electronics Engineering
□	Environmental Engineering
□	Industrial/Manufacturing Engineering
□	Mechanical Engineering
□	Other engineering, please specify ___________

15. ***[Presented only to teachers that selected "Yes" for Q12c]***
What type of natural science degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Biology/Life Science
□	Chemistry
□	Earth/Space Science
□	Environmental Science/Ecology
□	Physics
□	Other natural science, please specify __________

16. Did you complete any of the following types of biology/life science courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	General/introductory biology/life science courses (for example: Biology I, Introduction to Biology, Biology for Teachers)	○	○
b.	Biology/life science courses beyond the general/introductory level	○	○
c.	Biology/life science teaching methods courses	○	○

17. ***[Presented only to teachers that selected "Yes" for Q16b]***
Please indicate which of the following biology/life science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Anatomy/Physiology
□	Biochemistry
□	Botany
□	Cell Biology
□	Ecology
□	Evolution
□	Genetics
□	Microbiology
□	Zoology
□	Other biology/life science beyond the general/introductory level

18. Did you complete any of the following types of chemistry courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	General/introductory chemistry courses (for example: Chemistry I, Introduction to Chemistry)	○	○
b.	Chemistry courses beyond the general/introductory level	○	○
c.	Chemistry teaching methods courses	○	○

19. ***[Presented only to teachers that selected "Yes" for Q18b]***
Please indicate which of the following chemistry courses you completed (beyond a general/ introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Analytic Chemistry
□	Biochemistry
□	Inorganic Chemistry
□	Organic Chemistry
□	Physical Chemistry
□	Quantum Chemistry
□	Other chemistry beyond the general/introductory level

20. Did you complete any of the following types of physics courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	General/introductory physics courses (for example: Physics I, Introduction to Physics)	○	○
b.	Physics courses beyond the general/introductory level	○	○
c.	Physics teaching methods courses	○	○

21. ***[Presented only to teachers that selected "Yes" for Q20b]***
Please indicate which of the following physics courses you completed (beyond a general/ introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Astronomy/Astrophysics
□	Electricity and Magnetism
□	Heat and Thermodynamics
□	Mechanics
□	Modern or Quantum Physics
□	Nuclear Physics
□	Optics
□	Other physics beyond the general/introductory level

22. Did you complete any of the following types of Earth/space science courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	General/introductory Earth/space science courses (for example: Earth Science I, Introduction to Earth Science, Introductory Astronomy)	○	○
b.	Earth/space science courses beyond the general/introductory level	○	○
c.	Earth/space science teaching methods courses	○	○

23. *[Presented only to teachers that selected "Yes" for Q22b]*
Please indicate which of the following Earth/space science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Astronomy/Astrophysics
□	Geology
□	Meteorology
□	Oceanography
□	Physical Geography
□	Other Earth/space science beyond the general/introductory level

24. Did you complete any of the following types of environmental science courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	General/introductory environmental science courses (for example: Environmental Science I, Introduction to Environmental Science)	○	○
b.	Environmental science courses beyond the general/introductory level	○	○
c.	Environmental science teaching methods courses	○	○

25. *[Presented only to teachers that selected "Yes" for Q24b]*
Please indicate which of the following environmental science courses you completed (beyond a general/introductory course) at the undergraduate or graduate level. [Select all that apply.]

□	Conservation Biology
□	Ecology
□	Forestry
□	Hydrology
□	Oceanography
□	Toxicology
□	Other environmental science beyond the general/introductory level

26. *[Presented only to teachers who did not select Q12b]*
Did you complete one or more engineering courses at the undergraduate or graduate level?

○	Yes
○	No

27. Which of the following best describes the program you completed to earn your teaching credential (sometimes called certification or license)?

○	An undergraduate program leading to a bachelor's degree and a teaching credential
○	A post-baccalaureate credentialing program (no master's degree awarded)
○	A master's program that also led to a teaching credential
○	I have not completed a program to earn a teaching credential. *[Skip to Q29]*

28. ***[Presented only to high school teachers]***
In which of the following areas are you certified (have a credential, endorsement, or license) to teach at the high school level? [Select all that apply.]

□	Biology/life science
□	Chemistry
□	Earth/space science
□	Ecology/environmental science
□	Engineering
□	Physics

29. After completing your undergraduate degree and prior to becoming a teacher, did you have a full-time job in a science- or engineering-related field?

○	Yes
○	No

Professional Development

The questions in this section ask about your participation in professional development focused on science/engineering or science/engineering teaching. When answering these questions, please include:

- face-to-face and/or online courses;
- professional meetings/conferences;
- workshops;
- professional learning communities/lesson studies/teacher study groups; and
- coaching and mentoring.

Do not include:

- courses you took prior to becoming a teacher; and
- time spent providing professional development (including coaching and mentoring) for other teachers.

30. When did you **last participate** in professional development focused on science/engineering or science/engineering teaching?

○	In the last 12 months
○	1–3 years ago
○	4–6 years ago
○	7–10 years ago
○	More than 10 years ago
○	Never

[Skip to Q35]

31. **In the last 3 years,** which of the following types of professional development related to science/engineering or science/engineering teaching have you had? [Select one on each row.]

		YES	NO
a.	I attended a professional development program/workshop.	○	○
b.	I attended a national, state, or regional science teacher association meeting.	○	○
c.	I completed an online course/webinar.	○	○
d.	I participated in a professional learning community/lesson study/teacher study group	○	○
e.	I received assistance or feedback from a formally designated coach/mentor.	○	○
f.	I took a formal course for college credit.	○	○

32. What is the **total** amount of time you have spent on professional development related to science/engineering or science/engineering teaching **in the last 3 years**?

○	Less than 6 hours
○	6–15 hours
○	16–35 hours
○	36–80 hours
○	More than 80 hours

33. Considering all of your science- and engineering-related professional development **in the last 3 years**, to what extent does each of the following describe your experiences? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	I had opportunities to engage in science investigations/engineering design challenges.	①	②	③	④	⑤
b.	I had opportunities to experience lessons, as my students would, from the textbook/modules I use in my classroom.	①	②	③	④	⑤
c.	I had opportunities to examine classroom artifacts (for example: student work samples, videos of classroom instruction).	①	②	③	④	⑤
d.	I had opportunities to rehearse instructional practices during the professional development (meaning: try out, receive feedback, and reflect on those practices).	①	②	③	④	⑤
e.	I had opportunities to apply what I learned to my classroom and then come back and talk about it as part of the professional development.	①	②	③	④	⑤
f.	I worked closely with other teachers from my school.	①	②	③	④	⑤
g.	I worked closely with other teachers who taught the same grade and/or subject whether or not they were from my school.	①	②	③	④	⑤

34. Thinking about all of your science- and engineering-related professional development **in the last 3 years**, to what extent was each of the following emphasized? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	Deepening your own science content knowledge	①	②	③	④	⑤
b.	Deepening your understanding of how science is done (for example: developing scientific questions, developing and using models, engaging in argumentation)	①	②	③	④	⑤
c.	Deepening your understanding of how engineering is done (for example: identifying criteria and constraints, designing solutions, optimizing solutions)	①	②	③	④	⑤
d.	Implementing the science textbook/modules to be used in your classroom	①	②	③	④	⑤
e.	Learning about difficulties that students may have with particular science ideas	①	②	③	④	⑤
f.	Finding out what students think or already know prior to instruction on a topic	①	②	③	④	⑤
g.	Monitoring student understanding during science instruction	①	②	③	④	⑤
h.	Differentiating science instruction to meet the needs of diverse learners	①	②	③	④	⑤
i.	Incorporating students' cultural backgrounds into science instruction	①	②	③	④	⑤
j.	Learning how to provide science instruction that integrates engineering, mathematics, and/or computer science	①	②	③	④	⑤

Preparedness to Teach

35. *[Presented only to grades K–5 teachers; sub-items e-h for self-contained teachers only]*
Many teachers feel better prepared to teach some subject areas than others. How well prepared do you feel to teach each of the following subjects **at the grade level(s) you teach**, whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Life Science	①	②	③	④
b. Earth/Space Science	①	②	③	④
c. Physical Science	①	②	③	④
d. Engineering	①	②	③	④
e. Mathematics	①	②	③	④
f. Reading/Language Arts	①	②	③	④
g. Social Studies	①	②	③	④
h. Computer Science/Programming	①	②	③	④

36. ***[Subset of items related to topic of randomly selected class presented to non-self-contained teachers]***

Within science, many teachers feel better prepared to teach some topics than others. How well prepared do you feel to teach each of the following topics **at the grade level(s) you teach**, whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Earth/Space Science				
i. Earth's features and physical processes	①	②	③	④
ii. The solar system and the universe	①	②	③	④
iii. Climate and weather	①	②	③	④
b. Biology/Life Science				
i. Cell biology	①	②	③	④
ii. Structures and functions of organisms	①	②	③	④
iii. Ecology/ecosystems	①	②	③	④
iv. Genetics	①	②	③	④
v. Evolution	①	②	③	④
c. Chemistry				
i. Atomic structure	①	②	③	④
ii. Chemical bonding, equations, nomenclature, and reactions	①	②	③	④
iii. Elements, compounds, and mixtures	①	②	③	④
iv. The Periodic Table	①	②	③	④
v. Properties of solutions	①	②	③	④
vi. States, classes, and properties of matter	①	②	③	④
d. Physics				
i. Forces and motion	①	②	③	④
ii. Energy transfers, transformations, and conservation	①	②	③	④
iii. Properties and behaviors of waves	①	②	③	④
iv. Electricity and magnetism	①	②	③	④
v. Modern physics (for example: special relativity)	①	②	③	④
e. Engineering				
i. Defining engineering problems	①	②	③	④
ii. Developing possible solutions	①	②	③	④
iii. Optimizing a design solution	①	②	③	④
f. Environmental and resource issues (for example: land and water use, energy resources and consumption, sources and impacts of pollution)	①	②	③	④

37. How well prepared do you feel to do each of the following in your science instruction? [Select one on each row.]

		NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a.	Develop students' conceptual understanding of the science ideas you teach	①	②	③	④
b.	Develop students' abilities to do science (for example: develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)	①	②	③	④
c.	Develop students' awareness of STEM careers	①	②	③	④
d.	Provide science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach	①	②	③	④
e.	Use formative assessment to monitor student learning	①	②	③	④
f.	Differentiate science instruction to meet the needs of diverse learners	①	②	③	④
g.	Incorporate students' cultural backgrounds into science instruction	①	②	③	④
h.	Encourage students' interest in science and/or engineering	①	②	③	④
i.	Encourage participation of all students in science and/or engineering	①	②	③	④

Opinions about Science Instruction

38. Please provide your opinion about each of the following statements. [Select one on each row.]

		STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
a.	Students learn science best in classes with students of similar abilities.	①	②	③	④	⑤
b.	It is better for science instruction to focus on ideas in depth, even if that means covering fewer topics.	①	②	③	④	⑤
c.	At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.	①	②	③	④	⑤
d.	Teachers should explain an idea to students before having them consider evidence that relates to the idea.	①	②	③	④	⑤
e.	Most class periods should provide opportunities for students to share their thinking and reasoning.	①	②	③	④	⑤
f.	Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned.	①	②	③	④	⑤
g.	Teachers should ask students to support their conclusions about a science concept with evidence.	①	②	③	④	⑤
h.	Students learn best when instruction is connected to their everyday lives.	①	②	③	④	⑤
i.	Most class periods should provide opportunities for students to apply scientific ideas to real-world contexts.	①	②	③	④	⑤
j.	Students should learn science by doing science (for example: developing scientific questions; designing and conducting investigations; analyzing data; developing models, explanations, and scientific arguments).	①	②	③	④	⑤

Leadership Experiences

39. **In the last 3 years** have you… [Select one on each row.]

		YES	NO
a.	Served as a lead teacher or department chair in science?	○	○
b.	Served as a ***formal*** mentor or coach for a science teacher? (Do not include supervision of student teachers.)	○	○
c.	Supervised a student teacher in your classroom?	○	○
d.	Served on a school or district/diocese-wide science committee (for example: developing curriculum, developing pacing guides, selecting instructional materials)?	○	○
e.	Led or co-led a workshop or professional learning community (for example: teacher study group, lesson study) for other teachers focused on science or science teaching?	○	○
f.	Taught a science lesson for other teachers in your school to observe?	○	○
g.	Observed another teacher's science lesson for the purpose of giving him/her feedback?	○	○

Your Science Instruction

The rest of this questionnaire is about your science instruction in your *[[x^th]]* science class, which you indicated is *[[level indicated in Q10]] [[type indicated in Q9]]* and is titled *[[title provided in Q11]]*. ***[Instructions presented to non-self-contained teachers only]***

40. ***[Presented to non-self-contained teachers only]***
On average, how many minutes per week does this class meet? [Enter your response as a whole number (for example: 300).] __________

The rest of this questionnaire is about your science instruction in this randomly selected class. ***[Instructions presented to self-contained teachers only]***

41. Enter the number of students for each grade represented in this class. [Enter each response as a whole number (for example: 15).]

Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	

42. For the *[sum of Q41]* students in this class, indicate the number of males and females in each of the following categories of race/ethnicity. [Enter each response as a whole number (for example: 15).]

	MALES	FEMALES
a. American Indian or Alaskan Native		
b. Asian		
c. Black or African American		
d. Hispanic or Latino		
e. Native Hawaiian or Other Pacific Islander		
f. White		
g. Two or more races		

43. Which of the following best describes the prior science achievement levels of the students in this class relative to other students in this school?

○	Mostly low achievers
○	Mostly average achievers
○	Mostly high achievers
○	A mixture of levels

44. How much control do you have over each of the following for science instruction in this class? [Select one on each row.]

		NO CONTROL		MODERATE CONTROL		STRONG CONTROL
a.	Determining course goals and objectives	①	②	③	④	⑤
b.	Selecting curriculum materials (for example: textbooks/modules)	①	②	③	④	⑤
c.	Selecting content, topics, and skills to be taught	①	②	③	④	⑤
d.	Selecting the sequence in which topics are covered	①	②	③	④	⑤
e.	Determining the amount of instructional time to spend on each topic	①	②	③	④	⑤
f.	Selecting teaching techniques	①	②	③	④	⑤
g.	Determining the amount of homework to be assigned	①	②	③	④	⑤
h.	Choosing criteria for grading student performance	①	②	③	④	⑤

45. Think about your plans for this class for the entire course/year. By the end of the course/year, how much emphasis will each of the following student objectives receive? [Select one on each row.]

		NONE	MINIMAL EMPHASIS	MODERATE EMPHASIS	HEAVY EMPHASIS
a.	Learning science vocabulary and/or facts	①	②	③	④
b.	Understanding science concepts	①	②	③	④
c.	Learning about different fields of science/engineering	①	②	③	④
d.	Learning how to do science (develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)	①	②	③	④
e.	Learning how to do engineering (for example: identify criteria and constraints, design solutions, optimize solutions)	①	②	③	④
f.	Learning about real-life applications of science/engineering	①	②	③	④
g.	Increasing students' interest in science/engineering	①	②	③	④
h.	Developing students' confidence that they can successfully pursue careers in science/engineering	①	②	③	④
i.	Learning test-taking skills/strategies	①	②	③	④

46. How often do **you** do each of the following in your science instruction in this class? [Select one on each row.]

		NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL SCIENCE LESSONS
a.	Explain science ideas to the whole class	①	②	③	④	⑤
b.	Engage the whole class in discussions	①	②	③	④	⑤
c.	Have students work in small groups	①	②	③	④	⑤
d.	Have students do hands-on/laboratory activities	①	②	③	④	⑤
e.	Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	①	②	③	④	⑤
f.	Have students read from a textbook, module, or other material in class, either aloud or to themselves	①	②	③	④	⑤
g.	Engage the class in project-based learning (PBL) activities	①	②	③	④	⑤
h.	Have students write their reflections (for example: in their journals, on exit tickets) in class or for homework	①	②	③	④	⑤
i.	Focus on literacy skills (for example: informational reading or writing strategies)	①	②	③	④	⑤
j.	Have students practice for standardized tests	①	②	③	④	⑤

47. How often do you have **students** do each of the following during science instruction in this class? [Select one on each row.]

		NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL SCIENCE LESSONS
a.	Determine whether or not a question is “scientific” (meaning it requires an answer supported by evidence gathered through systematic investigation)	①	②	③	④	⑤
b.	Generate scientific questions based on their curiosity, prior knowledge, careful observation of real-world phenomena, scientific models, or preliminary data from an investigation	①	②	③	④	⑤
c.	Determine what data would need to be collected in order to answer a scientific question (regardless of who generated the question)	①	②	③	④	⑤
d.	Develop procedures for a scientific investigation to answer a scientific question (regardless of who generated the question)	①	②	③	④	⑤
e.	Conduct a scientific investigation (regardless of who developed the procedures)	①	②	③	④	⑤
f.	Organize and/or represent data using tables, charts, or graphs in order to facilitate analysis of the data	①	②	③	④	⑤
g.	Compare data from multiple trials or across student groups for consistency in order to identify potential sources of error or inconsistencies in the data	①	②	③	④	⑤
h.	Analyze data using grade-appropriate methods in order to identify patterns, trends, or relationships	①	②	③	④	⑤

i.	Consider how missing data or measurement error can affect the interpretation of data	①	②	③	④	⑤
j.	Make and support claims (proposed answers to scientific questions) with evidence	①	②	③	④	⑤
k.	Use multiple sources of evidence (for example: different investigations, scientific literature) to develop an explanation	①	②	③	④	⑤
l.	Revise their explanations (claims supported by evidence and reasoning) for real-world phenomena based on additional evidence	①	②	③	④	⑤
m.	Develop scientific models—physical, graphical, or mathematical representations of real-world phenomena—based on data and reasoning	①	②	③	④	⑤
n.	Identify the strengths and limitations of a scientific model—in terms of accuracy, clarity, generalizability, accessibility to others, strength of evidence supporting it—regardless of who created the model	①	②	③	④	⑤
o.	Select and use grade-appropriate mathematical and/or statistical techniques to analyze data (for example: determining the best measure of central tendency, examining variation in data, or developing a fit line)	①	②	③	④	⑤
p.	Use mathematical and/or computational models to generate data to support a scientific claim	①	②	③	④	⑤
q.	Determine what details about an investigation (for example: its design, implementation, and results) might persuade a targeted audience about a scientific claim (regardless of who made the claim)	①	②	③	④	⑤
r.	Use data and reasoning to defend, verbally or in writing, a claim or refute alternative scientific claims about a real-world phenomenon (regardless of who made the claims)	①	②	③	④	⑤
s.	Evaluate the strengths and weaknesses of competing scientific explanations (claims supported by evidence) for a real-world phenomenon	①	②	③	④	⑤
t.	Construct a persuasive case, verbally or in writing, for the best scientific model or explanation for a real-world phenomenon	①	②	③	④	⑤
u.	Pose questions that elicit relevant details about the important aspects of a scientific argument (for example: the claims/models/explanations, research design, implementation, data analysis)	①	②	③	④	⑤
v.	Evaluate the credibility of scientific information—for example: its reliability, validity, consistency, logical coherence, lack of bias, or methodological strengths and weaknesses (regardless of whether it is from their own or others' work)	①	②	③	④	⑤
w.	Summarize patterns, similarities, and differences in scientific information obtained from multiple sources (regardless of whether it is from their own or others' work)	①	②	③	④	⑤

48. Thinking about your instruction in this class over the entire year, about how often do you incorporate engineering into your science instruction?

o	Never
o	Rarely (for example: A few times per year)
o	Sometimes (for example: Once or twice a month)
o	Often (for example: Once or twice a week)
o	All or almost all science lessons

49. Thinking about your instruction in this class over the entire year, about how often do you have students use coding to develop or revise computer programs as part of your science instruction (for example: use Scratch or Python as part of doing science)?

o	Never
o	Rarely (for example: A few times per year)
o	Sometimes (for example: Once or twice a month)
o	Often (for example: Once or twice a week)
o	All or almost all science lessons

50. In a typical week, how much time outside of this class are students expected to spend on science assignments?

○	None
○	1–15 minutes per week
○	16–30 minutes per week
○	31–60 minutes per week
○	61–90 minutes per week
○	91–120 minutes per week
○	More than 2 hours per week

51. How often are students in this class required to take science tests that you did not choose to administer, for example state assessments or district benchmarks? Do not include Advanced Placement or International Baccalaureate exams or students retaking a test because of failure.

○	Never
○	Once a year
○	Twice a year
○	Three or four times a year
○	Five or more times a year

52. Please indicate the availability of each of the following for your science instruction in this class. [Select one on each row.]

		LOCATED IN YOUR CLASSROOM	AVAILABLE IN ANOTHER ROOM	NOT AVAILABLE
a.	Lab tables	○	○	○
b.	Electric outlets	○	○	○
c.	Faucets and sinks	○	○	○
d.	Gas for burners *[Grades 9-12 only]*	○	○	○
e.	Fume hoods *[Grades 9–12 only]*	○	○	○

53. Please indicate the availability of each of the following for your science instruction in this class. [Select one on each row.]

		ALWAYS AVAILABLE IN YOUR CLASSROOM	AVAILABLE UPON REQUEST	NOT AVAILABLE
a.	Probes for collecting data (for example: motion sensors, temperature probes)	○	○	○
b.	Microscopes	○	○	○
c.	Balances (for example: pan, triple beam, digital scale)	○	○	○
d.	Projection devices (for example: Smartboard, document camera, LCD projector)	○	○	○

54. Science courses may benefit from the availability of particular resources. Considering what you have available, how adequate is each of the following for teaching this science class? [Select one on each row.]

		NOT ADEQUATE		SOMEWHAT ADEQUATE		ADEQUATE
a.	Instructional technology (for example: calculators, computers, probes/sensors)	①	②	③	④	⑤
b.	Consumable supplies (for example: chemicals, living organisms, batteries)	①	②	③	④	⑤
c.	Equipment (for example: thermometers, magnifying glasses, microscopes, beakers, photogate timers, Bunsen burners)	①	②	③	④	⑤
d.	Facilities (for example: lab tables, electric outlets, faucets and sinks)	①	②	③	④	⑤

This item asks about different types of instructional materials; please read the entire list of materials before answering

55. Thinking about your instruction in this class over the entire year, about how often is instruction based on materials from each of the following sources? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL SCIENCE LESSONS
a. Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets, laboratory handouts) that accompany the textbooks	①	②	③	④	⑤
b. Commercially published kits/modules (printed or electronic)	①	②	③	④	⑤
c. State, county, or district/diocese-developed units or lessons	①	②	③	④	⑤
d. Online units or courses that students work through at their own pace (for example: i-Ready, Edgenuity)	①	②	③	④	⑤
e. Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)	①	②	③	④	⑤
f. Lessons or resources from websites that are free (for example: Khan Academy, PhET)	①	②	③	④	⑤
g. Units or lessons you created (either by yourself or with others)	①	②	③	④	⑤
h. Units or lessons you collected from any other source (for example: conferences, journals, colleagues, university or museum partners)	①	②	③	④	⑤

56. Does your school/district/diocese designate instructional materials (textbooks, kits, modules, units, or lessons) to be used in this class?

○	Yes
○	No *[Skip to Q58]*

57. Which of the following types of instructional materials does your school/district/diocese designate to be used in this class? [Select all that apply.]

□	Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets, laboratory handouts) that accompany the textbooks
□	Commercially published kits/modules (printed or online)
□	State, county, or district/diocese-developed instructional materials
□	Online units or courses that students work through at their own pace (for example: i-Ready, Edgenuity)
□	Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)
□	Lessons or resources from websites that are free (for example: Khan Academy, PhET)

58. Omitted – Used only for survey routing.

59. ***[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q55a, b, or d]*** [Version for teachers who indicate using a commercial textbook most often] Please indicate the title, author, most recent copyright year, and ISBN code of the commercially published textbook or kits/modules (printed or electronic) used <u>most often</u> by the students in this class.

- If you use multiple kits/modules, select one to enter the information for.
- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook or kit/module.
- Do not include the dashes when entering the ISBN.
- Example ISBN:

[Version for teachers who indicate using an online course most often] Please indicate the title and URL of the online units or courses used <u>most often</u> by the students in this class.

Title:	
First Author: [for teachers who indicate using a commercial textbook most often]	
Year: [for teachers who indicate using a commercial textbook most often]	
ISBN: [for teachers who indicate using a commercial textbook most often]	
URL: [for teachers who indicate using an online program most often]	

60. Please rate how each of the following affects your science instruction in this class. [Select one on each row.]

		INHIBITS EFFECTIVE INSTRUCTION		NEUTRAL OR MIXED		PROMOTES EFFECTIVE INSTRUCTION	N/A
a.	Current state standards	①	②	③	④	⑤	○
b.	District/diocese and/or school pacing guides	①	②	③	④	⑤	○
c.	State/district/diocese testing/accountability policies ***[Not presented to non-Catholic private schools]***	①	②	③	④	⑤	○
d.	Textbook/module selection policies	①	②	③	④	⑤	○
e.	Teacher evaluation policies	①	②	③	④	⑤	○
f.	College entrance requirements **[Presented to grades 9–12 teachers only]**	①	②	③	④	⑤	○
g.	Students' prior knowledge and skills	①	②	③	④	⑤	○
h.	Students' motivation, interest, and effort in science	①	②	③	④	⑤	○
i.	Parent/guardian expectations and involvement	①	②	③	④	⑤	○
j.	Principal support	①	②	③	④	⑤	○
k.	Amount of time for you to plan, individually and with colleagues	①	②	③	④	⑤	○
l.	Amount of time available for your professional development	①	②	③	④	⑤	○
m.	Amount of instructional time devoted to science **[Presented to grades K–5 teachers only]**	①	②	③	④	⑤	○

Your Most Recently Completed Science Unit in this Class

The questions in this section are about the most recently completed science unit in this class which you indicated is *[level indicated in Q10] [type indicated in Q9]* and is titled *[title provided in Q11]*.

- Depending on the structure of your class and the instructional materials you use, a unit may range from a few to many class periods.
- Do not be concerned if this unit was not typical of your instruction.

61. Which one of the following best describes the content of this unit?

○	Earth/space science
○	Life science/biology
○	Environmental science/ecology
○	Chemistry
○	Physics
○	Engineering

62. *[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q55a, b, or c]* Was this unit based primarily on a commercially published textbook/kit/module or state, county, or district/diocese-developed materials?

○	Yes
○	No *[Skip to Q66]*

This next set of items is about the commercially published textbook/kit/module or state, county, or district/diocese-developed lessons you used in this unit.

63. Please indicate the extent to which you did each of the following while teaching this unit. [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	I used these materials to guide the structure and content emphasis of the unit.	①	②	③	④	⑤
b.	I picked what is important from these materials and skipped the rest.	①	②	③	④	⑤
c.	I incorporated activities (for example: problems, investigations, readings) from other sources to supplement what these materials were lacking.	①	②	③	④	⑤
d.	I modified activities from these materials.	①	②	③	④	⑤

64. *[Presented only to teachers who did not select "Not at all" for Q63b]* During this unit, when you skipped activities (for example: problems, investigations, readings) in these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	The science ideas addressed in the activities I skipped are not included in my pacing guide/standards.	①	②	③
b.	I did not have the materials needed to implement the activities I skipped.	①	②	③
c.	I did not have the knowledge needed to implement the activities I skipped			
d.	The activities I skipped were too difficult for my students.	①	②	③
e.	My students already knew the science ideas or were able to learn them without the activities I skipped.	①	②	③
f.	I have different activities for those science ideas that work better than the ones I skipped.	①	②	③
g.	I did not have enough instructional time for the activities I skipped.	①	②	③

65. *[Presented only to teachers who did not select "Not at all" for Q63c]*
During this unit, when you supplemented these materials with additional activities, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	My pacing guide indicated that I should use supplemental activities.	①	②	③
b.	Supplemental activities were needed to prepare students for standardized tests.	①	②	③
c.	Supplemental activities were needed to provide students with additional practice.	①	②	③
d.	Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	①	②	③
e.	I had additional activities that I liked.	①	②	③

66. *[Presented only to teachers who did not select "Not at all" in Q63d]*
During this unit, when you modified activities from these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	I did not have the necessary materials/supplies for the original activities.	①	②	③
b.	The original activities were too difficult conceptually for my students.	①	②	③
c.	The original activities were too easy conceptually for my students.	①	②	③
d.	I did not have enough instructional time to implement the activities as designed.	①	②	③
e.	The original activities were too structured for my students.	①	②	③
f.	The original activities were not structured enough for my students.	①	②	③

67. How well prepared did you feel to do each of the following as part of your instruction on this particular unit? [Select one on each row.]

		NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a.	Anticipate difficulties that students may have with particular science ideas and procedures in this unit	①	②	③	④
b.	Find out what students thought or already knew about the key science ideas	①	②	③	④
c.	Implement the instructional materials (for example: textbook, module) to be used during this unit	①	②	③	④
d.	Monitor student understanding during this unit	①	②	③	④
e.	Assess student understanding at the conclusion of this unit	①	②	③	④

Your Most Recent Science Lesson in this Class

The next set of questions refer to the most recent science lesson in this class which you indicated is *[level indicated in Q10] [type indicated in Q9]* and is titled *[title provided in Q11]*, even if it included activities and/or interruptions that are not typical (for example: a test, students working on projects, a fire drill). If the lesson spanned multiple days, please answer for the most recent day.

68. How many minutes was that day's science lesson? Answer for the entire length of the class period, even if there were interruptions. [Enter your response as a non-zero whole number (for example: 50).] ___________

69. Of these *[[answer to Q68]]* minutes, how many were spent on the following: [Enter each response as a whole number (for example: 15).]

a.	Non-instructional activities (for example: attendance taking, interruptions)	
b.	Whole class activities (for example: lectures, explanations, discussions)	
c.	Small group work	
d.	Students working individually (for example: reading textbooks, completing worksheets, taking a test or quiz)	

70. Which of the following activities took place during that day's science lesson? [Select all that apply.]

□	Teacher explaining a science idea to the whole class
□	Teacher conducting a demonstration while students watched
□	Whole class discussion
□	Students working in small groups
□	Students completing textbook/worksheet problems
□	Students doing hands-on/laboratory activities
□	Students reading about science
□	Students writing about science (do not include students taking notes)
□	Practicing for standardized tests
□	Test or quiz
□	None of the above

Demographic Information

71. Are you:

○	Female
○	Male
○	Other

72. Are you of Hispanic or Latino origin?

○	Yes
○	No

73. What is your race? [Select all that apply.]

☐	American Indian or Alaskan Native
☐	Asian
☐	Black or African American
☐	Native Hawaiian or Other Pacific Islander
☐	White

74. In what year were you born? [Enter your response as a whole number (for example: 1969).]

____

Thank you!

2018 NSSME+
Mathematics Teacher Questionnaire

Teacher Background and Opinions

1. How many years have you taught prior to this school year: [Enter each response as a whole number (for example: 15).]

a. any subject at the K–12 level?	
b. mathematics at the K–12 level?	
c. at this school, any subject?	

2. At what grade levels do you currently teach mathematics? [Select all that apply.]

□	K–5
□	6–8
□	9–12
□	I do not currently teach mathematics.

3. ***[Presented to self-contained teachers only]***
Which best describes the mathematics instruction provided to the entire class?
   - Do not consider pull-out instruction that some students may receive for remediation or enrichment.
   - Do not consider instruction provided to individual or small groups of students, for example by an English-language specialist, special educator, or teacher assistant.

○	This class receives mathematics instruction only from you. ***[Presented only to teachers who answered in Q2 that they teach mathematics]***
○	This class receives mathematics instruction from you and other teachers (for example: a mathematics specialist or a teacher you team with). ***[Presented only to teachers who answered in Q2 that they teach mathematics]***
○	This class receives mathematics instruction only from another teacher (for example: a mathematics specialist or a teacher you team with). [Presented only to teachers who answered in Q2 that they do not currently teach mathematics] ***[Teacher ineligible, exit survey]***
○	This class does not receive mathematics instruction this year. ***[Presented only to teachers who answered in Q2 that they do not currently teach mathematics] [Teacher ineligible, exit survey]***

4. Omitted – Used only for survey routing.

5. ***[Presented to self-contained teachers only]***
Which best describes your mathematics teaching?

○	I teach mathematics all or most days, every week of the year.
○	I teach mathematics every week, but typically three or fewer days each week.
○	I teach mathematics some weeks, but typically not every week.

6. *[Presented to self-contained teachers only]*
Which best describes your science teaching?

○	I teach science all or most days, every week of the year.
○	I teach science every week, but typically three or fewer days each week.
○	I teach science some weeks, but typically not every week. *[Skip to Q8]*
○	I do not teach science.

7. *[Presented to self-contained teachers only]*
In a typical week, how many days do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 5, 150).]

	NUMBER OF DAYS PER WEEK	TOTAL NUMBER OF MINUTES PER WEEK
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

8. *[Presented to self-contained teachers who skipped Q7 only]*
In a typical year, how many weeks do you teach lessons on each of the following subjects and how many minutes per week are spent on each subject? [Enter each response as a whole number (for example: 36, 150).]

	NUMBER OF WEEKS PER YEAR	AVERAGE NUMBER OF MINUTES PER WEEK WHEN TAUGHT
a. Mathematics		
b. Science		
c. Social Studies		
d. Reading/Language Arts		

9. *[Presented to non-self-contained teachers only]*
In a typical week, how many different mathematics classes (sections) are you currently teaching?
- If you meet with the *same class of students* multiple times per week, count that class only once.
- If you teach the *same mathematics course* to multiple classes of students, count each class separately.

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

10. ***[Presented to non-self-contained teachers only]***

For each mathematics class you currently teach, select the course type and enter the number of students enrolled. Enter the classes in the order that you teach them. For teachers on an alternating day block schedule, please order your classes starting with the first class you teach this week. Select one course type on each row and enter the number of students as a whole number (for example: 25).]

GRADES 9–12 COURSE TYPE	EXAMPLE COURSES
Non-college prep mathematics courses	Developmental Math; High School Arithmetic; Remedial Math; General Math; Vocational Math; Consumer Math; Basic Math; Business Math; Career Math; Practical Math; Essential Math; Pre-Algebra; Introductory Algebra; Algebra 1 Part 1; Algebra 1A; Math A; Basic Geometry; Informal Geometry; Practical Geometry
Formal/College prep mathematics level 1 courses	Algebra 1; Math 1; Integrated/Unified Math I; Algebra 1 Part 2; Algebra 1B; Math B
Formal/College prep mathematics level 2 courses	Geometry; Plane Geometry; Solid Geometry; Math 2; Integrated/Unified Math II; Math C
Formal/College prep mathematics level 3 courses	Algebra 2; Intermediate Algebra; Algebra and Trigonometry; Advanced Algebra; Math 3; Integrated/Unified Math III
Formal/College prep mathematics level 4 courses	Algebra 3; Trigonometry; Pre-Calculus; Analytic/Advanced Geometry; Elementary Functions; Integrated Math 4; Unified Math IV; Calculus (not including college level/AP); any other college prep senior math with Algebra 2/Math 3 as a prerequisite
Mathematics courses that might qualify for college credit	Advanced Placement Calculus (AB, BC); Advanced Placement Statistics; IB Mathematics Standard Level; IB Mathematics Higher Level; concurrent college and high school credit/dual enrollment

CLASS	COURSE TYPE	NUMBER OF STUDENTS ENROLLED
Your 1st mathematics class:		
Your 2nd mathematics class:		
…		
Your 10th mathematics class:		

COURSE TYPE LIST	
1	Mathematics (Grades K–5)
2	Remedial Mathematics 6
3	Regular Mathematics 6
4	Accelerated/Pre-Algebra Mathematics 6
5	Remedial Mathematics 7
6	Regular Mathematics 7
7	Accelerated Mathematics 7
8	Remedial Mathematics 8
9	Regular Mathematics 8
10	Accelerated Mathematics 8
11	Algebra 1, Grade 7 or 8
12	Non-college prep mathematics course (Grades 9–12)
13	Formal/College prep mathematics level 1 course (Grades 9–12)
14	Formal/College prep mathematics level 2 course (Grades 9–12)
15	Formal/College prep mathematics level 3 course (Grades 9–12)
16	Formal/College prep mathematics level 4 course (Grades 9–12)
17	Mathematics course that might qualify for college credit (Grades 9–12)

11. *[Presented to non-self-contained teachers only]*
Later in this questionnaire, we will ask you questions about your *[[xth]]* mathematics class, which you indicated was *[[type indicated in Q10]]*. What is your school's title for this course? _______________

12. Have you been awarded one or more bachelor's and/or graduate degrees in the following fields? (With regard to bachelor's degrees, count only areas in which you majored. Do not include endorsements or certificates.) [Select one on each row.]

		YES	NO
a.	Education (general or subject specific such as mathematics education)	○	○
b.	Mathematics	○	○
c.	Statistics	○	○
d.	Computer Science	○	○
e.	Engineering	○	○
f.	Other, please specify.____________	○	○

13. *[Presented only to teachers that selected "Yes" for Q12a]*
What type of education degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

☐	Elementary Education
☐	Mathematics Education
☐	Science Education
☐	Other education, please specify. ____________

14. Did you complete any of the following mathematics courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	Mathematics content for elementary school teachers	○	○
b.	Mathematics content for middle school teachers	○	○
c.	Mathematics content for high school teachers	○	○
d.	Integrated mathematics (a single course that addresses content across ***multiple*** mathematics subjects, such as algebra and geometry)	○	○
e.	College algebra/trigonometry/functions	○	○
f.	Abstract algebra (for example: groups, rings, ideals, fields) ***[Presented to grades 6–12 teachers only]***	○	○
g.	Linear algebra (for example: vectors, matrices, eigenvalues) ***[Presented to grades 6–12 teachers only]***	○	○
h.	Calculus	○	○
i.	Advanced calculus ***[Presented to grades 6–12 teachers only]***	○	○
j.	Real analysis ***[Presented to grades 6–12 teachers only]***	○	○
k.	Differential equations ***[Presented to grades 6–12 teachers only]***	○	○
l.	Analytic/Coordinate Geometry (for example: transformations or isometries, conic sections) ***[Presented to grades 6–12 teachers only]***	○	○
m.	Axiomatic Geometry (Euclidean or non-Euclidean) ***[Presented to grades 6–12 teachers only]***	○	○
n.	College geometry ***[Presented to grades K–5 teachers only]***	○	○
o.	Probability	○	○
p.	Statistics	○	○
q.	Number theory (for example: divisibility theorems, properties of prime numbers) ***[Presented to grades 6–12 teachers only]***	○	○
r.	Discrete mathematics (for example: combinatorics, graph theory, game theory)	○	○
s.	Other upper division mathematics	○	○

15. Did you complete one or more courses in each of the following areas at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	Computer science	○	○
b.	Engineering	○	○

16. Which of the following best describes the program you completed to earn your teaching credential (sometimes called certification or license)?

○	An undergraduate program leading to a bachelor's degree and a teaching credential
○	A post-baccalaureate credentialing program (no master's degree awarded)
○	A master's program that also led to a teaching credential
○	I have not completed a program to earn a teaching credential.

17. After completing your undergraduate degree and prior to becoming a teacher, did you have a full-time job in a mathematics-related field (for example: accounting, engineering, computer programming)?

o	Yes
o	No

Professional Development

The questions in this section ask about your participation in professional development focused on mathematics or mathematics teaching. When answering these questions, please include:

- face-to-face and/or online courses;
- professional meetings/conferences;
- workshops;
- professional learning communities/lesson studies/teacher study groups; and
- coaching and mentoring.

Do not include:

- courses you took prior to becoming a teacher; and
- time spent providing professional development (including coaching and mentoring) for other teachers.

18. When did you **last participate** in professional development focused on mathematics or mathematics teaching?

○	In the last 12 months
○	1–3 years ago
○	4–6 years ago
○	7–10 years ago
○	More than 10 years ago
○	Never

Skip to Q23

19. **In the last 3 years,** which of the following types of professional development related to mathematics or mathematics teaching have you had? [Select one on each row.]

		YES	NO
a.	I attended a professional development program/workshop.	○	○
b.	I attended a national, state, or regional mathematics teacher association meeting.	○	○
c.	I completed an online course/webinar.	○	○
d.	I participated in a professional learning community/lesson study/teacher study group.	○	○
e.	I received assistance or feedback from a formally designated coach/mentor.	○	○
f.	I took a formal course for college credit.	○	○

20. What is the **total** amount of time you have spent on professional development related to mathematics or mathematics teaching **in the last 3 years**?

○	Less than 6 hours
○	6–15 hours
○	16–35 hours
○	36–80 hours
○	More than 80 hours

21. Considering all of your mathematics-related professional development **in the last 3 years**, to what extent does each of the following describe your experiences? [Select one on each row.]

	NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a. I had opportunities to engage in mathematics investigations.	①	②	③	④	⑤
b. I had opportunities to experience lessons, as my students would, from the textbook/units I use in my classroom.	①	②	③	④	⑤
c. I had opportunities to examine classroom artifacts (for example: student work samples, videos of classroom instruction).	①	②	③	④	⑤
d. I had opportunities to rehearse instructional practices during the professional development (meaning: try out, receive feedback, and reflect on those practices).	①	②	③	④	⑤
e. I had opportunities to apply what I learned to my classroom and then come back and talk about it as part of the professional development.	①	②	③	④	⑤
f. I worked closely with other teachers from my school.	①	②	③	④	⑤
g. I worked closely with other teachers who taught the same grade and/or subject whether or not they were from my school.	①	②	③	④	⑤

22. Thinking about all of your mathematics-related professional development **in the last 3 years**, to what extent was each of the following emphasized? [Select one on each row.]

	NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a. Deepening your own mathematics content knowledge	①	②	③	④	⑤
b. Deepening your understanding of how mathematics is done (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models)	①	②	③	④	⑤
c. Implementing the mathematics textbook to be used in your classroom	①	②	③	④	⑤
d. Learning how to use hands-on activities/manipulatives for mathematics instruction	①	②	③	④	⑤
e. Learning about difficulties that students may have with particular mathematical ideas and procedures	①	②	③	④	⑤
f. Finding out what students think or already know prior to instruction on a topic	①	②	③	④	⑤
g. Monitoring student understanding during mathematics instruction	①	②	③	④	⑤
h. Differentiating mathematics instruction to meet the needs of diverse learners	①	②	③	④	⑤
i. Incorporating students' cultural backgrounds into mathematics instruction	①	②	③	④	⑤
j. Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	①	②	③	④	⑤

Preparedness to Teach Mathematics

23. *[Presented to self-contained teachers only]*
Many teachers feel better prepared to teach some subject areas than others. How well prepared do you feel to teach each of the following subjects **at the grade level(s) you teach**, whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Number and Operations	①	②	③	④
b. Early Algebra	①	②	③	④
c. Geometry	①	②	③	④
d. Measurement and Data Representation	①	②	③	④
e. Science	①	②	③	④
f. Computer science/Programming	①	②	③	④
g. Reading/Language Arts	①	②	③	④
h. Social Studies	①	②	③	④

24. *[Presented to non-self-contained teachers only]*
Within mathematics, many teachers feel better prepared to teach some topics than others. How prepared do you feel to teach each of the following topics **at the grade level(s) you teach**, whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. The number system and operations	①	②	③	④
b. Algebraic thinking	①	②	③	④
c. Functions	①	②	③	④
d. Modeling	①	②	③	④
e. Measurement	①	②	③	④
f. Geometry	①	②	③	④
g. Statistics and probability	①	②	③	④
h. Discrete mathematics	①	②	③	④
i. Computer science/programming	①	②	③	④

25. How well prepared do you feel to do each of the following in your mathematics instruction? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Develop students' conceptual understanding of the mathematical ideas you teach	①	②	③	④
b. Develop students' abilities to do mathematics (for example: consider how to approach a problem, explain and justify solutions, create and use mathematical models)	①	②	③	④
c. Develop students' awareness of STEM careers	①	②	③	④
d. Provide mathematics instruction that is based on students' ideas (whether completely correct or not) about the topics you teach	①	②	③	④
e. Use formative assessment to monitor student learning	①	②	③	④
f. Differentiate mathematics instruction to meet the needs of diverse learners	①	②	③	④
g. Incorporate students' cultural backgrounds into mathematics instruction	①	②	③	④
h. Encourage students' interest in mathematics	①	②	③	④
i. Encourage participation of all students in mathematics	①	②	③	④

Opinions about Mathematics Instruction

26. Please provide your opinion about each of the following statements. [Select one on each row.]

		STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
a.	Students learn mathematics best in classes with students of similar abilities.	①	②	③	④	⑤
b.	It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	①	②	③	④	⑤
c.	At the beginning of instruction on a mathematical idea, students should be provided with definitions for new mathematics vocabulary that will be used.	①	②	③	④	⑤
d.	Teachers should explain an idea to students before having them investigate the idea.	①	②	③	④	⑤
e.	Most class periods should provide opportunities for students to share their thinking and reasoning.	①	②	③	④	⑤
f.	Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.	①	②	③	④	⑤
g.	Teachers should ask students to justify their mathematical thinking.	①	②	③	④	⑤
h.	Students learn best when instruction is connected to their everyday lives.	①	②	③	④	⑤
i.	Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	①	②	③	④	⑤
j.	Students should learn mathematics by doing mathematics (for example: considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models).	①	②	③	④	⑤

Leadership Experiences

27. **In the last 3 years** have you… [Select one on each row.]

		YES	NO
a.	Served as a lead teacher or department chair in mathematics?	○	○
b.	Served as a ***formal*** mentor or coach for a mathematics teacher? (Do not include supervision of student teachers.)	○	○
c.	Supervised a student teacher in your classroom?	○	○
d.	Served on a school or district/diocese-wide mathematics committee (for example: developing curriculum, developing pacing guides, selecting instructional materials)?	○	○
e.	Led or co-led a workshop or professional learning community (for example: teacher study group, lesson study) for other teachers focused on mathematics or mathematics teaching?	○	○
f.	Taught a mathematics lesson for other teachers in your school to observe?	○	○
g.	Observed another teacher's mathematics lesson for the purpose of giving him/her feedback?	○	○

Your Mathematics Instruction

The rest of this questionnaire is about your *[[x^{th}]]* mathematics class, which you indicated was *[[type indicated in Q10]]* and is titled *[[title provided in Q11]]*. ***[Instructions presented to non-self-contained teachers only]***

The rest of this questionnaire is about your mathematics instruction in this class. ***[Instructions presented to self-contained teachers only]***

28. ***[Presented to non-self-contained teachers only]***
On average, how many minutes per week does this class meet? [Enter your response as a whole number (for example: 300).] __________

29. Enter the number of students for each grade represented in this class. [Enter each response as a whole number (for example: 15).]

Kindergarten	
1st grade	
2nd grade	
3rd grade	
4th grade	
5th grade	
6th grade	
7th grade	
8th grade	
9th grade	
10th grade	
11th grade	
12th grade	

30. For the *[[sum of Q29]]* students in this class, indicate the number of males and females in each of the following categories of race/ethnicity. [Enter each response as a whole number (for example: 15).]

	MALES	FEMALES
a. American Indian or Alaskan Native		
b. Asian		
c. Black or African American		
d. Hispanic or Latino		
e. Native Hawaiian or Other Pacific Islander		
f. White		
g. Two or more races		

31. Which of the following best describes the prior mathematics achievement levels of the students in this class relative to other students in this school?

○	Mostly low achievers
○	Mostly average achievers
○	Mostly high achievers
○	A mixture of levels

32. How much control do you have over each of the following for mathematics instruction in this class? [Select one on each row.]

		NO CONTROL		MODERATE CONTROL		STRONG CONTROL
a.	Determining course goals and objectives	①	②	③	④	⑤
b.	Selecting curriculum materials (for example: textbooks)	①	②	③	④	⑤
c.	Selecting content, topics, and skills to be taught	①	②	③	④	⑤
d.	Selecting the sequence in which topics are covered	①	②	③	④	⑤
e.	Determining the amount of instructional time to spend on each topic	①	②	③	④	⑤
f.	Selecting teaching techniques	①	②	③	④	⑤
g.	Determining the amount of homework to be assigned	①	②	③	④	⑤
h.	Choosing criteria for grading student performance	①	②	③	④	⑤

33. Think about your plans for this class for the entire course/year. By the end of the course/year, how much emphasis will each of the following student objectives receive? [Select one on each row.]

		NONE	MINIMAL EMPHASIS	MODERATE EMPHASIS	HEAVY EMPHASIS
a.	Learning mathematics vocabulary	①	②	③	④
b.	Learning mathematical procedures and/or algorithms	①	②	③	④
c.	Learning to perform computations with speed and accuracy	①	②	③	④
d.	Understanding mathematical ideas	①	②	③	④
e.	Learning how to do mathematics (for example: consider how to approach a problem, explain and justify solutions, create and use mathematical models)	①	②	③	④
f.	Learning about real-life applications of mathematics	①	②	③	④
g.	Increasing students' interest in mathematics	①	②	③	④
h.	Developing students' confidence that they can successfully pursue careers in mathematics	①	②	③	④
i.	Learning test-taking skills/strategies	①	②	③	④

34. How often do **you** do each of the following in your mathematics instruction in this class? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL MATHEMATICS LESSONS
a. Explain mathematical ideas to the whole class	①	②	③	④	⑤
b. Engage the whole class in discussions	①	②	③	④	⑤
c. Have students work in small groups	①	②	③	④	⑤
d. Provide manipulatives for students to use in problem-solving/investigations	①	②	③	④	⑤
e. Use flipped instruction (have students watch lectures/ demonstrations outside of class to prepare for in-class activities)	①	②	③	④	⑤
f. Have students read from a textbook or other material in class, either aloud or to themselves	①	②	③	④	⑤
g. Have students write their reflections (for example: in their journals, on exit tickets) in class or for homework	①	②	③	④	⑤
h. Focus on literacy skills (for example: informational reading or writing strategies)	①	②	③	④	⑤
i. Have students practice for standardized tests	①	②	③	④	⑤

35. How often do you have **students** do each of the following during mathematics instruction in this class? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL MATHEMATICS LESSONS
a. Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	①	②	③	④	⑤
b. Figure out what a challenging problem is asking (by talking with their classmates and/or using manipulatives, pictures, diagrams, tables, or equations)	①	②	③	④	⑤
c. Reflect on their solution strategies as they work through a mathematics problem and revise as needed	①	②	③	④	⑤
d. Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	①	②	③	④	⑤
e. Determine whether their answer makes sense (for example: the answer has reasonable magnitude or sign, uses appropriate units, fits the context of the problem)	①	②	③	④	⑤
f. Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	①	②	③	④	⑤
g. Provide mathematical reasoning to explain, justify, or prove their thinking	①	②	③	④	⑤
h. Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations (for example: their efficiency, generalizability, interpretability by others)	①	②	③	④	⑤
i. Analyze the mathematical reasoning of others (for example: decide if their reasoning makes sense, identify correct ideas or flaws in their thinking)	①	②	③	④	⑤
j. Pose questions to clarify, challenge, or improve the mathematical reasoning of others	①	②	③	④	⑤

k. Identify relevant information and relationships that could be used to solve a mathematics problem (for example: quantities and relationships needed to develop an equation that illustrates a situation or determines an outcome)	①	②	③	④	⑤
l. Develop a mathematical model (meaning, a representation of relevant information and relationships such as an equation, tape diagram, algorithm, or function) to solve a mathematics problem	①	②	③	④	⑤
m. Determine what tools (for example: pencil and paper, manipulatives, ruler, protractor, calculator, spreadsheet) are appropriate for solving a mathematics problem	①	②	③	④	⑤
n. Determine what units are appropriate for expressing numerical answers, data, and/or measurements	①	②	③	④	⑤
o. Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	①	②	③	④	⑤
p. Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	①	②	③	④	⑤
q. Work on generating a rule or formula (for example: based on multiple problems, patterns, or repeated calculations)	①	②	③	④	⑤

36. Thinking about your instruction in this class over the entire year, about how often do you have students use coding to develop or revise computer programs as part of your mathematics instruction (for example: use Scratch or Python as part of doing mathematics)?

o	Never
o	Rarely (for example: A few times per year)
o	Sometimes (for example: Once or twice a month)
o	Often (for example: Once or twice a week)
o	All or almost all mathematics lessons

37. In a typical week, how much time outside of this class are students expected to spend on mathematics assignments?

○	None
○	1–15 minutes per week
○	16–30 minutes per week
○	31–60 minutes per week
○	61–90 minutes per week
○	91–120 minutes per week
○	More than 2 hours per week

38. How often are students in this class required to take mathematics tests that you did not choose to administer, for example state assessments or district benchmarks? Do not include Advanced Placement or International Baccalaureate exams or students retaking a test because of failure.

○	Never
○	Once a year
○	Twice a year
○	Three or four times a year
○	Five or more times a year

39. Please indicate the availability of projection devices (for example: Smartboard, document camera, LCD projector) for your mathematics instruction in this class.

○	Always available in your classroom
○	Available upon request
○	Not available

40. Mathematics courses may benefit from the availability of particular resources. Considering what you have available, how adequate is each of the following for teaching this mathematics class? [Select one on each row.]

		NOT ADEQUATE		SOMEWHAT ADEQUATE		ADEQUATE
a.	Instructional technology (for example: calculators, computers, probes/sensors)	①	②	③	④	⑤
b.	Measurement tools (for example: protractors, rulers)	①	②	③	④	⑤
c.	Manipulatives (for example: pattern blocks, algebra tiles)	①	②	③	④	⑤
d.	Consumable supplies (for example: graphing paper, batteries)	①	②	③	④	⑤

This item asks about different types of instructional materials; please read the entire list of materials before answering

41. Thinking about your instruction in this class over the entire year, about how often is instruction based on materials from each of the following sources? [Select one on each row.]

		NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL MATHEMATICS LESSONS
a.	Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets) that accompany the textbooks	①	②	③	④	⑤
b.	State, county, or district/diocese-developed units or lessons	①	②	③	④	⑤
c.	Online units or courses that students work through at their own pace (for example: i-Ready, Edgenuity)	①	②	③	④	⑤
d.	Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)	①	②	③	④	⑤
e.	Lessons or resources from websites that are free (for example: Khan Academy, Illustrative Math)	①	②	③	④	⑤
f.	Units or lessons you created (either by yourself or with others)	①	②	③	④	⑤
g.	Units or lessons you collected from any other source (for example: conferences, journals, colleagues, university or museum partners)	①	②	③	④	⑤

42. Does your school/district/diocese designate instructional materials (textbooks, units, or lessons) to be used in this class?

○	Yes
○	No *[Skip to Q44]*

43. Which of the following types of instructional materials does your school/district/diocese designate to be used in this class? [Select all that apply.]

□	Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets) that accompany the textbooks
□	State, county, or district/diocese-developed instructional materials
□	Online units or courses that students work through at their own pace (for example: i-Ready, Edgenuity)
□	Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)
□	Lessons or resources from websites that are free (for example: Khan Academy, Illustrative Math)

44. Omitted – Used only for survey routing.

45. ***[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q41a or c]***
[Version for teachers who indicate using a commercial textbook most often] Please indicate the title, author, most recent copyright year, and ISBN code of the commercially published textbook (printed or electronic) used most often by the students in this class.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook.
- Do not include the dashes when entering the ISBN.

  Example ISBN:

[Version for teachers who indicate using an online course most often] Please indicate the title and URL of the online units or courses used most often by the students in this class.

Title:	
First Author: [for teachers who indicate using a commercial textbook most often]	
Year: [for teachers who indicate using a commercial textbook most often]	
ISBN: [for teachers who indicate using a commercial textbook most often]	
URL: [for teachers who indicate using an online program most often]	

46. Please rate how each of the following affects your mathematics instruction in this class. [Select one on each row.]

	INHIBITS EFFECTIVE INSTRUCTION		NEUTRAL OR MIXED		PROMOTES EFFECTIVE INSTRUCTION	N/A
a. Current state standards	①	②	③	④	⑤	○
b. District/Diocese and/or school pacing guides	①	②	③	④	⑤	○
c. State/district/diocese testing/ accountability policies *[Not presented to non-Catholic private schools]*	①	②	③	④	⑤	○
d. Textbook selection policies	①	②	③	④	⑤	○
e. Teacher evaluation policies	①	②	③	④	⑤	○
f. College entrance requirements *[Presented to grades 9–12 teachers only]*	①	②	③	④	⑤	○
g. Students' prior knowledge and skills	①	②	③	④	⑤	○
h. Students' motivation, interest, and effort in mathematics	①	②	③	④	⑤	○
i. Parent/guardian expectations and involvement	①	②	③	④	⑤	○
j. Principal support	①	②	③	④	⑤	○
k. Amount of time for you to plan, individually and with colleagues	①	②	③	④	⑤	○
l. Amount of time available for your professional development	①	②	③	④	⑤	○
m. Amount of instructional time devoted to mathematics *[Presented to grades K–5 teachers only]*	①	②	③	④	⑤	○

Your Most Recently Completed Mathematics Unit in this Class

The questions in this section are about the most recently completed mathematics unit in this class which you indicated is *[type indicated in Q10]* and is titled *[title provided in Q11]*.

- Depending on the structure of your class and the instructional materials you use, a unit may range from a few to many class periods.
- Do not be concerned if this unit was not typical of your instruction.

47. Which one of the following best describes the content focus of this unit?

○	Number and operations
○	Measurement and data representation
○	Algebra
○	Geometry
○	Probability
○	Statistics
○	Trigonometry
○	Calculus

48. *[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q41 a or b]* Was this unit based primarily on a commercially published textbook or state, county, or district/diocese-developed materials?

○	Yes
○	No *[Skip to Q53]*

This next set of items is about the textbook or state, county, or district/diocese-developed lessons you used in this unit.

49. Please indicate the extent to which you did each of the following while teaching this unit. [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	I used these materials to guide the structure and content emphasis of the unit.	①	②	③	④	⑤
b.	I picked what is important from these materials and skipped the rest.	①	②	③	④	⑤
c.	I incorporated activities (for example: problems, investigations, readings) from other sources to supplement what these materials were lacking.	①	②	③	④	⑤
d.	I modified activities from these materials.	①	②	③	④	⑤

50. *[Presented only to teachers who did not select "Not at all" for Q49b]* During this unit, when you skipped activities (for example: problems, investigations, readings) in these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	The mathematical ideas addressed in the activities I skipped are not included in my pacing guide/standards.	①	②	③
b.	I did not have the materials needed to implement the activities I skipped.	①	②	③
c.	I did not have the knowledge needed to implement the activities I skipped.	①	②	③
d.	The activities I skipped were too difficult for my students.	①	②	③
e.	My students already knew the mathematical ideas or were able to learn them without the activities I skipped.	①	②	③
f.	I have different activities for those mathematical ideas that work better than the ones I skipped.	①	②	③
g.	I did not have enough instructional time for the activities I skipped.	①	②	③

51. *[Presented only to teachers who did not select "Not at all" for Q49c]*
During this unit, when you supplemented these materials with additional activities, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	My pacing guide indicated that I should use supplemental activities.	①	②	③
b.	Supplemental activities were needed to prepare students for standardized tests.	①	②	③
c.	Supplemental activities were needed to provide students with additional practice.	①	②	③
d.	Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	①	②	③
e.	I had additional activities that I liked.	①	②	③

52. *[Presented only to teachers who did not select "Not at all" in Q49d]*
During this unit, when you modified activities from these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	I did not have the necessary materials/supplies for the original activities.	①	②	③
b.	The original activities were too difficult conceptually for my students.	①	②	③
c.	The original activities were too easy conceptually for my students.	①	②	③
d.	I did not have enough instructional time to implement the activities as designed.	①	②	③
e.	The original activities were too structured for my students.	①	②	③
f.	The original activities were not structured enough for my students.	①	②	③

53. How well prepared did you feel to do each of the following as part of your instruction on this particular unit? [Select one on each row.]

		NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a.	Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit	○	○	○	○
b.	Find out what students thought or already knew about the key mathematical ideas	○	○	○	○
c.	Implement the instructional materials (for example: mathematics textbook) to be used during this unit	○	○	○	○
d.	Monitor student understanding during this unit	○	○	○	○
e.	Assess student understanding at the conclusion of this unit	○	○	○	○

Your Most Recent Mathematics Lesson in this Class

The next three questions refer to the most recent mathematics lesson in this class, which you indicated is *[type indicated in Q10]* and is titled *[title provided in Q11]*, even if it included activities and/or interruptions that are not typical (for example: a test, students working on projects, a fire drill). If the lesson spanned multiple days, please answer for the most recent day.

54. How many minutes was that day's mathematics lesson? Answer for the entire length of the class period, even if there were interruptions. [Enter your response as a non-zero whole number (for example: 50).] ____________________

55. Of these *[answer to Q54]* minutes, how many were spent on the following: [Enter each response as a whole number (for example: 15).]

a.	Non-instructional activities (for example: attendance taking, interruptions)	
b.	Whole class activities (for example: lectures, explanations, discussions)	
c.	Small group work	
d.	Students working individually (for example: reading textbooks, completing worksheets, taking a test or quiz)	

56. Which of the following activities took place during that day's mathematics lesson? [Select all that apply.]

□	Teacher explaining a mathematical idea to the whole class
□	Teacher conducting a demonstration while students watched
□	Whole class discussion
□	Students working in small groups
□	Students completing textbook/worksheet problems
□	Students doing hands-on/manipulative activities
□	Students reading about mathematics
□	Students writing about mathematics (do not include students taking notes)
□	Practicing for standardized tests
□	Test or quiz
□	None of the above

Demographic Information

57. Are you:

○	Female
○	Male
○	Other

58. Are you of Hispanic or Latino origin?

○	Yes
○	No

59. What is your race? [Select all that apply.]

☐	American Indian or Alaskan Native
☐	Asian
☐	Black or African American
☐	Native Hawaiian or Other Pacific Islander
☐	White

60. In what year were you born? [Enter your response as a whole number (for example: 1969).]

____

Thank you!

2018 NSSME+

High School Computer Science Teacher Questionnaire

Teacher Background and Opinions

1. How many years have you taught prior to this school year: [Enter each response as a whole number (for example: 15).]

a.	any subject at the K–12 level?	
b.	computer science at the K–12 level?	
c.	at this school, any subject?	

2. At what grade levels do you currently teach computer science? [Select all that apply.]

□	K–5
□	6–8
□	9–12
□	I do not currently teach computer science. *[Teacher ineligible, exit survey]*

3. Omitted – Used only for survey routing.

4. In a typical week, how many different computer science classes (sections) are you currently teaching?
   - If you meet with the *same class of students* multiple times per week, count that class only once.
   - If you teach the *same computer science course* to multiple classes of students, count each class separately.

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

5. For each computer science class you currently teach, select the course type and enter the number of students enrolled. Enter the classes in the order that you teach them. For teachers on an alternating day block schedule, please order your classes starting with the first class you teach this week. [Select one course type on each row and enter the number of students as a whole number (for example: 25).]

GRADES 9–12 COURSE TYPE	EXAMPLE COURSES
Computer technology courses that do not include programming	Computer literacy; Keyboarding; Media technology (digital video/audio, multimedia presentations, digital arts); Desktop publishing; Computer applications (word processing, spreadsheets, slide presentations); Computer repair and computer networking; Web design; Computer-aided design (architectural drawing, fashion design)
Introductory high school computer science courses that include programming	Computer Science Discoveries such as code.org; Exploring computer science; Computer Science Essentials such as PLTW; Introductory Programming; IB Computer Science Standard Level
Computer science courses that might qualify for college credit	AP Computer Science A; AP Computer Science Principles; IB Computer Science Higher Level
Specialized/elective computer science courses with programming as a prerequisite	Advanced Computer science electives such as Robotics; Game or mobile app development; or other advanced computer science elective with programming as a prerequisite

CLASS	COURSE TYPE	NUMBER OF STUDENTS ENROLLED
Your 1st computer science class:		
Your 2nd computer science class:		
…		
Your 10th computer science class:		

COURSE TYPE LIST	
1	Computer technology courses that do not include programming
2	Introductory high school computer science courses that include programming
3	Computer science courses that might qualify for college credit
4	Specialized/elective computer science courses with programming as a prerequisite

6. Later in this questionnaire, we will ask you questions about your *[[xth]]* computer science class, which you indicated was *[[course type indicated in Q5]]*. What is your school's title for this course? _______________

7. Have you been awarded one or more bachelor's and/or graduate degrees in the following fields? (With regard to bachelor's degrees, count only areas in which you majored. Do not include endorsements or certificates.) [Select one on each row.]

		YES	NO
a.	Business	○	○
b.	Computer science	○	○
c.	Education (general or subject specific such as computer science education)	○	○
d.	Information science	○	○
e.	Mathematics	○	○
f.	Natural sciences (for example: Biology, Chemistry, Physics, Earth Sciences)	○	○
g.	Computer engineering	○	○
h.	Electrical engineering	○	○
i.	Other engineering	○	○
j.	Other, please specify.____________	○	○

8. *[Presented only to teachers that selected "Yes" for Q7c]*
What type of education degree do you have? (With regard to bachelor's degrees, count only areas in which you majored.) [Select all that apply.]

□	Computer Science Education
□	Elementary Education
□	Mathematics Education
□	Science Education
□	Other education, please specify. ____________

9. Did you complete one or more computer science courses in each of the following areas at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	Introduction to computer science	○	○
b.	Introduction to programming	○	○
c.	Algorithms (for example: sorting; search trees, heaps, and hashing; divide-and-conquer)	○	○
d.	Artificial intelligence (for example: machine learning, robotics, computer vision)	○	○
e.	Computer graphics (for example: ray tracing, the graphics pipeline, transformations, texture mapping)	○	○
f.	Computer networks (for example: application layer protocols, Internet protocols, network interfaces)	○	○
g.	Database systems (for example: the relational model, relational algebra, SQL)	○	○
h.	Human-computer interaction (for example: human information processing subsystems; libraries of standard graphical user interface objects; methodologies to measure the usability of software)	○	○
i.	Operating systems/computer systems	○	○
j.	Software design/engineering	○	○
k.	Other upper division computer science	○	○

10. Did you complete the following mathematics courses at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	Linear algebra	○	○
b.	Probability	○	○
c.	Statistics	○	○
d.	Number theory (for example: divisibility theorems, properties of prime numbers)	○	○
e.	Discrete mathematics (for example: combinatorics, graph theory, game theory)	○	○

11. Did you complete courses in each of the following areas at the undergraduate or graduate level? [Select one on each row.]

		YES	NO
a.	Computer engineering	○	○
b.	Electrical/Electronics engineering	○	○
c.	Other types of engineering courses	○	○

12. Which of the following best describes the program you completed to earn your teaching credential (sometimes called certification or license)?

○	An undergraduate program leading to a bachelor's degree and a teaching credential
○	A post-baccalaureate credentialing program (no master's degree awarded)
○	A master's program that also led to a teaching credential
○	I have not completed a program to earn a teaching credential. *[Skip to Q14]*

13. In which of the following areas are you certified (have a credential or endorsement) to teach at the high school level? [Select all that apply.]

□	Business
□	Computer science
□	Engineering
□	Mathematics
□	Science (any area)
□	Other

14. After completing your undergraduate degree and prior to becoming a teacher, did you have a full-time job that included computer programming or computer/software engineering?

o	Yes
o	No

Professional Development

The questions in this section ask about your participation in professional development focused on computer science or computer science teaching. When answering these questions, please include:

- face-to-face and/or online courses;
- professional meetings/conferences;
- workshops;
- professional learning communities/lesson studies/teacher study groups; and
- coaching and mentoring.

Do not include:

- courses you took prior to becoming a teacher; and
- time spent providing professional development (including coaching and mentoring) for other teachers.

15. When did you **last participate** in professional development focused on computer science or computer science teaching?

○	In the last 12 months	
○	1–3 years ago	
○	4–6 years ago	*[Skip to Q20]*
○	7–10 years ago	*[Skip to Q20]*
○	More than 10 years ago	*[Skip to Q20]*
○	Never	*[Skip to Q20]*

16. **In the last 3 years,** which of the following types of professional development related to computer science or computer science teaching have you had? [Select one on each row.]

		YES	NO
a.	I attended a professional development program/workshop.	○	○
b.	I attended a national, state, or regional computer science teacher association meeting.	○	○
c.	I completed an online course/webinar.	○	○
d.	I participated in a professional learning community/lesson study/teacher study group.	○	○
e.	I received assistance or feedback from a formally designated coach/mentor.	○	○
f.	I took a formal course for college credit.	○	○

17. What is the **total** amount of time you have spent on professional development related to computer science or computer science teaching **in the last 3 years**?

○	Less than 6 hours
○	6–15 hours
○	16–35 hours
○	36–80 hours
○	More than 80 hours

18. Considering all of your computer science-related professional development **in the last 3 years**, to what extent does each of the following describe your experiences? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	I had opportunities to engage in activities to learn computer science content.	①	②	③	④	⑤
b.	I had opportunities to experience lessons, as my students would, from the textbook/units I use in my classroom.	①	②	③	④	⑤
c.	I had opportunities to examine classroom artifacts (for example: student work samples, e-portfolios, videos of classroom instruction).	①	②	③	④	⑤
d.	I had opportunities to rehearse instructional practices during the professional development (meaning: try out, receive feedback, and reflect on those practices).	①	②	③	④	⑤
e.	I had opportunities to apply what I learned to my classroom and then come back and talk about it as part of the professional development.	①	②	③	④	⑤
f.	I worked closely with other teachers from my school.	①	②	③	④	⑤
g.	I worked closely with other teachers who taught the same grade and/or subject whether or not they were from my school.	①	②	③	④	⑤

19. Thinking about all of your computer science-related professional development **in the last 3 years**, to what extent was each of the following emphasized? [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	Deepening your own computer science content knowledge, including programming	①	②	③	④	⑤
b.	Deepening your understanding of how computer science is done (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	①	②	③	④	⑤
c.	Implementing the computer science textbook/online course to be used in your classroom	①	②	③	④	⑤
d.	Learning how to use programming activities that require a computer	①	②	③	④	⑤
e.	Learning about difficulties that students may have with particular computer science ideas and/or practices	①	②	③	④	⑤
f.	Monitoring student understanding during computer science instruction					
g.	Differentiating computer science instruction to meet the needs of diverse learners	①	②	③	④	⑤
h.	Incorporating students' cultural backgrounds into computer science instruction	①	②	③	④	⑤
i.	Learning how to provide computer science instruction that integrates engineering, mathematics, and/or science	①	②	③	④	⑤

Preparedness to Teach Computer Science

20. Within computer science, many teachers feel better prepared to teach some topics than others. How prepared do you feel to teach each of the following topics **at the grade level(s) you teach,** whether or not they are currently included in your teaching responsibilities? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Computing systems	①	②	③	④
b. Networks and the Internet	①	②	③	④
c. Data and analysis	①	②	③	④
d. Algorithms and programming	①	②	③	④
e. Impacts of computing	①	②	③	④

21. How well prepared do you feel to do each of the following in your computer science instruction? [Select one on each row.]

	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a. Develop students' conceptual understanding of the computer science ideas you teach	①	②	③	④
b. Develop students' abilities to do computer science (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	①	②	③	④
c. Develop students' awareness of STEM careers	①	②	③	④
d. Provide computer science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach	①	②	③	④
e. Use formative assessment to monitor student learning	①	②	③	④
f. Differentiate computer science instruction to meet the needs of diverse learners	①	②	③	④
g. Incorporate students' cultural backgrounds into computer science instruction	①	②	③	④
h. Encourage students' interest in computer science	①	②	③	④
i. Encourage participation of all students in computer science	①	②	③	④

Opinions about Computer Science Instruction

22. Please provide your opinion about each of the following statements. [Select one on each row.]

		STRONGLY DISAGREE	DISAGREE	NO OPINION	AGREE	STRONGLY AGREE
a.	Students learn computer science best in classes with students of similar abilities.	①	②	③	④	⑤
b.	It is better for computer science instruction to focus on ideas in depth, even if that means covering fewer topics.	①	②	③	④	⑤
c.	At the beginning of instruction on a computer science idea, students should be provided with definitions for new vocabulary that will be used.	①	②	③	④	⑤
d.	Most class periods should provide opportunities for students to share their thinking and reasoning.	①	②	③	④	⑤
e.	Hands-on/manipulatives/programming activities should be used primarily to reinforce a computer science idea that the students have already learned.	①	②	③	④	⑤
f.	Teachers should ask students to justify their solutions to a computational problem.	①	②	③	④	⑤
g.	Students learn best when instruction is connected to their everyday lives.	①	②	③	④	⑤
h.	Most class periods should provide opportunities for students to apply computer science ideas to real-world contexts.	①	②	③	④	⑤
i.	Students should learn computer science by doing computer science (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts).	①	②	③	④	⑤

Leadership Experiences

23. **In the last 3 years** have you… [Select one on each row.]

		YES	NO
a.	Served as a lead teacher or department chair?	○	○
b.	Served as a ***formal*** mentor or coach for a computer science teacher? (Do not include supervision of student teachers.)	○	○
c.	Supervised a student teacher in your classroom?	○	○
d.	Served on a school or district/diocese-wide computer science committee (for example: developing curriculum, developing pacing guides, selecting instructional materials)?	○	○
e.	Led or co-led a workshop or professional learning community (for example: teacher study group, lesson study) for other teachers focused on computer science or computer science teaching?	○	○
f.	Taught a computer science lesson for other teachers to observe?	○	○
g.	Observed another teacher's computer science lesson for the purpose of giving him/her feedback?	○	○

Your Computer Science Instruction

The rest of this questionnaire is about your *[[x^th]]*computer science class, which you indicated was *[[type indicated in Q5]]* and is titled *[[title provided in Q6]]*.

24. On average, how many minutes per week does this class meet? [Enter your response as a whole number (for example: 300).] __________

25. Enter the number of students for each grade represented in this class. [Enter each response as a whole number (for example: 15).]

9th grade	
10th grade	
11th grade	
12th grade	
Other	

26. For the students in this class, indicate the number of males and females in each of the following categories of race/ethnicity. [Enter each response as a whole number (for example: 15).]

		MALES	FEMALES
a.	American Indian or Alaskan Native		
b.	Asian		
c.	Black or African American		
d.	Hispanic or Latino		
e.	Native Hawaiian or Other Pacific Islander		
f.	White		
g.	Two or more races		

27. Which of the following best describes the prior achievement levels of the students in this class relative to other students in this school?

○	Mostly low achievers
○	Mostly average achievers
○	Mostly high achievers
○	A mixture of levels

28. How much control do you have over each of the following for computer science instruction in this class? [Select one on each row.]

		NO CONTROL		MODERATE CONTROL		STRONG CONTROL
a.	Determining course goals and objectives	①	②	③	④	⑤
b.	Selecting curriculum materials (for example: textbooks/online courses)	①	②	③	④	⑤
c.	Selecting content, topics, and skills to be taught	①	②	③	④	⑤
d.	Selecting programming languages to use	①	②	③	④	⑤
e.	Selecting the sequence in which topics are covered	①	②	③	④	⑤
f.	Determining the amount of instructional time to spend on each topic	①	②	③	④	⑤
g.	Selecting teaching techniques	①	②	③	④	⑤
h.	Determining the amount of homework to be assigned	①	②	③	④	⑤
i.	Choosing criteria for grading student performance	①	②	③	④	⑤

29. Think about your plans for this class for the entire course. By the end of the course, how much emphasis will each of the following student objectives receive? [Select one on each row.]

		NONE	MINIMAL EMPHASIS	MODERATE EMPHASIS	HEAVY EMPHASIS
a.	Learning computer science vocabulary and/or program syntax	①	②	③	④
b.	Understanding computer science concepts	①	②	③	④
c.	Learning how to do computer science (for example: breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)	①	②	③	④
d.	Learning how to develop computational solutions	①	②	③	④
e.	Learning about real-life applications of computer science	①	②	③	④
f.	Increasing students' interest in computer science	①	②	③	④
g.	Developing students' confidence that they can successfully pursue careers in computer science	①	②	③	④

30. How often do **you** do each of the following in your computer science instruction in this class? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL COMPUTER SCIENCE LESSONS
a. Explain computer science ideas to the whole class	①	②	③	④	⑤
b. Engage the whole class in discussions	①	②	③	④	⑤
c. Have students work in small groups	①	②	③	④	⑤
d. Have students do hands-on/manipulative programming activities that do not require a computer	①	②	③	④	⑤
e. Have students work on programming activities using a computer	①	②	③	④	⑤
f. Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	①	②	③	④	⑤
g. Have students read from a textbook/ online course in class, either aloud or to themselves	①	②	③	④	⑤
h. Have students explain and justify their method for solving a problem	①	②	③	④	⑤
i. Have students present their solution strategies to the rest of the class	①	②	③	④	⑤
j. Have students compare and contrast different methods for solving a problem	①	②	③	④	⑤
k. Have students write their reflections (for example: in their journals, on exit tickets) in class or for homework	①	②	③	④	⑤
l. Focus on literacy skills (for example: informational reading or writing strategies)	①	②	③	④	⑤

31. How often do you have **students** do each of the following in this class? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL COMPUTER SCIENCE LESSONS
a. Create computational artifacts (for example: programs, simulations, visualizations, digital animations, robotic systems, or apps)	①	②	③	④	⑤
b. Create a computational artifact designed to be used by someone outside the class or other students	①	②	③	④	⑤
c. Provide feedback on other students' computational products or designs	①	②	③	④	⑤
d. Get input on computational products or designs from people with different perspectives (do not include feedback that you give students)	①	②	③	④	⑤
e. Systematically use test cases to verify program performance and/or identify problems	①	②	③	④	⑤
f. Identify real-world problems that might be solved computationally	①	②	③	④	⑤
g. Consider how a program they are creating can be separated into modules/ procedures/objects	①	②	③	④	⑤
h. Identify and adapt existing code to solve a new computational problem	①	②	③	④	⑤
i. Use computational methods to simulate events or processes (for example: rolling dice, supply and demand)	①	②	③	④	⑤
j. Analyze datasets using a computer to detect patterns	①	②	③	④	⑤
k. Write comments within code to document purposes or features	①	②	③	④	⑤
l. Create instructions for an end-user explaining how to use a computational artifact	①	②	③	④	⑤
m. Explain computational solution strategies verbally or in writing	①	②	③	④	⑤
n. Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures	①	②	③	④	⑤

32. Which best describes how each of the following devices (if required) is provided for this computer science class? [Select one on each row.]

	NOT REQUIRED FOR THIS CLASS	PROVIDED BY THE SCHOOL, AND STUDENTS ARE NOT ALLOWED TO USE THEIR OWN	PROVIDED BY THE SCHOOL, BUT STUDENTS ARE ALLOWED TO USE THEIR OWN	STUDENTS ARE EXPECTED TO PROVIDE THEIR OWN, BUT THE SCHOOL HAS SOME AVAILABLE FOR USE	STUDENTS ARE REQUIRED TO PROVIDE THEIR OWN
a. Computers (desktops or laptops)	○	○	○	○	○
b. Mobile computing devices (tablets or smartphones)	○	○	○	○	○
c. Data storage devices	○	○	○	○	○

33. Please indicate the availability of each of the following for your computer science instruction in this class. [Select one on each row.]

	ALWAYS AVAILABLE IN YOUR CLASSROOM	AVAILABLE UPON REQUEST	NOT AVAILABLE
a. Probes for collecting data (for example: motion sensors, temperature probes)	○	○	○
b. Projection devices (for example: Smartboard, document camera, LCD projector)	○	○	○
c. Robotics equipment	○	○	○

34. In a typical week, how much time outside of this class are students expected to spend on computer science assignments?

○	None
○	1–15 minutes per week
○	16–30 minutes per week
○	31–60 minutes per week
○	61–90 minutes per week
○	91–120 minutes per week
○	More than 2 hours per week

This next item asks about different types of instructional materials; please read the entire list of materials before answering

35. Thinking about your instruction in this class over the entire year, about how often is instruction based on materials from each of the following sources? [Select one on each row.]

	NEVER	RARELY (FOR EXAMPLE: A FEW TIMES A YEAR)	SOMETIMES (FOR EXAMPLE: ONCE OR TWICE A MONTH)	OFTEN (FOR EXAMPLE: ONCE OR TWICE A WEEK)	ALL OR ALMOST ALL COMPUTER SCIENCE LESSONS
a. Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets) that accompany the textbooks	①	②	③	④	⑤
b. State, county, or district/diocese-developed units or lessons	①	②	③	④	⑤
c. Online units or courses that students work through at their own pace (for example: MOOCs, EdX, IMACS)	①	②	③	④	⑤
d. Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)	①	②	③	④	⑤
e. Lessons or resources from websites that are free (for example: Khan Academy, code.org)	①	②	③	④	⑤
f. Units or lessons you created (either by yourself or with others)	①	②	③	④	⑤
g. Units or lessons you collected from any other source (for example: conferences, journals, colleagues, university or museum partners)	①	②	③	④	⑤

36. Does your school/district/diocese designate instructional materials (textbooks, units, or lessons) to be used in this class?

o	Yes
o	No *[Skip to 39]*

37. Which of the following types of instructional materials does your school/district/diocese designate to be used in this class? [Select all that apply.]

□	Commercially published textbooks (printed or electronic), including the supplementary materials (for example: worksheets) that accompany the textbooks
□	State, county, or district/diocese-developed instructional materials
□	Online units or courses that students work through at their own pace (for example: MOOCs, EdX, IMACS)
□	Lessons or resources from websites that have a subscription fee or per lesson cost (for example: BrainPOP, Discovery Ed, Teachers Pay Teachers)
□	Lessons or resources from websites that are free (for example: Khan Academy, code.org)

38. Omitted – Used only for survey routing.

39. ***[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q35a or c]***
[Version for teachers who indicate using a commercial textbook most often] Please indicate the title, author, most recent copyright year, and ISBN code of the commercially published textbook (printed or electronic) used most often by the students in this class.

- The 10- or 13-character ISBN code can be found on the copyright page and/or the back cover of the textbook.
- Do not include the dashes when entering the ISBN.
- Example ISBN:

[Version for teachers who indicate using an online course most often] Please indicate the title and URL of the online units or courses used most often by the students in this class.

Title:	
First Author: [for teachers who indicate using a commercial textbook most often]	
Year: [for teachers who indicate using a commercial textbook most often]	
ISBN: [for teachers who indicate using a commercial textbook most often]	
URL: [for teachers who indicate using an online program most often]	

40. ***[Presented only to teachers who did not select "Never" for Q35d or e]***
Please indicate up to 3 online sources of lessons/activities that you use most frequently in this class. Enter only the host/domain name, for example: www.myfavoriteCSsite.net

URL:	
URL:	
URL:	

41. Please rate how each of the following affects your computer science instruction in this class. [Select one on each row.]

		INHIBITS EFFECTIVE INSTRUCTION		NEUTRAL OR MIXED		PROMOTES EFFECTIVE INSTRUCTION	N/A
a.	Current state standards	①	②	③	④	⑤	○
b.	Textbook selection policies	①	②	③	④	⑤	○
c.	Teacher evaluation policies	①	②	③	④	⑤	○
d.	College entrance requirements	①	②	③	④	⑤	○
e.	Students' prior knowledge and skills	①	②	③	④	⑤	○
f.	Students' motivation, interest, and effort in computer science	①	②	③	④	⑤	○
g.	Parent/guardian expectations and involvement	①	②	③	④	⑤	○
h.	Principal support	①	②	③	④	⑤	○
i.	Amount of time for you to plan, individually and with colleagues	①	②	③	④	⑤	○
j.	Amount of time available for your professional development	①	②	③	④	⑤	○

42. In your opinion, how great a problem is each of the following for your computer science instruction in this class? [Select one on each row.]

		NOT A SIGNIFICANT PROBLEM	SOMEWHAT OF A PROBLEM	SERIOUS PROBLEM
a.	Lack of reliable access to the Internet	①	②	③
b.	Lack of functioning computing devices (for example: desktop computers, laptop computers, tablets, smartphones)	①	②	③
c.	Insufficient power sources for devices (for example: electrical outlets, charging stations)	①	②	③
d.	Lack of support to maintain technology (for example: repair broken devices, install software)	①	②	③
e.	School restrictions on Internet content that is allowed	①	②	③

Your Most Recently Completed Computer Science Unit in this Class

The questions in this section are about the most recently completed computer science unit in this class which you indicated is *[[type indicated in Q5]]* and is titled *[[title provided in Q6]]*.

- Depending on the structure of your class and the instructional materials you use, a unit may range from a few to many class periods.
- Do not be concerned if this unit was not typical of your instruction.

43. Which of the following best describes the content focus of this unit?

○	Computing systems
○	Networks and the Internet
○	Data and analysis
○	Algorithms and programming
○	Impacts of computing

44. *[Presented only to teachers who selected "Sometimes" "Often" or "All" for Q35a or b]* Was this unit based primarily on a commercially published textbook/online course or state, county, or district/diocese-developed materials?

○	Yes
○	No *[Skip to Q47]*

This next set of items is about the textbook or state, county, or district/diocese-developed lessons you used in this unit.

45. Please indicate the extent to which you did each of the following while teaching this unit. [Select one on each row.]

		NOT AT ALL		SOMEWHAT		TO A GREAT EXTENT
a.	I used these materials to guide the structure and content emphasis of the unit.	①	②	③	④	⑤
b.	I picked what is important from these materials and skipped the rest.	①	②	③	④	⑤
c.	I incorporated activities (for example: problems, investigations, readings) from other sources to supplement what these materials were lacking.	①	②	③	④	⑤
d.	I modified activities from these materials.	①	②	③	④	⑤

46. *[Presented only to teachers who did not select "Not at all" for Q45b]* During this unit, when you skipped activities (for example: problems, programming activities, readings) in these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	The computer science ideas addressed in the activities I skipped are not included in my pacing guide/standards.	①	②	③
b.	I did not have the materials needed to implement the activities I skipped.	①	②	③
c.	I did not have the knowledge needed to implement the activities I skipped.			
d.	The activities I skipped were too difficult for my students.	①	②	③
e.	My students already knew the computer science ideas or were able to learn them without the activities I skipped.	①	②	③
f.	I have different activities for those computer science ideas that work better than the ones I skipped.	①	②	③
g.	I did not have enough instructional time for the activities I skipped.	①	②	③

47. *[Presented only to teachers who did not select "Not at all" for Q45c]*
During this unit, when you supplemented these materials with additional activities, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	My pacing guide indicated that I should use supplemental activities.	①	②	③
b.	Supplemental activities were needed to prepare students for standardized tests.	①	②	③
c.	Supplemental activities were needed to provide students with additional practice.	①	②	③
d.	Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	①	②	③
e.	I had additional activities that I liked.	①	②	③

48. *[Presented only to teachers who did not select "Not at all" for Q45d]*
During this unit, when you modified activities from these materials, how much was each of the following a factor in your decisions? [Select one on each row.]

		NOT A FACTOR	A MINOR FACTOR	A MAJOR FACTOR
a.	I did not have the necessary materials/supplies for the original activities.	①	②	③
b.	The original activities were too difficult conceptually for my students.	①	②	③
c.	The original activities were too easy conceptually for my students.	①	②	③
d.	I did not have enough instructional time to implement the activities as designed.	①	②	③
e.	The original activities were too structured for my students.	①	②	③
f.	The original activities were not structured enough for my students.	①	②	③

49. How well prepared did you feel to do each of the following as part of your instruction on this particular unit? [Select one on each row.]

		NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
a.	Anticipate difficulties that students may have with particular computer science ideas and procedures in this unit	①	②	③	④
b.	Find out what students thought or already knew about the key computer science ideas	①	②	③	④
c.	Implement the instructional materials (for example: textbook, online course) to be used during this unit	①	②	③	④
d.	Monitor student understanding during this unit	①	②	③	④
e.	Assess student understanding at the conclusion of this unit	①	②	③	④

Your Most Recent Computer Science Lesson in this Class

The next three questions refer to the most recent computer science lesson in this class, which you indicated is *[[type indicated in Q5]]* and is titled *[[title provided in Q6]]*, even if it included activities and/or interruptions that are not typical (for example: a test, students working on projects, a fire drill). If the lesson spanned multiple days, please answer for the most recent day.

50. How many minutes was that day's computer science lesson? Answer for the entire length of the class period, even if there were interruptions. [Enter your response as a non-zero whole number (for example: 50).] ____________________

51. Of these *[[answer to Q50]]* minutes, how many were spent on the following: [Enter each response as a whole number (for example: 15).]

a.	Non-instructional activities (for example: attendance taking, interruptions)	
b.	Whole class activities (for example: lectures, explanations, discussions)	
c.	Small group work	
d.	Students working individually (for example: reading textbooks, programming, taking a test or quiz)	

52. Which of the following activities took place during that day's computer science lesson? [Select all that apply.]

◻	Teacher explaining a computer science idea to the whole class
◻	Teacher conducting a demonstration while students watched
◻	Whole class discussion
◻	Students working in small groups
◻	Students completing textbook/worksheet problems
◻	Students doing hands-on/manipulative programming activities not using a computer
◻	Students working on programming tasks using a computer
◻	Students reading about computer science
◻	Students writing about computer science (do not include students taking notes)
◻	Test or quiz
◻	None of the above

Demographic Information

53. Are you:

○	Female
○	Male
○	Other

54. Are you of Hispanic or Latino origin?

○	Yes
○	No

55. What is your race? [Select all that apply.]

☐	American Indian or Alaskan Native
☐	Asian
☐	Black or African American
☐	Native Hawaiian or Other Pacific Islander
☐	White

56. In what year were you born? [Enter your response as a whole number (for example: 1969).]

____

Thank you!

Description of Reporting Variables

Region

Type of Community

Percentage of Students in School Eligible for Free/Reduced-Price Lunch

School Size

Grade Range

Percentage of Students from Race/Ethnicity Groups Historically Underrepresented in STEM in Class

Overview of Composites

Definitions of Teacher Composites

Extent to Which the Policy Environment Promotes Effective Instruction

Extent to Which Stakeholders Promote Effective Instruction

Extent to Which School Support Promotes Effective Instruction

Definitions of Program Composites

State Standards for Science and Mathematics Education

Focus on State Science/Mathematics Standards

Factors Affecting Instruction

Supportive Context for Science/Mathematics Instruction

Extent to Which a Lack of Resources Is Problematic

Extent to Which Student Issues Are Problematic

Extent to Which Teacher Issues Are Problematic

Description of Reporting Variables

Region

Each sample school and teacher was classified as belonging to 1 of 4 census regions:

- Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI;
- Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT;
- South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, SC, TN, VA, WV; or
- West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OK, OR, TX, UT, WA, WY.

Type of Community

Each sample school and teacher was classified as belonging to 1 of 3 types of communities:

- Urban: Central city;
- Suburban: Area surrounding a central city, but still located within the counties constituting a Metropolitan Statistical Area (MSA); or
- Rural: Area outside any MSA.

Percentage of Students in School Eligible for Free/Reduced-Price Lunch

Each school was classified into one of four categories based on the proportion of students eligible for free/reduced-price lunch (FRL). Defining common categories across grades K–12 would have been misleading, as students tend to select out of the FRL program as they advance in grade due to perceived social stigma. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

School Size

Schools were classified into one of four categories based on the number of students served in the school. Defining common categories across grades K–12 would have been misleading, as average school size tends to increase from elementary to middle to high school. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

Grade Range

Teachers were classified by grade range according to the information they provided about their teaching schedule. Most of the analyses in this report used elementary, middle, and high with teachers and classes being categorized based on the grade range information provided by the teacher. Elementary was defined as grades K–5 plus 6th grade self-contained; middle was defined as 6th grade non-self-contained and grades 7–8; high was defined as grades 9–12.

Percentage of Students from Race/Ethnicity Groups Historically Underrepresented STEM in Class

Each randomly selected class was classified into one of four categories based on the proportion of students in the class identified as being from race/ethnicity groups historically underrepresented in STEM (i.e., American Indian or Alaskan Native, Black or African

American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, multi-racial). As this proportion is similar in schools regardless of grades served, the categories were defined as quartiles across all classes.

Overview of Composites

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites." Each composite represents an important construct related to computer science, mathematics or science education. Composites were calculated for the computer science, mathematics and science versions of the teacher questionnaire and for the program questionnaire completed by each responding school in the sample.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for example, an item with a scale ranging from 1 to 4 was re-coded to have a scale of 0 to 3. By doing this, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a 9-item composite where each item is on a scale of 0–3 would have a denominator of 0.27. Composites values were not computed for participants who respond to fewer than two-thirds of the items that form the composite.

The composites were derived through a multi-stage process. As a first step, to test whether the items intended to target the same underlying construct indeed showed similar response patterns, an exploratory factor analysis was conducted on a subset of the data. (The complete dataset was split randomly into two subsets to allow for independent exploratory and confirmatory factor analyses.) Using Mplus version 8.1 and applying the appropriate weights (teacher, class, or school weights), several different factor solutions were produced and scree plots, eigenvalues, and factor patterns were examined. Based on item fit and conceptual coherence, preliminary composite definitions were created. Next, the preliminary composite definitions were applied to a different subset of the data and a confirmatory factor analysis was performed, again using Mplus. When analyzing data from a complex sample design, Mplus provides one fit index to evaluate the model: the standardized root mean square residual (SRMR). The psychometric literature provides multiple criteria for judging acceptable model fit using this index, ranging from 0.05–0.10.[28] The obtained values from final models[29] are presented in the tables, allowing the reader to apply his or her preferred criteria for evaluating fit. Lastly, to further aid in the assessment of the composites, Cronbach's coefficient alpha, a common measure of reliability,

[28] Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

[29] Final models were occasionally adjusted to allow for correlated errors among individual items, typically when the items were worded similarly and the modification indices suggested that the proposed correlations would lead to substantially better fit. Multi-factor models were used in situations when a single-factor specification would result in an over-identified model.

was calculated and is presented in the tables. An alpha of 0.6–0.8 is evidence of moderate reliability and a value over 0.8 is considered evidence of strong reliability.

Definitions of Teacher Composites

Composite definitions for the science, mathematics, and computer science teacher questionnaire are presented below along with the item numbers from the respective questionnaires. Composites that are identical for the two subjects are presented in the same table; composites unique to a subject are presented in separate tables.

Teacher Background and Opinions

These composites estimate the extent to which teachers feel prepared in both science and mathematics content and pedagogy.

Table D-1
Extent Professional Development Aligns With Elements of Effective Professional Development†

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
I had opportunities to engage in science investigations/engineering design challenges.‡	Q33a		
I had opportunities to engage in mathematics investigations.‡		Q21a	
I had opportunities to engage in activities to learn computer science content.‡			Q18a
I had opportunities to experience lessons, as my students would, from the textbook/ modules/units I use in my classroom.	Q33b	Q21b	Q18b
I had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction, e-portfolios).	Q33c	Q21c	Q18c
I had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect on those practices).	Q33d	Q21d	Q18d
I had opportunities to apply what I learned to my classroom and then come back and talk about it as part of the professional development.	Q33e	Q21e	Q18e
I worked closely with other teachers from my school.	Q33f	Q21f	Q18f
I worked closely with other teachers who taught the same grade and/or subject whether or not they were from my school.	Q33g	Q21g	Q18g
Number of Items in Composite	**7**	**7**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.78**	**0.77**	**0.70**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.05**	**0.06**

† These items were presented only to teachers who participated in science/mathematics/computer science-related professional development in the last three years.

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

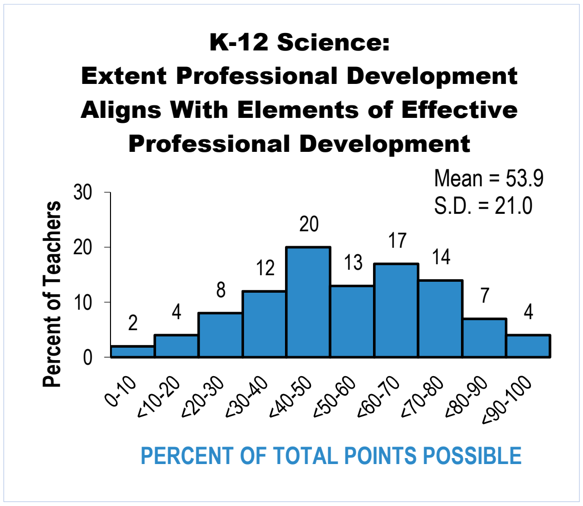


Figure D-1

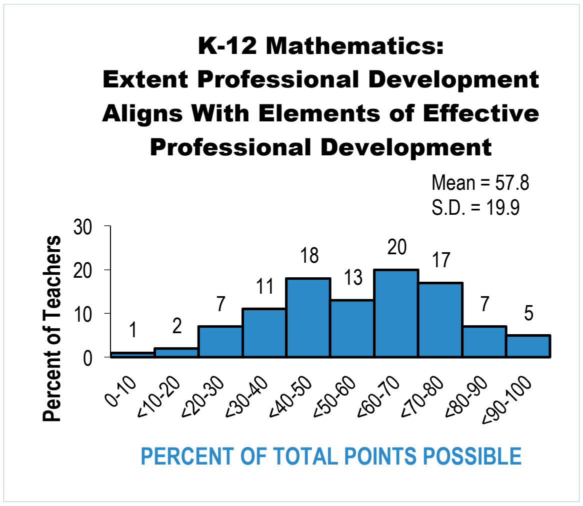


Figure D-2

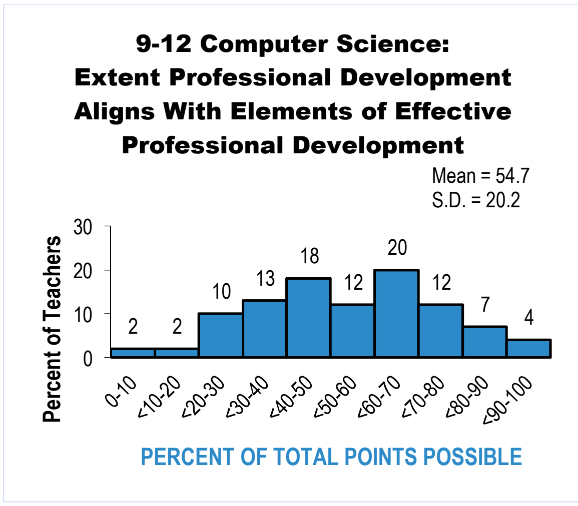


Figure D-3

Table D-2
Extent Professional Development Supports Student-Centered Instruction†

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Deepening your own science content knowledge‡	Q34a		
Deepening your own mathematics content knowledge‡		Q22a	
Deepening your own computer science content knowledge, including programming‡			Q19a
Deepening your understanding of how science is done (e.g., developing scientific questions, developing and using models, engaging in argumentation)‡	Q34b		
Deepening your understanding of how mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models‡		Q22b	
Deepening your understanding of how computer science is done (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)‡			Q19b
Deepening your understanding of how engineering is done (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	Q34c		
Implementing the science textbook/modules to be used in your classroom‡	Q34d		
Implementing the mathematics textbook to be used in your classroom‡		Q22c	
Implementing the computer science textbook/online course to be used in your classroom‡			Q19c
Learning how to use hands-on activities/manipulatives for mathematics instruction		Q22d	
Learning how to use programming activities that require a computer			Q19d
Learning about difficulties that students may have with particular science ideas‡	Q34e		
Learning about difficulties that students may have with particular mathematical ideas and procedures‡		Q22e	
Learning about difficulties that students may have with particular computer science ideas and/or practices‡			Q19e
Finding out what students think or already know prior to instruction on a topic	Q34f	Q22f	
Monitoring student understanding during science instruction‡	Q34g		
Monitoring student understanding during mathematics instruction‡		Q22g	
Monitoring student understanding during computer science instruction‡			Q19f
Differentiating science instruction to meet the needs of diverse learners‡	Q34h		
Differentiating mathematics instruction to meet the needs of diverse learners‡		Q22h	
Differentiating computer science instruction to meet the needs of diverse learners‡			Q19g
Number of Items in Composite	**8**	**8**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.85**	**0.97**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.03**	**0.07**

† These items were presented only to teachers who participated in science/mathematics/computer science-related professional development or coursework within the last three years.
‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

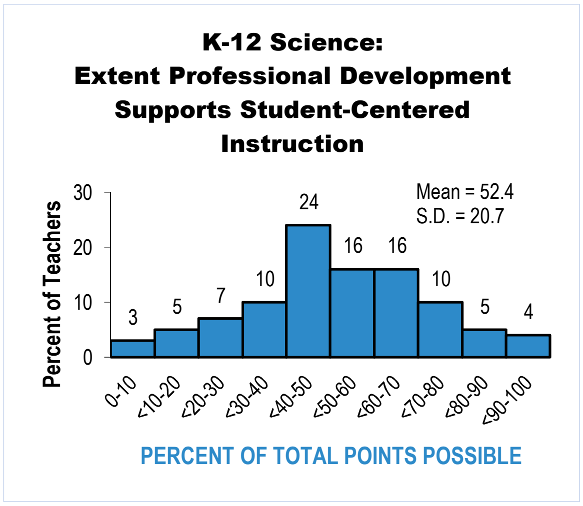


Figure D-4

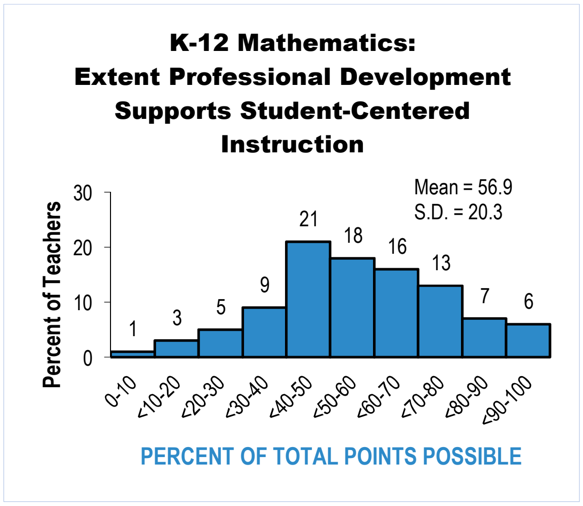


Figure D-5

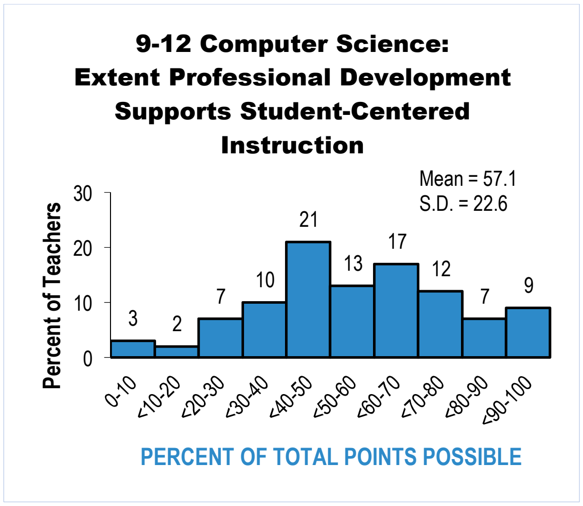


Figure D-6

The Perceptions of Content Preparedness composite was calculated based on the topics taught in the targeted class. Thus, it is defined differently across the subjects and grade ranges included in this study.

Table D-3
Perceptions of Content Preparedness: Elementary Science

	SCIENCE
Life Science	Q35a
Earth/Space Science	Q35b
Physical Science	Q35c
Engineering	Q35d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

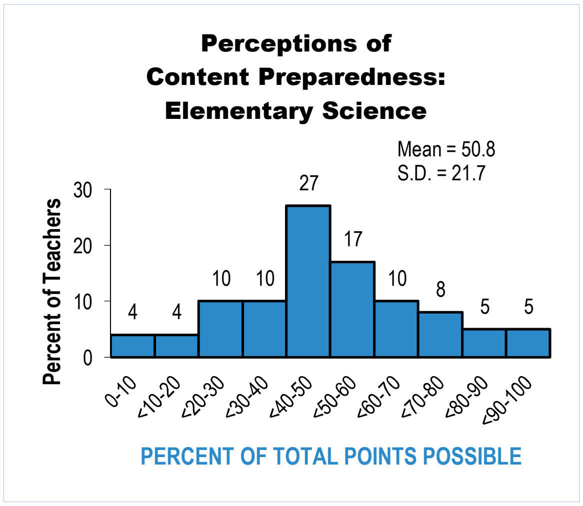


Figure D-7

Table D-4
Perceptions of Content Preparedness: Elementary Mathematics

	MATHEMATICS
Number and Operations	Q23a
Early Algebra	Q23b
Geometry	Q23c
Measurement and Data Representation	Q23d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.82**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**

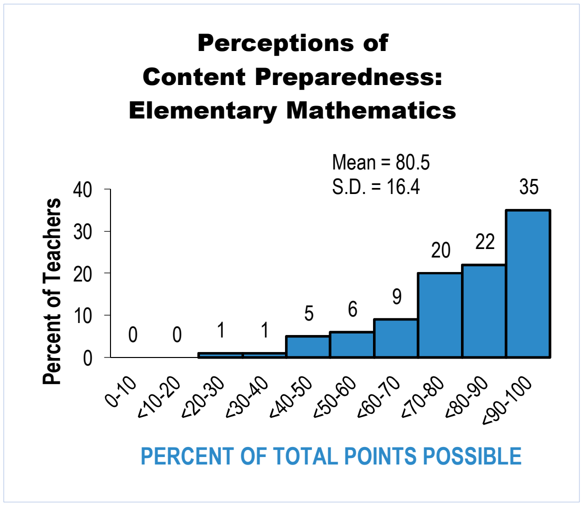


Figure D-8

Table D-5
Perceptions of Content Preparedness: Secondary Science†

	BIOLOGY/LIFE SCIENCE	CHEMISTRY	EARTH SCIENCE	INTEGRATED/ GENERAL SCIENCE	PHYSICAL SCIENCE	PHYSICS
Earth's features and physical processes			Q36ai	Q36ai		
The solar system and the universe			Q36aii	Q36aii		
Climate and weather			Q36aiii	Q36aiii		
Cell biology	Q36bi			Q36bi		
Structures and functions of organisms	Q36bii			Q36bii		
Ecology/ecosystems	Q36biii			Q36biii		
Genetics	Q36biv			Q36biv		
Evolution	Q36bv			Q36bv		
Atomic structure		Q36ci		Q36ci	Q36ci	
Chemical bonding, equations, nomenclature, and reactions		Q36cii		Q36cii	Q36cii	
Elements, compounds, and mixtures		Q36ciii		Q36ciii	Q36ciii	
The Periodic Table		Q36civ		Q36civ	Q36civ	
Properties of solutions		Q36cv		Q36cv	Q36cv	
States, classes, and properties of matter		Q36cvi		Q36cvi	Q36cvi	
Forces and motion				Q36di	Q36di	Q36di
Energy transfers, transformations, and conservation				Q36dii	Q36dii	Q36dii
Properties and behaviors of waves				Q36diii	Q36diii	Q36diii
Electricity and magnetism				Q36div	Q36div	Q36div
Modern physics (e.g., special relativity)				Q36dv	Q36dv	Q36dv
Defining engineering problems				Q36ei		
Developing possible solutions				Q36eii		
Optimizing a design solution				Q36eii		
Environmental and resource issues (e.g., land and water use, energy resources and consumption, sources and impacts of pollution)				Q36f		
Number of Items in Composite	**5**	**6**	**3**	**23**	**11**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.89**	**0.96**	**0.80**	**0.93**	**0.92**	**0.89**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.02**	**0.00**	**0.13**	**0.17**	**0.06**

† Items in these composites were presented only to non-self-contained teachers.

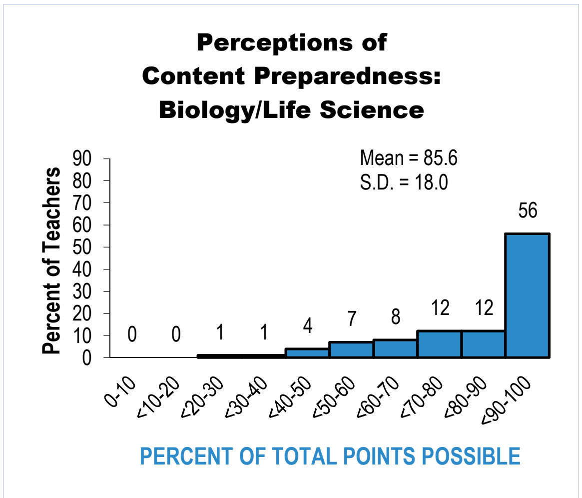


Figure D-9

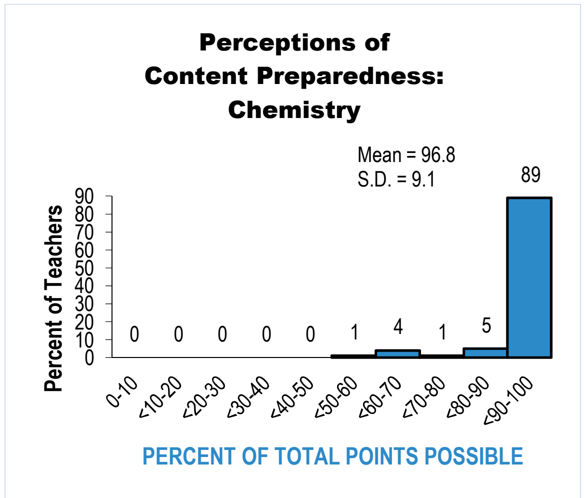


Figure D-10

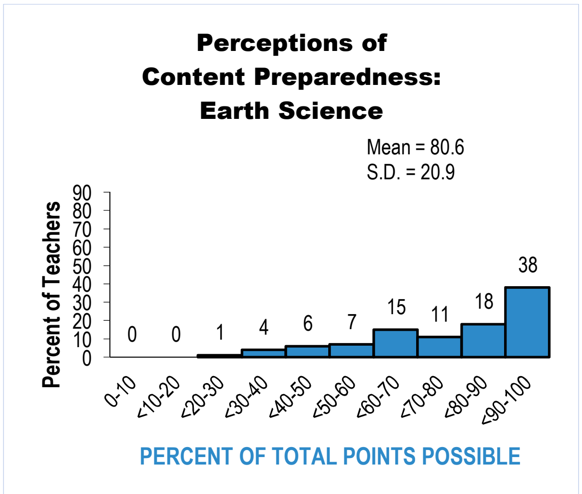


Figure D-11

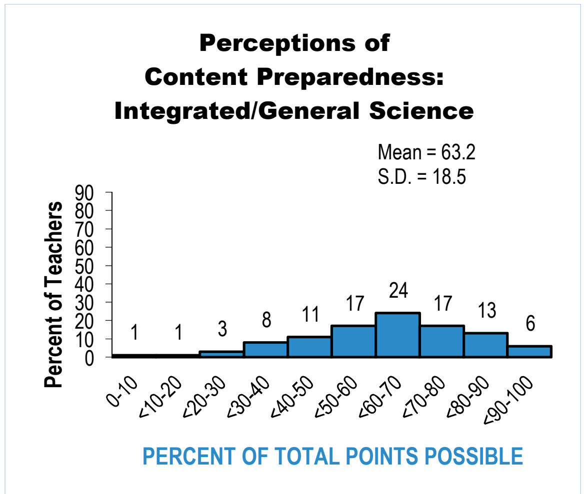
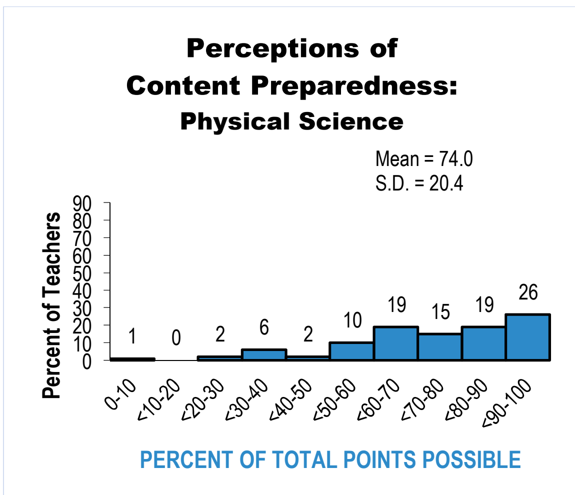


Figure D-12



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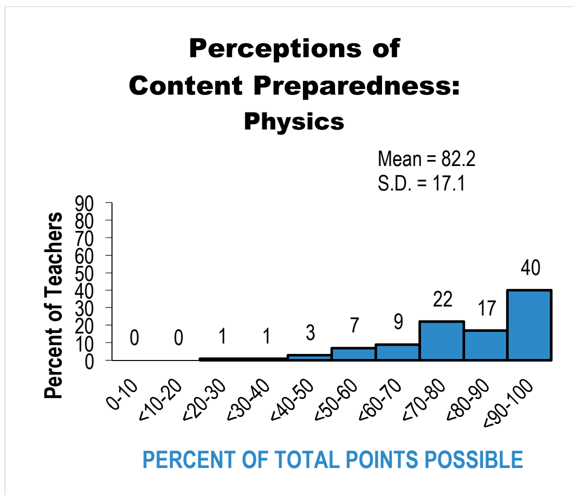


Figure D-14

Table D-6
Perceptions of Content Preparedness: Secondary Mathematics†

	MATHEMATICS
The number system and operations	Q24a
Algebraic thinking	Q24b
Functions	Q24c
Modeling	Q24d
Measurement	Q24e
Geometry	Q24f
Statistics and probability	Q24g
Discrete mathematics	Q24h
Number of Items in Composite	**8**
Reliability – Cronbach's Coefficient Alpha	**0.79**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**

† These items were presented only to non-self-contained teachers.

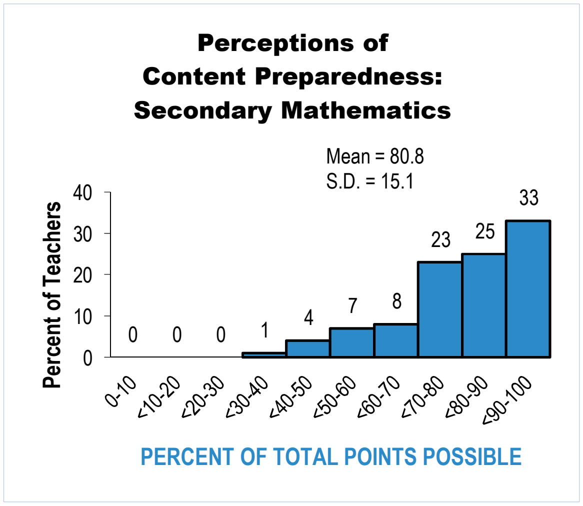


Figure D-15

Table D-7
Perceptions of Content Preparedness: High School Computer Science

	COMPUTER SCIENCE
Computing systems	Q20a
Networks and the Internet	Q20b
Data and analysis	Q20c
Algorithms and programming	Q20d
Impacts of computing	Q20e
Number of Items in Composite	**5**
Reliability – Cronbach's Coefficient Alpha	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**

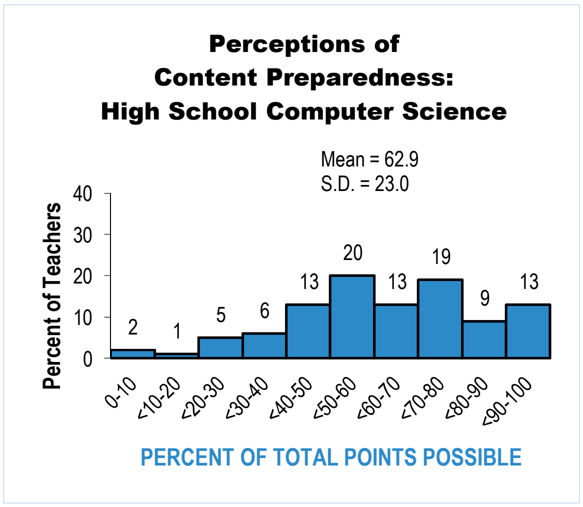


Figure D-16

Table D-8
Perceptions of Preparedness to Teach Engineering

	ENGINEERING
Defining engineering problems	Q36ei
Developing possible solutions	Q36eii
Optimizing a design solution	Q36eiii
Number of Items in Composite	**3**
Reliability – Cronbach's Coefficient Alpha	**0.96**
Confirmatory Factor Analysis Fit Index – SRMR	**0.00**

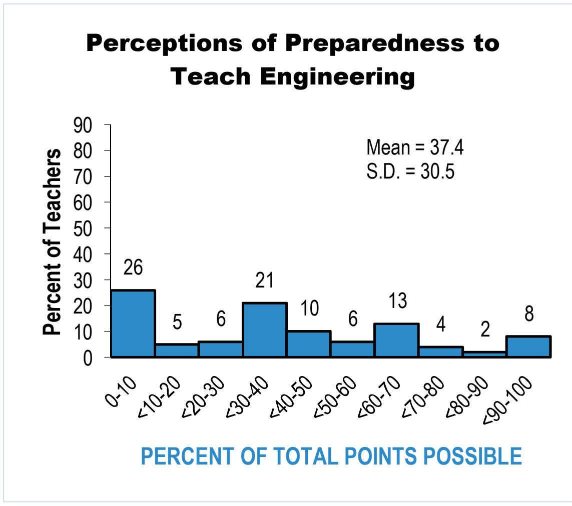


Figure D-17

Table D-9
Perceptions of Pedagogical Preparedness

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Develop students' conceptual understanding of the science ideas you teach‡	Q37a		
Develop students' conceptual understanding of the mathematical ideas you teach‡		Q25a	
Develop students' conceptual understanding of the computer science ideas you teach‡			Q21a
Develop students' abilities to do science (e.g., develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)‡	Q37b		
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)‡		Q25b	
Develop students' abilities to do computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)‡			Q21b
Develop students' awareness of STEM careers	Q37c	Q25c	Q21c
Provide science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡	Q37d		
Provide mathematics instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡		Q25d	
Provide computer science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡			Q21d
Use formative assessment to monitor student learning	Q37e	Q25e	Q21e
Differentiate science instruction to meet the needs of diverse learners‡	Q37f		
Differentiate mathematics instruction to meet the needs of diverse learners‡		Q25f	
Differentiate computer science instruction to meet the needs of diverse learners‡			Q21f
Incorporate students' cultural backgrounds into science instruction‡	Q37g		
Incorporate students' cultural backgrounds into mathematics instruction‡		Q25g	
Incorporate students' cultural backgrounds into computer science instruction‡			Q21g
Encourage students' interest in science and/or engineering‡	Q37h		
Encourage students' interest in mathematics‡		Q25h	
Encourage students' interest in computer science‡			Q21h
Encourage participation of all students in science and/or engineering‡	Q37i		
Encourage participation of all students in mathematics‡		Q25i	
Encourage participation of all students in computer science‡			Q21i
Number of Items in Composite	**9**	**9**	**9**
Reliability – Cronbach's Coefficient Alpha	**0.90**	**0.84**	**0.89**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.04**	**0.04**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.

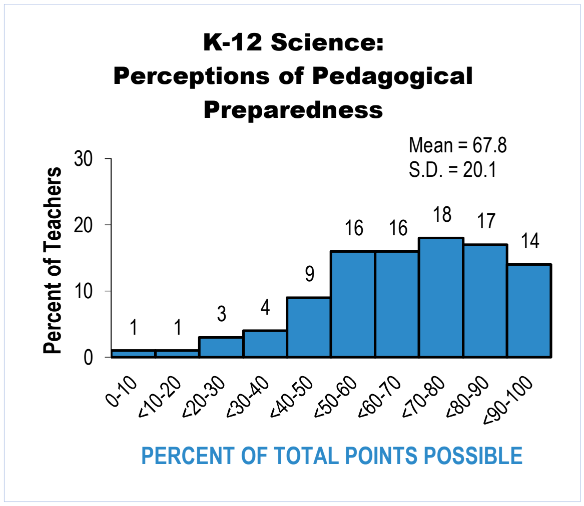


Figure D-18

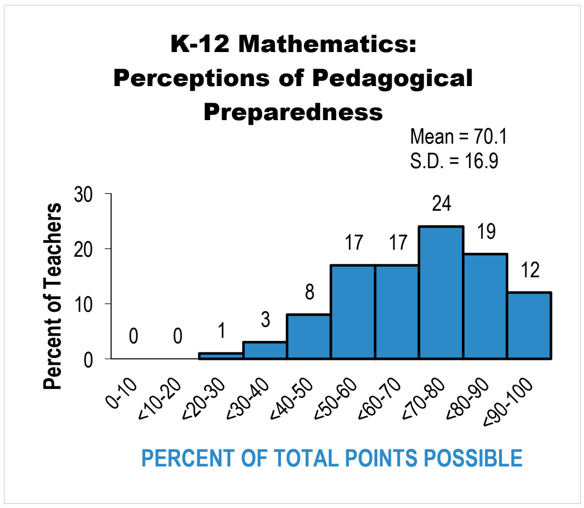


Figure D-19

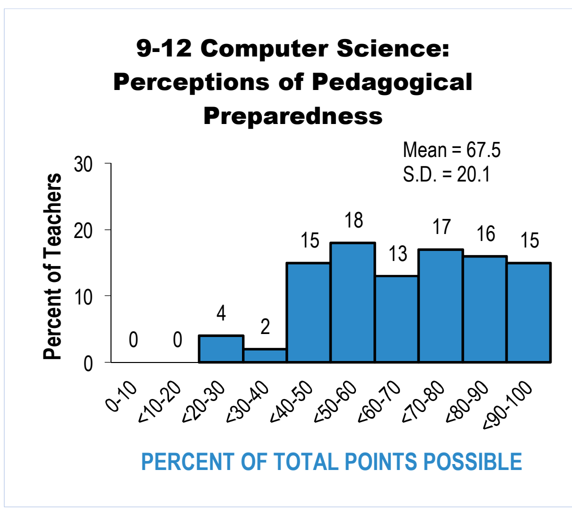


Figure D-20

Table D-10
Perceptions of Preparedness to Implement Instruction in Particular Unit

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Anticipate difficulties that students will have with particular science ideas and procedures in this unit‡	Q67a		
Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit‡		Q53a	
Anticipate difficulties that students may have with particular computer science ideas and procedures in this unit‡			Q49a
Find out what students thought or already knew about the key science ideas‡	Q67b		
Find out what students thought or already knew about the key mathematical ideas‡		Q53b	
Find out what students thought or already knew about the key computer science ideas‡			Q49b
Implement the instructional materials (e.g., textbook, module, online course) to be used during this unit	Q67c	Q53c	Q49c
Monitor student understanding during this unit	Q67d	Q53d	Q49d
Assess student understanding at the conclusion of this unit	Q67e	Q53e	Q49e
Number of Items in Composite	**5**	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.90**	**0.87**	**0.88**
Confirmatory Factor Analysis Fit Index – SRMR	**<0.01**	**<0.01**	**0.04**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.

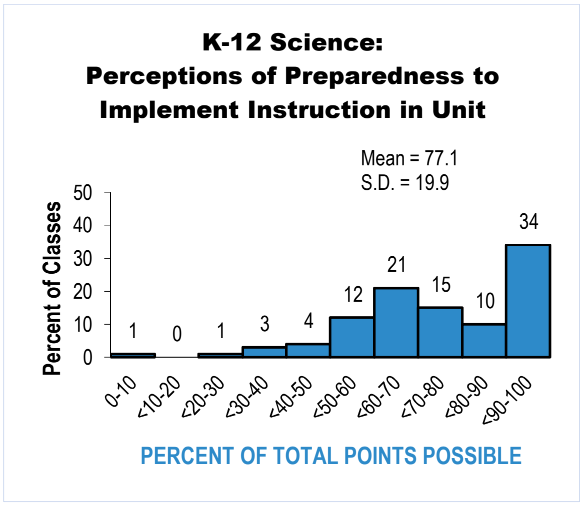


Figure D-21

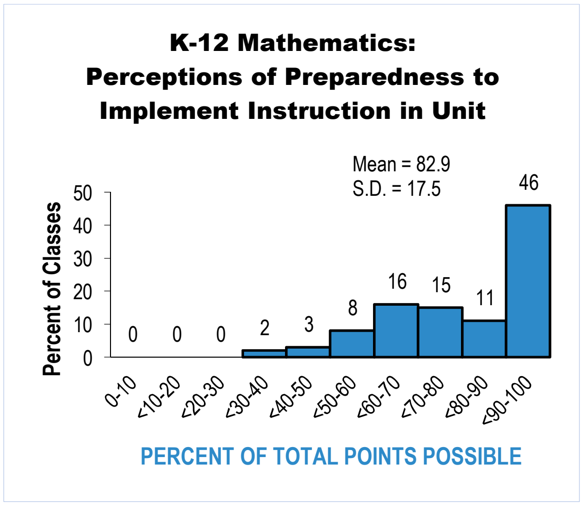


Figure D-22

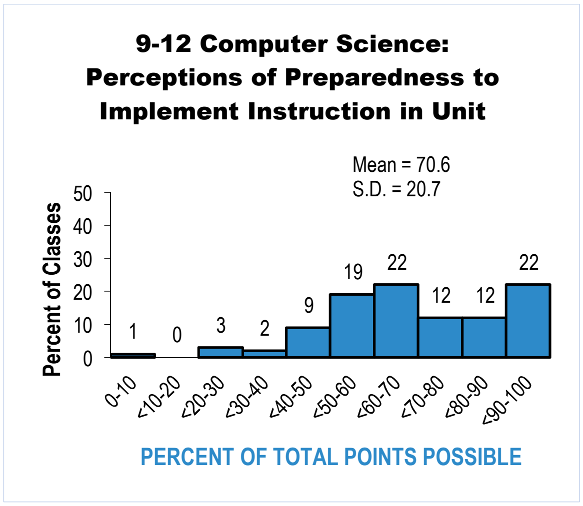


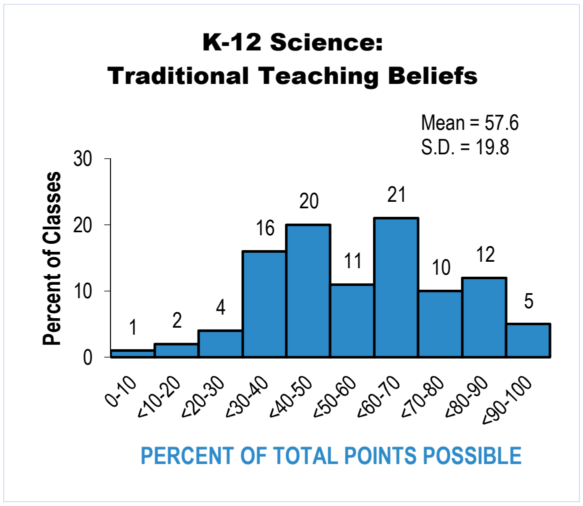
Figure D-23

Table D-11
Traditional Teaching Beliefs

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Students learn science best in classes with students of similar abilities.‡	Q38a		
Students learn mathematics best in classes with students of similar abilities.‡		Q26a	
Students learn computer science best in classes with students of similar abilities.‡			Q22a
At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.‡	Q38c		
At the beginning of instruction on a mathematical idea, students should be provided with definitions for new mathematics vocabulary that will be used.‡		Q26c	
At the beginning of instruction on a computer science idea, students should be provided with definitions for new vocabulary that will be used.‡			Q22c
Teachers should explain an idea to students before having them consider evidence that relates to the idea.‡	Q38d		
Teachers should explain an idea to students before having them investigate the idea.‡		Q26d	
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned.‡	Q38f		
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.‡		Q26f	
Hands-on/manipulatives/programming activities should be used primarily to reinforce a computer science idea that the students have already learned.‡			Q22e
Number of Items in Composite	**4**	**4**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.65**	**0.60**	**0.37†**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.05**	**0.05**

† Although the Cronbach's alpha is lower than typically accepted standards, the composite was computed for computer science because the SRMR statistic is good to maintain consistency across subjects.

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.



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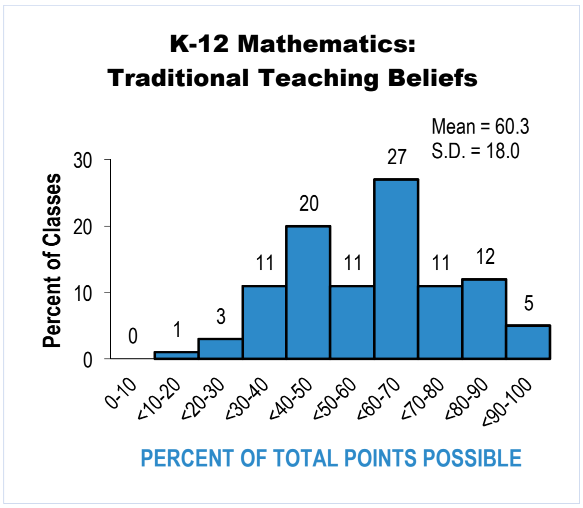

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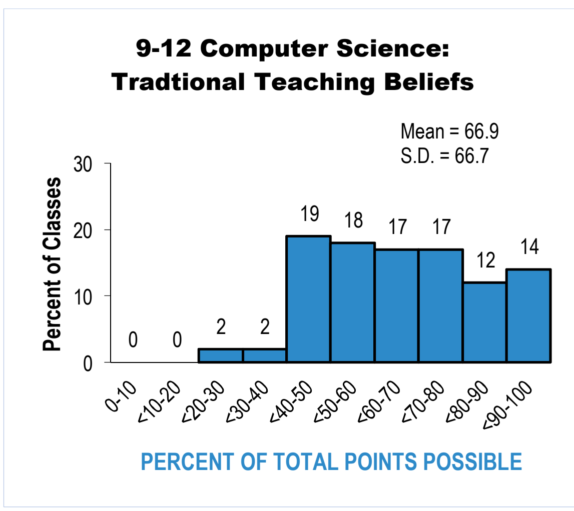
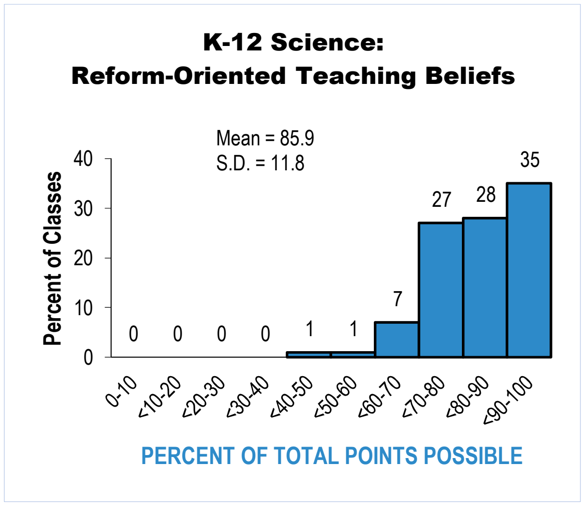


Figure D-26

Table D-12
Reform-Oriented Teaching Beliefs

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Most class periods should provide opportunities for students to share their thinking and reasoning.	Q38e	Q26e	Q22d
Teachers should ask students to support their conclusions about a science concept with evidence.‡	Q38g		
Teachers should ask students to justify their mathematical thinking.‡		Q26g	
Teachers should ask students to justify their solutions to a computational problem.‡			Q22f
Students learn best when instruction is connected to their everyday lives.	Q38h	Q26h	Q22g
Most class periods should provide opportunities for students to apply scientific ideas to real-world contexts.‡	Q38i		
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.‡		Q26i	
Most class periods should provide opportunities for students to apply computer science ideas to real-world contexts.‡			Q22h
Students should learn science by doing science (e.g., developing scientific questions; designing and conducting investigations; analyzing data; developing models, explanations, and scientific arguments).‡	Q38j		
Students should learn mathematics by doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models).‡		Q26j	
Students should learn computer science by doing computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts).‡			Q22i
Number of Items in Composite	**5**	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.77**	**0.72**	**0.65**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.05**	**0.05**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.



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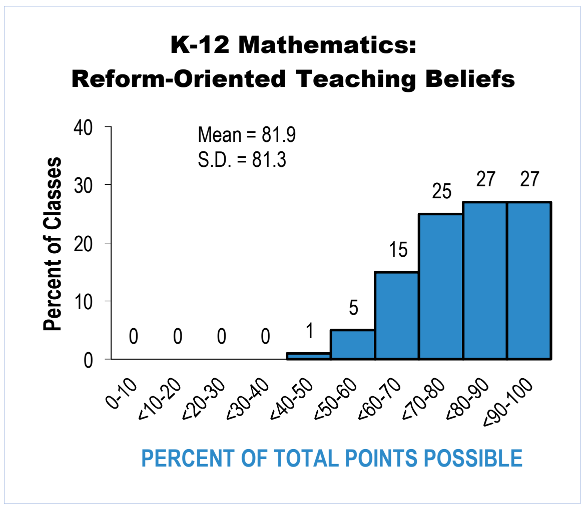


Figure D-28

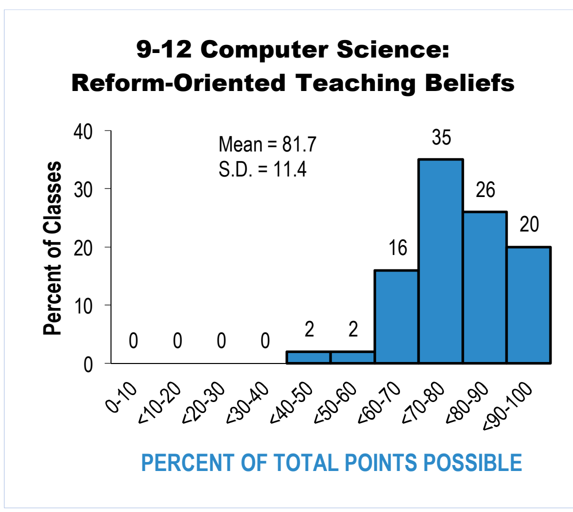


Figure D-29

Decision-Making Autonomy

These composites estimate the level of control teachers perceive having over curriculum and pedagogy decisions for their classrooms.

Table D-13
Curriculum Control

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Determining course goals and objectives	Q44a	Q32a	Q28a
Selecting curriculum materials (e.g., textbooks/modules)	Q44b	Q32b	Q28b
Selecting content, topics, and skills to be taught	Q44c	Q32c	Q28c
Selecting programming languages to use			Q28d
Selecting the sequence in which topics are covered	Q44d	Q44d	Q28e
Number of Items in Composite	**4**	**4**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.85**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**	**0.04**	**0.05**

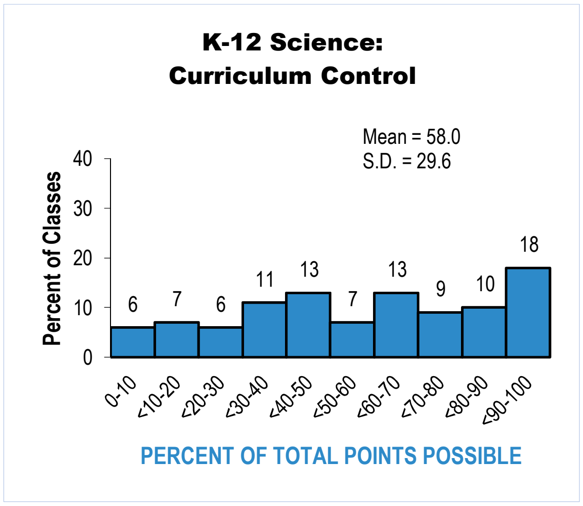
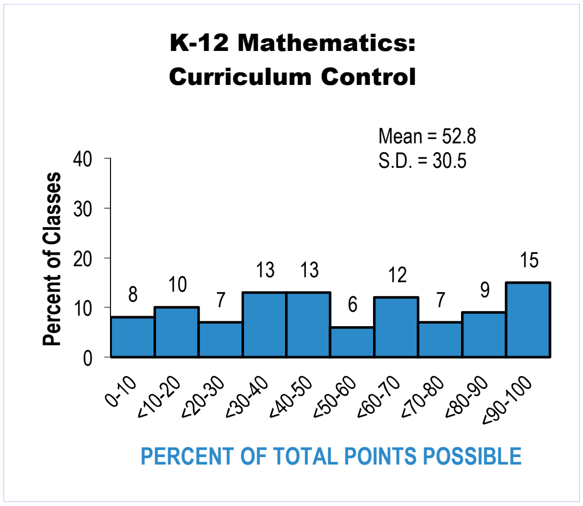


Figure D-30



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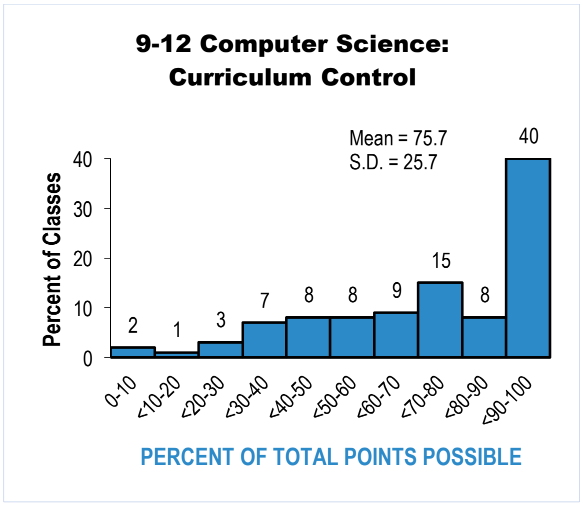
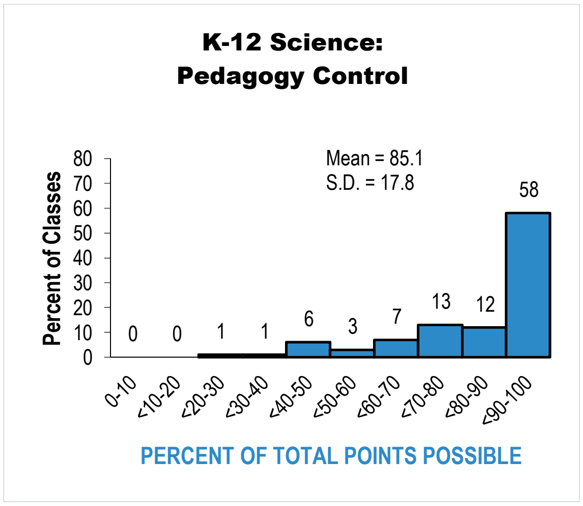


Figure D-32

Table D-14
Pedagogy Control

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Selecting teaching techniques	Q44f	Q32f	Q28g
Determining the amount of homework to be assigned	Q44g	Q32g	Q28h
Choosing criteria for grading student performance	Q44h	Q32h	Q28i
Number of Items in Composite	**3**	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.77**	**0.70**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**	**0.04**	**0.05**



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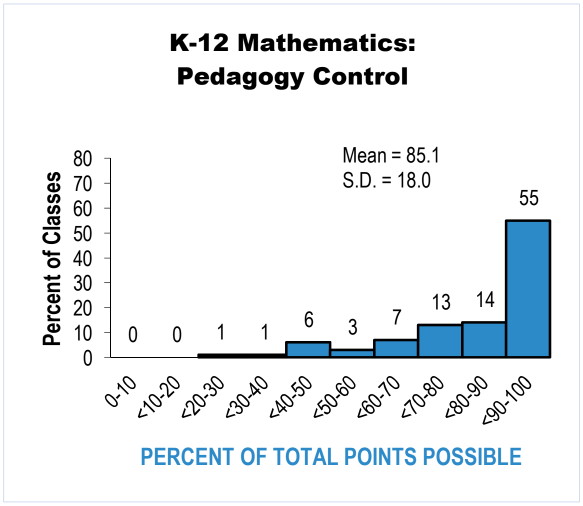

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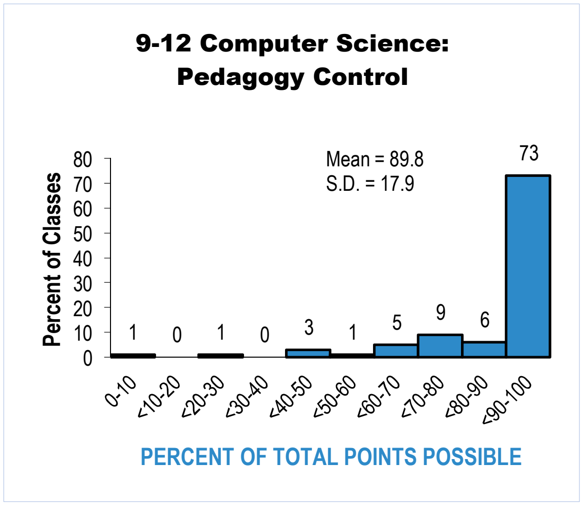


Figure D-35

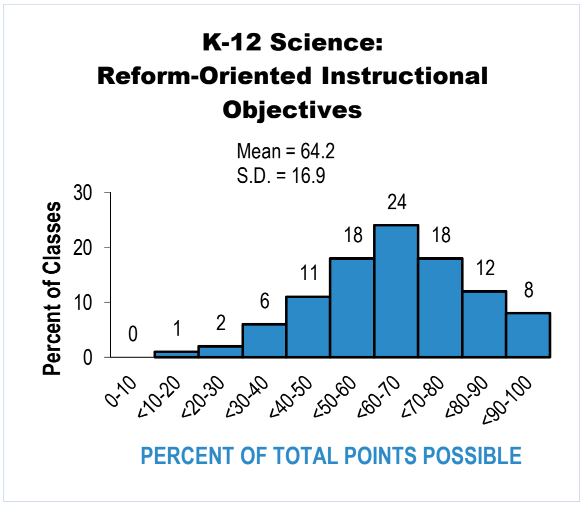
Instructional Objectives

These composites estimate the amount of emphasis teachers place on reform-oriented instructional objectives.

Table D-15
Reform-Oriented Instructional Objectives

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Understanding science concepts‡	Q45b		
Understanding mathematical ideas‡		Q33d	
Understanding computer science concepts‡			Q29b
Learning about different fields of science/engineering	Q45c		
Learning how to do science‡	Q45d		
Learning how to do mathematics‡		Q33e	
Learning how to do computer science‡			Q29c
Learning how to develop computational solutions			Q29d
Learning how to do engineering	Q45e		
Learning about real-life applications of science/engineering‡	Q45f		
Learning about real-life applications of mathematics‡		Q33f	
Learning about real-life applications of computer science‡			Q29e
Increasing students' interest in science‡	Q45g		
Increasing students' interest in mathematics‡		Q33g	
Increasing students' interest in computer science‡			Q29f
Developing students' confidence that they can successfully pursue careers in science/engineering‡	Q45h		
Developing students' confidence that they can successfully pursue careers in mathematics‡		Q33h	
Developing students' confidence that they can successfully pursue careers in computer science‡			Q29g
Number of Items in Composite	**7**	**5**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.73**	**0.72**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.08**	**0.10**

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.



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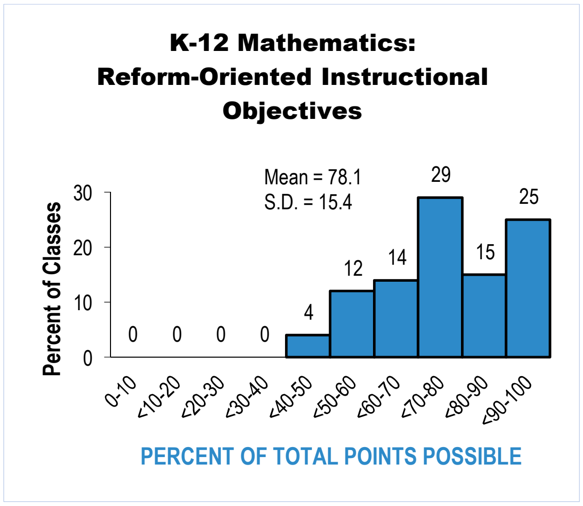

Figure D-37

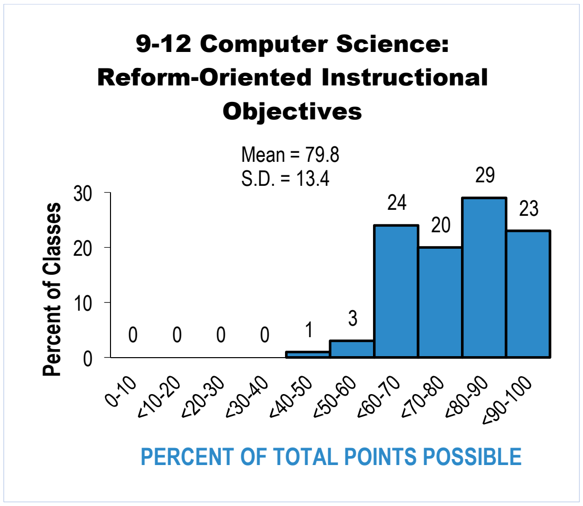

Figure D-38

Teaching Practices

These composites estimate the extent to which teachers engage students in the practices of their discipline.

Table D-16
Engaging Students in Practices of Science

	SCIENCE
Determine whether or not a question is "scientific"	Q47a
Generate scientific questions based on their curiosity, prior knowledge, careful observation of real-world phenomena, scientific models, or preliminary data from an investigation	Q47b
Determine what data would need to be collected in order to answer a scientific question	Q47c
Develop procedures for a scientific investigation to answer a scientific question	Q47d
Conduct a scientific investigation	Q47e
Organize and/or represent data using tables, charts, or graphs in order to facilitate analysis of the data	Q47f
Compare data from multiple trials or across student groups for consistency in order to identify potential sources of error or inconsistencies in the data	Q47g
Analyze data using grade-appropriate methods in order to identify patterns, trends, or relationships	Q47h
Consider how missing data or measurement error can affect the interpretation of data	Q47i
Make and support claims (proposed answers to scientific questions) with evidence	Q47j
Use multiple sources of evidence (e.g., different investigations, scientific literature) to develop an explanation	Q47k
Revise their explanations (claims supported by evidence and reasoning) for real-world phenomena based on additional evidence	Q47l
Develop scientific models—physical, graphical, or mathematical representations of real-world phenomena—based on data and reasoning	Q47m
Identify the strengths and limitations of a scientific model—in terms of accuracy, clarity, generalizability, accessibility to others, strength of evidence supporting it—regardless of who created the model	Q47n
Select and use grade-appropriate mathematical and/or statistical techniques to analyze data	Q47o
Use mathematical and/or computational models to generate data to support a scientific claim	Q47p
Determine what details about an investigation (e.g., its design, implementation, and results) might persuade a targeted audience about a scientific claim	Q47q
Use data and reasoning to defend, verbally or in writing, a claim or refute alternative scientific claims about a real-world phenomenon	Q47r
Evaluate the strengths and weaknesses of competing scientific explanations (claims supported by evidence) for a real-world phenomenon	Q47s
Construct a persuasive case, verbally or in writing, for the best scientific model or explanation for a real-world phenomenon	Q47t
Pose questions that elicit relevant details about the important aspects of a scientific argument	Q47u
Evaluate the credibility of scientific information—e.g., its reliability, validity, consistency, logical coherence, lack of bias, or methodological strengths and weaknesses	Q47v
Summarize patterns, similarities, and differences in scientific information obtained from multiple sources	Q47w
Number of Items in Composite	**23**
Reliability – Cronbach's Coefficient Alpha	**0.96**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**

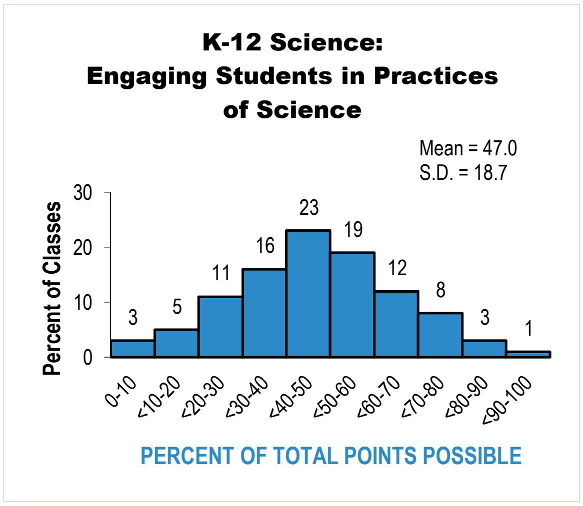
K-12 Science:
Engaging Students in Practices of Science
Mean = 47.0
S.D. = 18.7
Percent of Classes
30
20
10
0
3
5
11
16
23
19
12
8
3
1
0-10
<10-20
<20-30
<30-40
<40-50
<50-60
<60-70
<70-80
<80-90
<90-100
PERCENT OF TOTAL POINTS POSSIBLE

Figure D-39

Table D-17
Engaging Students in Practices of Mathematics

	MATHEMATICS
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	Q35a
Figure out what a challenging problem is asking	Q35b
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	Q35c
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	Q35d
Determine whether their answer makes sense	Q35e
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	Q35f
Provide mathematical reasoning to explain, justify, or prove their thinking	Q35g
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	Q35h
Analyze the mathematical reasoning of others	Q35i
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	Q35j
Identify relevant information and relationships that could be used to solve a mathematics problem	Q35k
Develop a mathematical model (i.e., a representation of relevant information and relationships such as an equation, tape diagram, algorithm, or function) to solve a mathematics problem	Q35l
Determine what tools (e.g., pencil and paper, manipulatives, ruler, protractor, calculator, spreadsheet) are appropriate for solving a mathematics problem	Q35m
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	Q35n
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	Q35o
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	Q35p
Work on generating a rule or formula	Q35q
Number of Items in Composite	**17**
Reliability – Cronbach's Coefficient Alpha	**0.92**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**

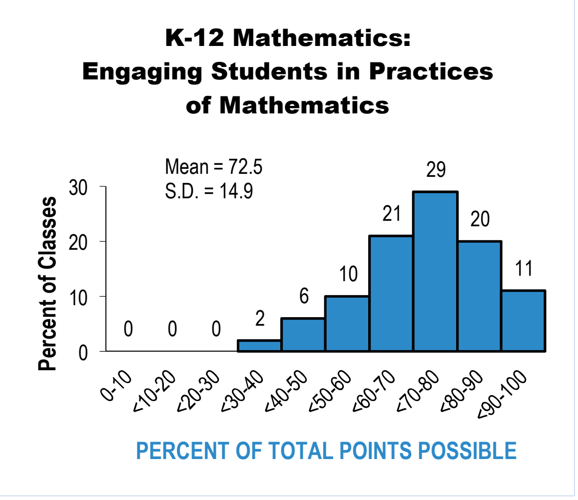

Figure D-40

Table D-18
Engaging Students in Practices of Computer Science

	COMPUTER SCIENCE
Create computational artifacts	Q31a
Create a computational artifact designed to be used by someone outside the class or other students	Q31b
Provide feedback on other students' computational products or designs	Q31c
Get input on computational products or designs from people with different perspectives	Q31d
Systematically use test cases to verify program performance and/or identify problems	Q31e
Identify real-world problems that might be solved computationally	Q31f
Consider how a program they are creating can be separated into modules/procedures/objects	Q31g
Identify and adapt existing code to solve a new computational problem	Q31h
Use computational methods to simulate events or processes	Q31i
Analyze datasets using a computer to detect patterns	Q31j
Write comments within code to document purposes or features	Q31k
Create instructions for an end-user explaining how to use a computational artifact	Q31l
Explain computational solution strategies verbally or in writing	Q31m
Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures	Q31n
Number of Items in Composite	**14**
Reliability – Cronbach's Coefficient Alpha	**0.87**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**

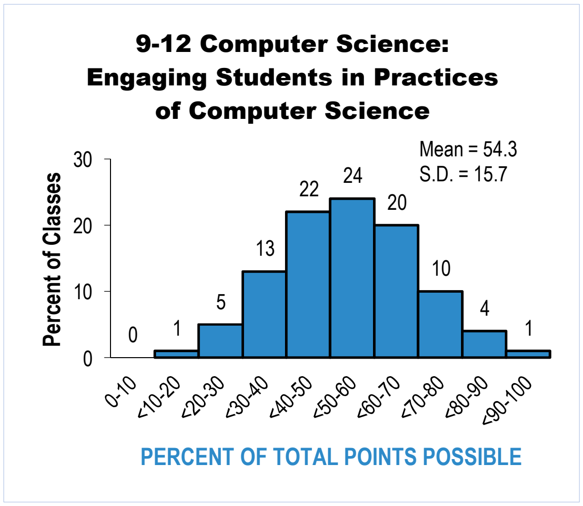

Figure D-41

Influences on Instruction

These composites estimate the extent to which teachers perceive various factors as promoting/ inhibiting effective instruction.

Table D-19
Adequacy of Resources for Science Instruction

	SCIENCE
Instructional technology (e.g., calculators, computers, probes/sensors)	Q54a
Consumable supplies (e.g., chemicals, living organisms, batteries)	Q54b
Equipment (e.g., thermometers, magnifying glasses, microscopes, beakers, photogate timers, Bunsen burners)	Q54c
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	Q54d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.85**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

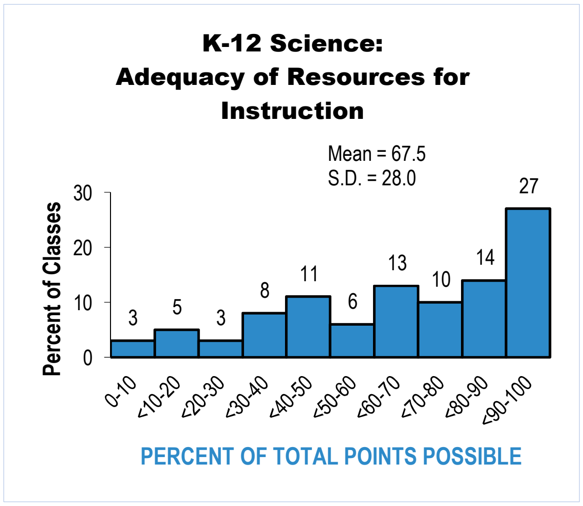

Figure D-42

Table D-20
Adequacy of Resources for Mathematics Instruction

	MATHEMATICS
Instructional technology (e.g., calculators, computers, probes/sensors)	Q40a
Measurement tools (e.g., protractors, rulers)	Q40b
Manipulatives (e.g., pattern blocks, algebra tiles)	Q40c
Consumable supplies (e.g., graphing paper, batteries)	Q40d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.72**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**

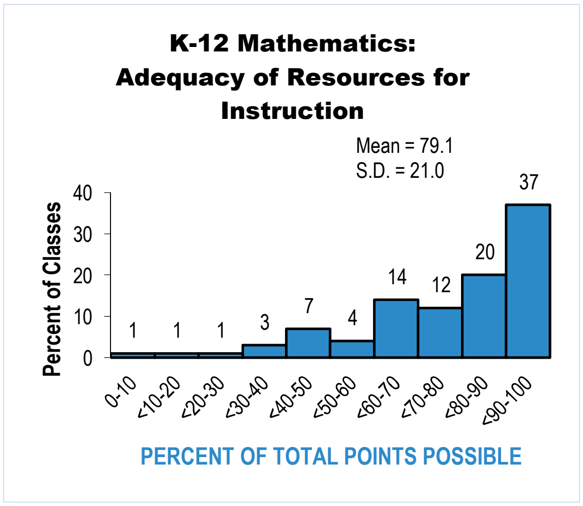

Figure D-43

Table D-21
Extent to Which Computer/Internet Access is Problematic

	COMPUTER SCIENCE
Lack of reliable access to the Internet	Q42a
Lack of functioning computing devices (e.g., desktop computers, laptop computers, tablets, smartphones)	Q42b
Insufficient power sources for devices (e.g., electrical outlets, charging stations)	Q42c
Lack of support to maintain technology (e.g., repair broken devices, install software)	Q42d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**

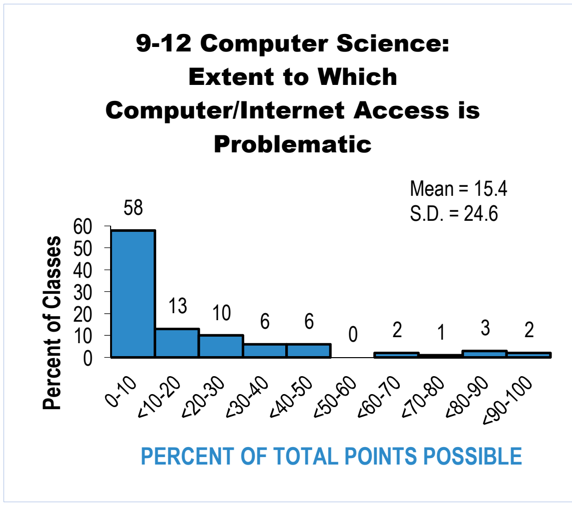

Figure D-44

Table D-22
Extent to Which the Policy Environment Promotes Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Current state standards	Q60a	Q46a	Q41a
School/District/Diocese pacing guides	Q60b	Q46b	
State/District/Diocese testing/accountability policies†	Q60c	Q46c	
Textbook/module selection policies	Q60d	Q46d	Q41b
Teacher evaluation policies	Q60e	Q46e	Q41c
Number of Items in Composite	**5**	**5**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.79**	**0.73**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

† This item was presented only to teachers in public and Catholic schools.

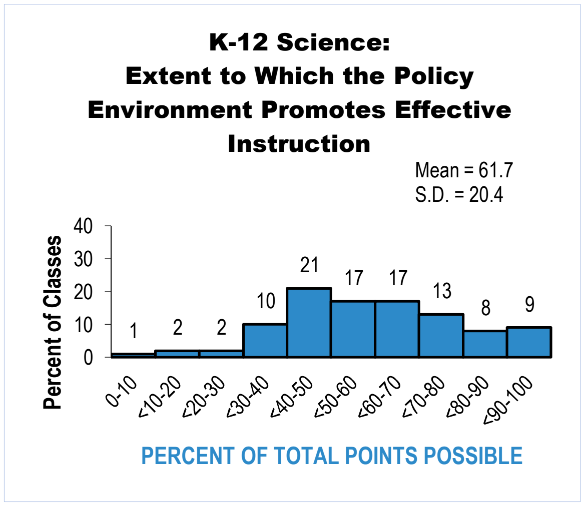

Figure D-45

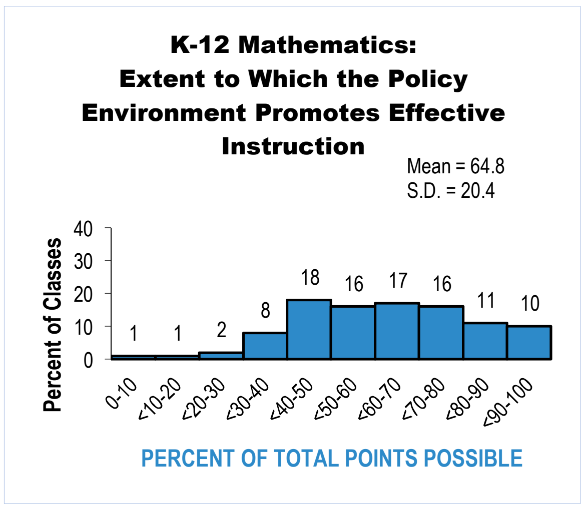

Figure D-46

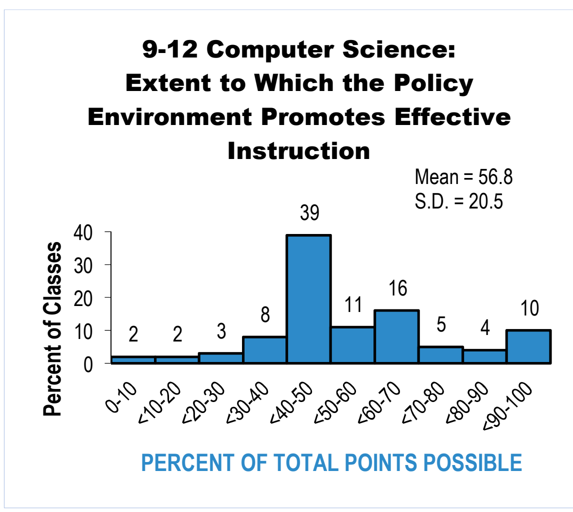

Figure D-47

Table D-23
Extent to Which Stakeholders Promote Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Students' prior knowledge and skills	Q60g	Q46g	Q41e
Students' motivation, interest, and effort in science‡	Q60h		
Students' motivation, interest, and effort in mathematics‡		Q46h	
Students' motivation, interest, and effort in computer science‡			Q41f
Parent/guardian expectations and involvement	Q60i	Q46i	Q41g
Number of Items in Composite	**3**	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.88**	**0.70**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

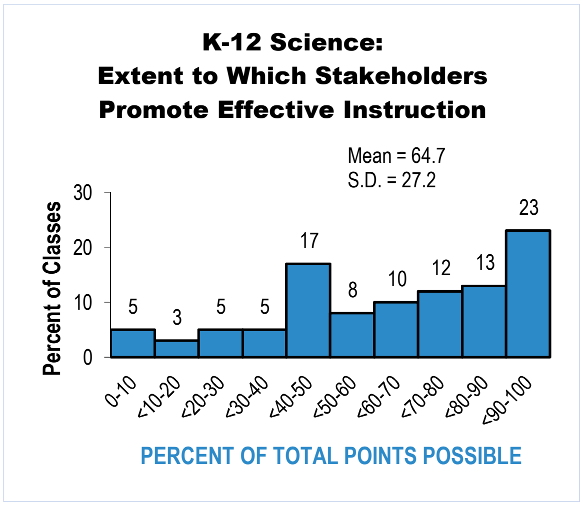

Figure D-48

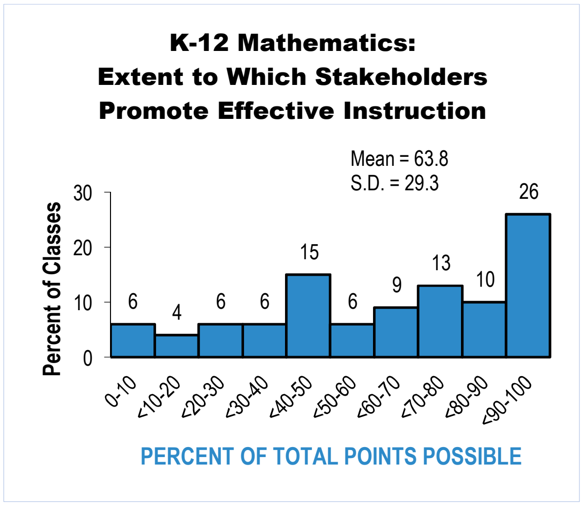

Figure D-49

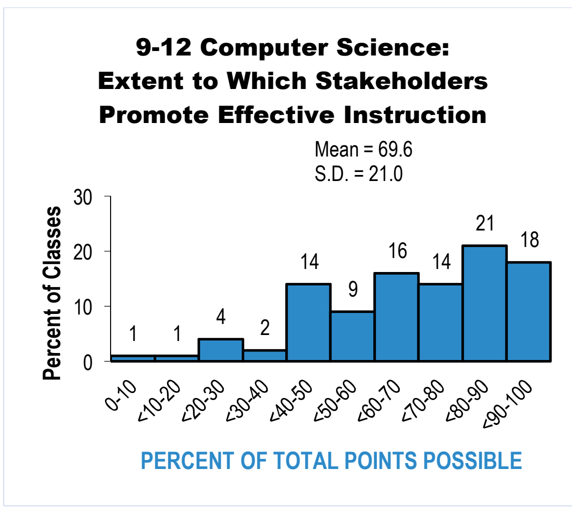

Figure D-50

Table D-24
Extent to Which School Support Promotes Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Amount of time for you to plan, individually and with colleagues	Q60k	Q46k	Q41i
Amount of time available for your professional development	Q60l	Q46l	Q41j
Number of Items in Composite	**2**	**2**	**2**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.79**	**0.77**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

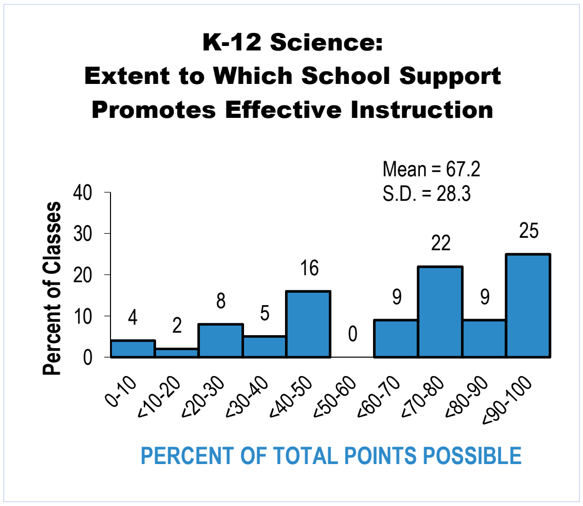

Figure D-51

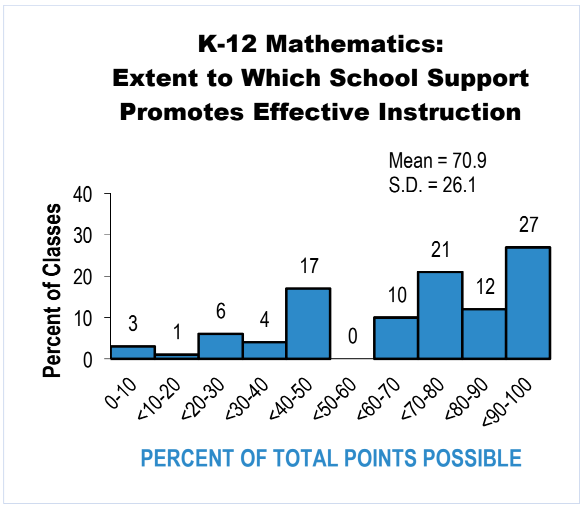

Figure D-52

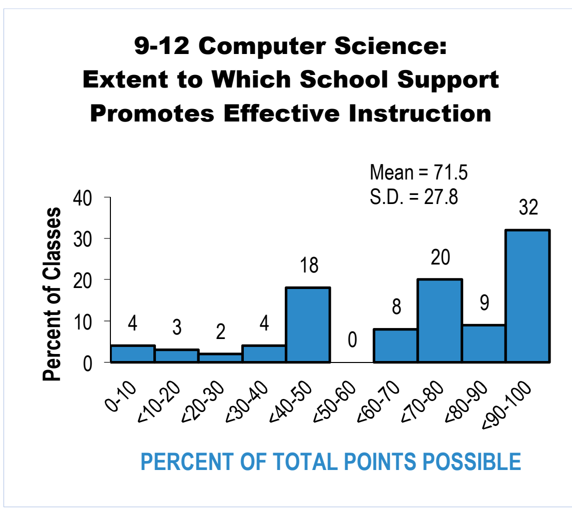

Figure D-53

Definitions of Program Composites

Composite definitions for the science and mathematics program questionnaire are presented below along with the item numbers from the respective questionnaires.

State Standards for Science and Mathematics Education

These composites estimate the level of attention to state standards given by teachers and other stakeholders.

Table D-25
Focus on State Science/Mathematics Standards

	SCIENCE	MATHEMATICS
State science standards have been thoroughly discussed by science teachers in this school.‡	Q5a	
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.‡		Q5a
There is a school-wide effort to align science instruction with the state science standards.‡	Q5b	
There is a school-wide effort to align mathematics instruction with the state mathematics standards.‡		Q5b
Most science teachers in this school teach to the state standards.‡	Q5c	
Most mathematics teachers in this school teach to the state standards.‡		Q5c
Your district/diocese organizes science professional development based on state standards.†, ‡	Q5d	
Your district/diocese organizes mathematics professional development based on state standards.†, ‡		Q5d
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.86**	**0.87**
Confirmatory Factor Analysis Fit Index – SRMR	**<0.01**	**0.01**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

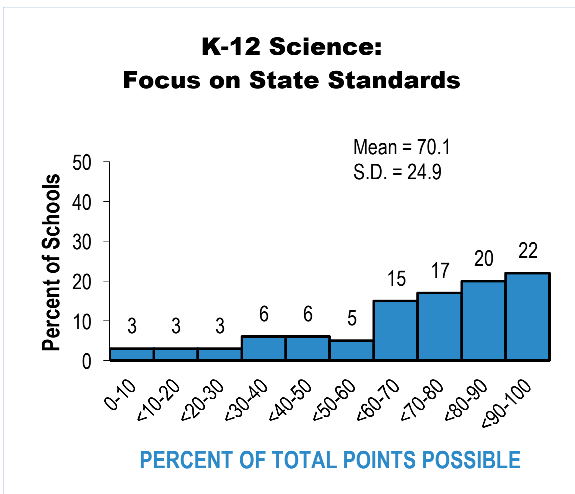

Figure D-54

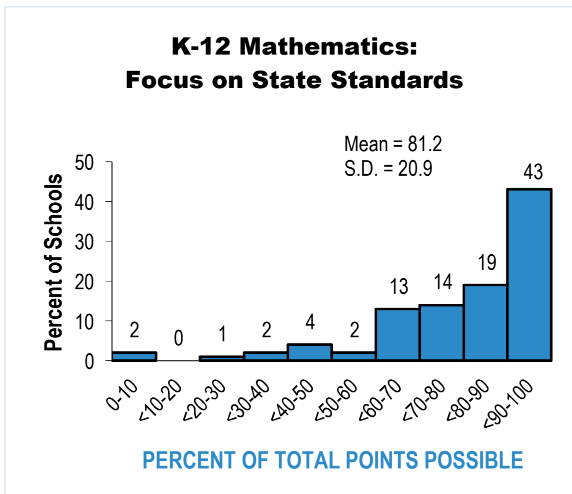

Figure D-55

Factors Affecting Instruction

These composites estimate the extent to which various factors impact science/mathematics instruction in schools.

Table D-26
Supportive Context for Science/Mathematics Instruction

	SCIENCE	MATHEMATICS
School/district/Diocese science professional development policies and practices†, ‡	Q16a	
School/district/Diocese mathematics professional development policies and practices†, ‡		Q19a
Amount of time provided for teacher professional development in science‡	Q16b	
Amount of time provided for teacher professional development in mathematics‡		Q19b
Importance that the school places on science‡	Q16c	
Importance that the school places on mathematics‡		Q19c
Other school and/or district and/or diocese initiatives‡	Q16d	
Other school and/or district and/or diocese initiatives‡		Q19d
The amount of time provided by the school/district/diocese for teachers to share ideas about science instruction‡	Q16e	
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction‡		Q19e
How science instructional resources are managed (e.g., distributing and refurbishing materials)‡	Q16f	
How mathematics instructional resources are managed (e.g., distributing and replacing materials)‡		Q19f
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.89**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.05**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

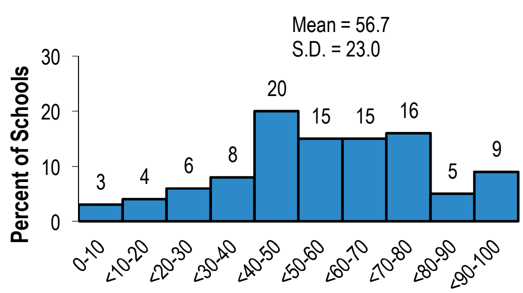

Figure D-56

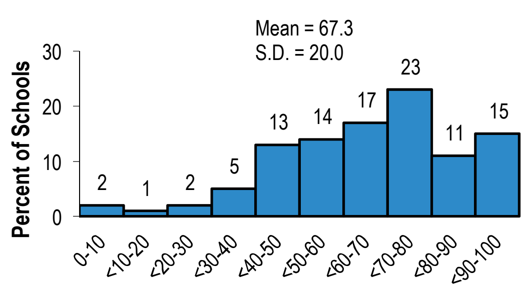

Figure D-57

Table D-27
Extent to Which a Lack of Resources Is Problematic

	SCIENCE	MATHEMATICS
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)‡	Q17a	
Lack of equipment and supplies and/or manipulatives for teaching mathematics (e.g., materials for students to draw, cut, and build in order to make sense of problems)‡		Q20a
Inadequate funds for purchasing science equipment and supplies‡	Q17b	
Inadequate funds for purchasing mathematics equipment and supplies‡		Q20b
Lack of science textbooks/modules‡	Q17c	
Lack of mathematics textbooks‡		Q20c
Poor quality science textbooks/modules‡	Q17d	
Poor quality mathematics textbooks‡		Q20d
Inadequate materials for differentiating science instruction‡	Q17e	
Inadequate materials for differentiating mathematics instruction‡		Q20e
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.09**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

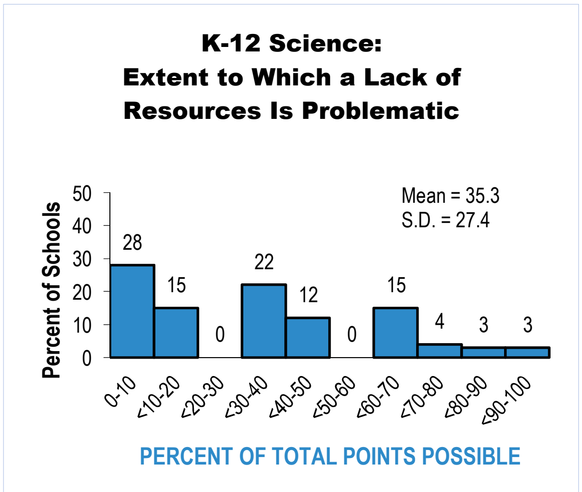

Figure D-58

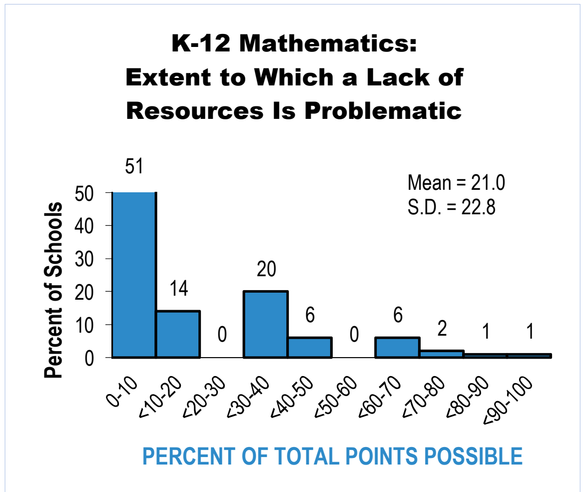

Figure D-59

Table D-28
Extent to Which Student Issues Are Problematic

	SCIENCE	MATHEMATICS
Low student interest in science‡	Q17f	
Low student interest in mathematics‡		Q20f
Low student prior knowledge and skills	Q17g	Q20g
High student absenteeism	Q17n	Q20n
Inappropriate student behavior	Q17o	Q20o
Lack of parent/guardian support and involvement	Q17p	Q20p
Community resistance to the teaching of "controversial" issues in science (e.g., evolution, climate change)‡	Q17q	
Community attitudes toward mathematics instruction‡		Q20q
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.78**	**0.85**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

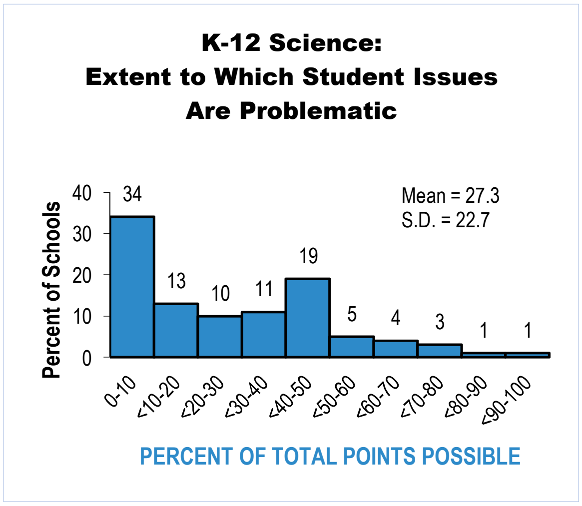

Figure D-60

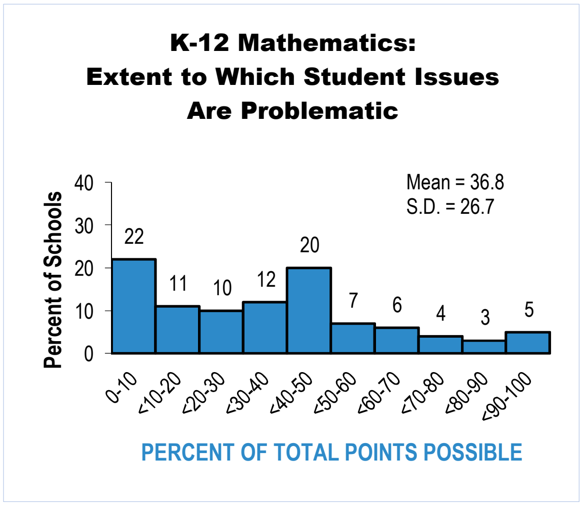

Figure D-61

Table D-29
Extent to Which Teacher Issues Are Problematic

	SCIENCE	MATHEMATICS
Lack of teacher interest in science‡	Q17h	
Lack of teacher interest in mathematics‡		Q20h
Inadequate teacher preparation to teach science‡	Q17i	
Inadequate teacher preparation to teach mathematics‡		Q20i
Insufficient instructional time to teach science‡	Q17k	
Insufficient instructional time to teach mathematics‡		Q20k
Inadequate science-related professional development opportunities‡	Q17l	
Inadequate mathematics-related professional development opportunities‡		Q20l
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.74**	**0.62**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

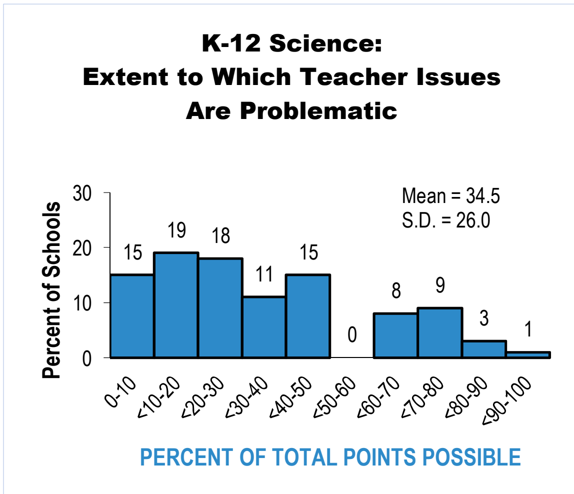

Figure D-62

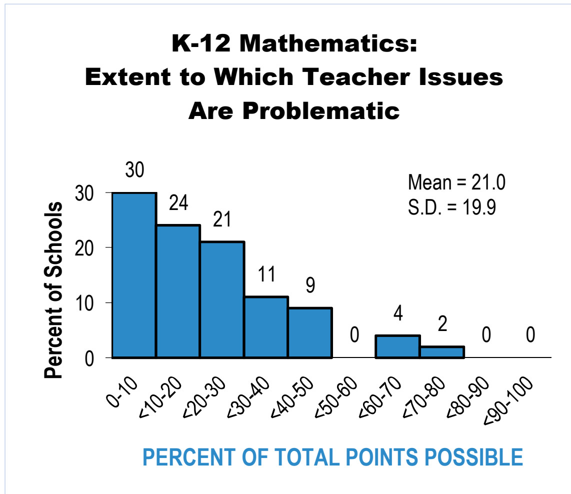

Figure D-63

Additional Equity Cross-Tabulations

Additional Equity Cross-Tabulations

Chapters 2–7 report data on several key indicators, disaggregated by one or more equity factors: the prior achievement level of students in the class, the percentage of students in the class from race/ethnicity groups historically underrepresented in STEM, the percentage of students in the school eligible for free/reduced-price lunch, school size, community type, and region. This appendix includes data on each of these indicators by all relevant equity factors. Each table title includes a reference to the related table in the body of the report.

Table E-1 (Table 2.4)
Equity Analyses of Science Classes Taught by Teachers With Varying Experience Teaching Science

	PERCENT OF CLASSES									
	0–2 YEARS		3–5 YEARS		6–10 YEARS		11–20 YEARS		≥ 21 YEARS	
Prior Achievement Level of Class										
Mostly High	11	(1.6)	16	(1.7)	20	(2.0)	36	(2.8)	17	(1.9)
Average/Mixed	17	(1.1)	16	(1.3)	19	(1.2)	32	(1.5)	17	(1.1)
Mostly Low	19	(3.2)	21	(3.0)	20	(2.4)	29	(3.0)	10	(1.7)
Percent of Historically Underrepresented Students in Class										
Lowest Quartile	13	(1.4)	14	(1.5)	18	(1.6)	38	(2.2)	17	(1.5)
Second Quartile	13	(1.6)	16	(1.8)	19	(2.3)	34	(2.5)	18	(1.9)
Third Quartile	19	(1.7)	19	(2.0)	18	(1.5)	26	(2.3)	18	(2.4)
Highest Quartile	20	(2.2)	20	(3.3)	20	(2.4)	29	(3.1)	11	(1.4)
Percent of Students in School Eligible for FRL										
Lowest Quartile	11	(1.4)	16	(1.9)	18	(2.1)	40	(2.3)	15	(1.4)
Second Quartile	13	(1.3)	13	(1.6)	22	(2.2)	33	(2.6)	19	(2.0)
Third Quartile	22	(2.4)	20	(3.0)	16	(1.9)	27	(2.3)	16	(2.0)
Highest Quartile	19	(2.2)	19	(1.9)	21	(2.1)	27	(2.3)	13	(2.1)
School Size										
Smallest Schools	16	(2.6)	19	(3.8)	21	(3.8)	31	(3.5)	13	(2.3)
Second Group	16	(2.0)	17	(4.0)	18	(2.3)	31	(3.0)	17	(2.3)
Third Group	17	(1.6)	14	(1.4)	17	(1.5)	34	(2.0)	18	(1.9)
Largest Schools	16	(1.5)	18	(1.3)	20	(1.5)	32	(1.7)	14	(1.3)
Community Type										
Rural	17	(1.9)	15	(1.7)	19	(2.0)	33	(2.3)	16	(1.7)
Suburban	14	(1.2)	18	(1.2)	19	(1.4)	34	(1.6)	15	(1.1)
Urban	19	(2.1)	17	(2.9)	19	(2.1)	28	(2.2)	17	(2.1)
Region										
Midwest	15	(2.1)	15	(1.4)	16	(1.7)	32	(2.3)	23	(2.4)
Northeast	11	(1.4)	17	(4.5)	21	(3.2)	40	(3.6)	11	(1.6)
South	21	(1.8)	19	(1.5)	20	(1.2)	27	(1.7)	13	(1.3)
West	14	(1.9)	15	(1.6)	19	(2.2)	35	(3.0)	17	(1.9)

Table E-2 (Table 2.4)
Equity Analyses of Mathematics Classes Taught by Teachers With Varying Experience Teaching Mathematics

	PERCENT OF CLASSES									
	0–2 YEARS		3–5 YEARS		6–10 YEARS		11–20 YEARS		≥ 21 YEARS	
Prior Achievement Level of Class										
Mostly High	10	(1.7)	15	(1.9)	20	(2.3)	33	(2.3)	22	(2.1)
Average/Mixed	14	(1)	16	(1.2)	19	(1.1)	34	(1.4)	16	(1.2)
Mostly Low	17	(1.8)	20	(2.6)	17	(2.4)	33	(2.8)	13	(1.7)
Percent of Historically Underrepresented Students in Class										
Lowest Quartile	9	(1.4)	15	(1.8)	19	(1.5)	35	(2.1)	22	(1.6)
Second Quartile	14	(1.8)	19	(1.6)	20	(1.9)	33	(1.9)	15	(1.6)
Third Quartile	15	(1.6)	15	(2.1)	18	(1.7)	36	(2.6)	17	(1.9)
Highest Quartile	18	(2.3)	19	(2.4)	19	(2.1)	32	(2.8)	13	(1.9)
Percent of Students in School Eligible for FRL										
Lowest Quartile	12	(1.8)	17	(2.0)	19	(1.8)	34	(2.2)	18	(1.5)
Second Quartile	11	(1.4)	18	(1.9)	18	(1.8)	36	(2.2)	17	(1.6)
Third Quartile	17	(1.7)	14	(1.9)	18	(1.5)	33	(2.7)	17	(2.0)
Highest Quartile	15	(2.1)	18	(2.0)	19	(1.8)	32	(2.7)	15	(2.0)
School Size										
Smallest Schools	15	(2.4)	20	(2.3)	18	(2.8)	28	(2.7)	18	(2.7)
Second Group	17	(1.9)	16	(2.0)	19	(1.8)	31	(2.2)	18	(2.5)
Third Group	12	(1.6)	16	(1.5)	17	(1.6)	37	(1.9)	18	(1.7)
Largest Schools	14	(1.1)	17	(1.4)	19	(1.4)	34	(1.7)	15	(1.2)
Community Type										
Rural	12	(1.4)	15	(1.8)	22	(1.7)	33	(1.9)	18	(1.7)
Suburban	14	(1.1)	17	(1.2)	18	(1.2)	36	(1.6)	16	(1.3)
Urban	16	(2.0)	18	(2.0)	18	(1.5)	31	(1.7)	17	(1.9)
Region										
Midwest	11	(1.4)	16	(2.1)	16	(1.6)	35	(2.3)	22	(2.1)
Northeast	11	(1.9)	16	(2.5)	20	(2.1)	37	(3.1)	15	(2.0)
South	18	(1.5)	18	(1.3)	20	(1.6)	30	(1.8)	14	(1.3)
West	12	(1.8)	16	(2.2)	18	(2.0)	37	(3.0)	17	(2.1)

Table E-3 (Table 2.4)
Equity Analyses of High School Computer Science Classes Taught by Teachers With Varying Experience Teaching Computer Science

	PERCENT OF CLASSES									
	0–2 YEARS		3–5 YEARS		6–10 YEARS		11–20 YEARS		≥ 21 YEARS	
Prior Achievement Level of Class										
Mostly High	27	(6.1)	30	(5.9)	19	(5.0)	19	(4.6)	5	(2.5)
Average/Mixed	35	(4.8)	27	(4.6)	13	(2.4)	24	(4.5)	2	(0.8)
Percent of Historically Underrepresented Students in Class										
Lowest Quartile	25	(6.5)	38	(8.0)	14	(4.5)	19	(5.1)	4	(2.8)
Second Quartile	25	(7.4)	26	(9.5)	18	(5.8)	30	(8.0)	1	(0.7)
Third Quartile	27	(6.5)	36	(6.8)	16	(5.7)	18	(6.6)	4	(2.2)
Highest Quartile	49	(9.5)	12	(5.2)	13	(3.7)	22	(9.2)	4	(2.1)
Percent of Students in School Eligible for FRL										
Lowest Quartile	28	(5.0)	30	(5.3)	16	(3.6)	24	(4.9)	2	(1.4)
Second Quartile	31	(8.3)	29	(7.1)	17	(5.9)	22	(6.5)	2	(1.9)
Third Quartile	23	(8.2)	36	(12.1)	8	(3.5)	33	(11.4)	1	(0.7)
Highest Quartile	56	(9.8)	12	(6.7)	21	(5.3)	3	(2.8)	8	(4.9)
School Size										
Smallest Schools	31	(17.8)	30	(15.9)	0	---†	36	(26.2)	4	(3.9)
Second Group	56	(10.4)	17	(7.4)	12	(5.4)	15	(8.5)	0	---†
Third Group	23	(6.2)	40	(10.5)	13	(6.1)	22	(9.2)	2	(1.5)
Largest Schools	29	(4.6)	25	(3.8)	19	(3.5)	23	(3.7)	4	(1.6)
Community Type										
Rural	46	(8.7)	25	(6.7)	11	(5.7)	12	(4.7)	6	(3.9)
Suburban	27	(3.9)	26	(4.2)	22	(4.5)	23	(3.9)	3	(1.3)
Urban	32	(7.5)	31	(6.8)	10	(3.9)	25	(7.5)	1	(1.2)
Region										
Midwest	18	(4.0)	43	(11.7)	9	(4.6)	30	(10.0)	0	(0.4)
Northeast	27	(8.7)	21	(6.8)	24	(6.3)	23	(7.3)	6	(3.6)
South	43	(6.8)	21	(4.9)	18	(4.2)	12	(3.5)	5	(2.2)
West	34	(8.7)	28	(6.4)	10	(4.5)	28	(7.1)	0	---†

† No computer science classes in the sample were taught by teachers in this category. Thus, it is not possible to calculate the standard error of this estimate.

Table E-4 (Table 2.5)
Equity Analyses of Classes Taught by Teachers From Race/Ethnicity Groups Historically Underrepresented in STEM

	PERCENT OF CLASSES		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Prior Achievement Level of Class			
Mostly High	14 (1.9)	12 (1.8)	9 (2.9)
Average/Mixed	16 (1.4)	17 (1.3)	20 (5.6)
Mostly Low	17 (2.7)	18 (2.4)	n/a
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	2 (0.7)	3 (0.7)	5 (3.0)
Second Quartile	6 (1.1)	5 (0.9)	7 (3.6)
Third Quartile	13 (1.4)	12 (1.4)	3 (2.3)
Highest Quartile	42 (4.1)	45 (3.4)	47 (11.1)
Percent of Students in School Eligible for FRL			
Lowest Quartile	8 (1.3)	7 (1.8)	6 (2.1)
Second Quartile	11 (2.5)	9 (1.5)	12 (3.9)
Third Quartile	13 (2.1)	12 (1.4)	19 (13.1)
Highest Quartile	33 (2.9)	38 (3.1)	42 (11.6)
School Size			
Smallest Schools	15 (3.5)	16 (2.7)	19 (14.7)
Second Group	13 (2.4)	14 (2.6)	28 (13.2)
Third Group	16 (2.3)	15 (2.3)	12 (11.1)
Largest Schools	18 (2.2)	18 (1.8)	14 (2.8)
Community Type			
Rural	8 (2.1)	8 (1.4)	13 (6.5)
Suburban	15 (1.3)	14 (1.6)	12 (3.0)
Urban	24 (3.3)	26 (2.6)	22 (7.6)
Region			
Midwest	6 (1.8)	3 (0.9)	14 (9.5)
Northeast	8 (1.9)	10 (2.1)	10 (4.5)
South	23 (2.3)	24 (2.1)	24 (7.8)
West	19 (2.4)	21 (2.9)	11 (3.6)

Table E-5 (Table 2.16)
Equity Analyses of Secondary Science Classes With Teachers With Substantial Background† in Subject of Selected Class

	PERCENT OF CLASSES
Prior Achievement Level of Class	
Mostly High	72 (2.5)
Average/Mixed	61 (2.2)
Mostly Low	43 (5.1)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	63 (3.0)
Second Quartile	67 (3.1)
Third Quartile	57 (2.9)
Highest Quartile	56 (5.0)
Percent of Students in School Eligible for FRL	
Lowest Quartile	66 (2.7)
Second Quartile	64 (3.1)
Third Quartile	62 (3.6)
Highest Quartile	52 (4.2)
School Size	
Smallest Schools	55 (7.0)
Second Group	56 (4.1)
Third Group	68 (3.4)
Largest Schools	61 (2.5)
Community Type	
Rural	58 (3.2)
Suburban	65 (1.9)
Urban	59 (3.7)
Region	
Midwest	69 (2.9)
Northeast	71 (4.0)
South	58 (2.7)
West	50 (4.3)

† Defined as having either a degree or at least three advanced courses in the subject of their selected class.

Table E-6 (Table 2.34)
Equity Analyses of Class Mean Scores for Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Prior Achievement Level of Class		
Mostly High	57 (1.4)	88 (0.5)
Average/Mixed	55 (0.8)	87 (0.5)
Mostly Low	61 (1.5)	84 (1.1)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	56 (1.1)	86 (0.7)
Second Quartile	55 (1.2)	86 (0.8)
Third Quartile	55 (1.0)	87 (0.6)
Highest Quartile	59 (2.5)	87 (0.9)
Percent of Students in School Eligible for FRL		
Lowest Quartile	54 (1.1)	87 (0.7)
Second Quartile	56 (1.1)	86 (0.8)
Third Quartile	56 (2.4)	87 (0.7)
Highest Quartile	60 (0.9)	86 (0.7)
School Size		
Smallest Schools	59 (1.4)	85 (1.3)
Second Group	52 (2.4)	87 (1.0)
Third Group	57 (0.9)	86 (0.5)
Largest Schools	57 (1.0)	87 (0.5)
Community Type		
Rural	57 (1.2)	85 (0.9)
Suburban	55 (2.0)	87 (0.4)
Urban	55 (2.0)	87 (0.9)
Region		
Midwest	55 (0.9)	86 (0.6)
Northeast	52 (2.8)	88 (1.1)
South	59 (0.8)	87 (0.5)
West	56 (1.1)	85 (1.0)

Table E-7 (Table 2.35)
Equity Analyses of Class Mean Scores for Mathematics Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Prior Achievement Level of Class		
Mostly High	60 (0.9)	82 (0.8)
Average/Mixed	60 (0.7)	83 (0.5)
Mostly Low	61 (1.1)	83 (0.7)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	58 (0.9)	81 (0.7)
Second Quartile	60 (1.1)	82 (0.8)
Third Quartile	59 (1.3)	84 (0.6)
Highest Quartile	63 (1.0)	85 (0.7)
Percent of Students in School Eligible for FRL		
Lowest Quartile	57 (0.9)	82 (0.7)
Second Quartile	59 (1.2)	82 (0.7)
Third Quartile	61 (1.1)	84 (0.7)
Highest Quartile	63 (1.0)	85 (0.7)
School Size		
Smallest Schools	62 (1.9)	83 (1.1)
Second Group	58 (1.1)	84 (0.8)
Third Group	60 (0.9)	82 (0.8)
Largest Schools	60 (0.9)	83 (0.5)
Community Type		
Rural	61 (1.0)	82 (0.6)
Suburban	59 (0.7)	83 (0.5)
Urban	60 (1.1)	84 (0.6)
Region		
Midwest	57 (0.9)	82 (0.7)
Northeast	61 (1.2)	82 (1.1)
South	64 (0.9)	84 (0.5)
West	55 (1.0)	82 (0.7)

Table E-8 (Table 2.36)
Equity Analyses of Class Mean Scores for High School Computer Science Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Prior Achievement Level of Class		
Mostly High	65 (2.7)	81 (1.4)
Average/Mixed	66 (1.9)	83 (1.4)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	65 (2.1)	80 (1.7)
Second Quartile	72 (4.1)	82 (2.5)
Third Quartile	61 (1.8)	85 (1.8)
Highest Quartile	66 (4.5)	84 (1.8)
Percent of Students in School Eligible for FRL		
Lowest Quartile	65 (1.7)	80 (1.4)
Second Quartile	67 (3.5)	82 (1.6)
Third Quartile	69 (5.2)	86 (2.4)
Highest Quartile	61 (2.8)	85 (2.3)
School Size		
Smallest Schools	80 (4.9)	84 (2.9)
Second Group	63 (3.7)	83 (3.0)
Third Group	65 (4.6)	84 (2.3)
Largest Schools	67 (2.0)	81 (0.9)
Community Type		
Rural	68 (3.6)	83 (2.8)
Suburban	68 (1.7)	83 (1.0)
Urban	62 (3.9)	81 (2.1)
Region		
Midwest	66 (4.7)	84 (2.9)
Northeast	71 (2.4)	81 (1.9)
South	65 (1.9)	83 (1.5)
West	63 (3.9)	81 (1.2)

Table E-9 (Table 2.60)
Equity Analyses of Class Mean Scores for Science Teachers' Perceptions of Preparedness Composites

	MEAN SCORE			
	SCIENCE CONTENT PREPAREDNESS	PREPAREDNESS TO TEACH ENGINEERING†	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class				
Mostly High	81 (1.3)	38 (1.9)	72 (1.1)	82 (0.9)
Average/Mixed	62 (0.8)	38 (1.0)	63 (0.7)	73 (0.6)
Mostly Low	61 (1.7)	33 (2.6)	60 (1.3)	69 (1.4)
Percent of Historically Underrepresented Students in Class				
Lowest Quartile	67 (1.4)	38 (1.8)	64 (0.9)	75 (1.0)
Second Quartile	66 (1.3)	37 (1.7)	65 (1.0)	77 (0.9)
Third Quartile	63 (1.5)	39 (1.6)	64 (1.1)	74 (1.0)
Highest Quartile	62 (1.5)	35 (2.0)	62 (1.7)	70 (1.4)
Percent of Students in School Eligible for FRL				
Lowest Quartile	68 (1.6)	38 (1.5)	64 (1.0)	76 (0.9)
Second Quartile	65 (1.5)	39 (1.5)	65 (1.1)	75 (0.9)
Third Quartile	63 (1.5)	35 (1.6)	63 (1.3)	73 (1.1)
Highest Quartile	62 (1.5)	37 (2.2)	63 (1.4)	71 (1.4)
School Size				
Smallest Schools	60 (2.7)	33 (3.2)	59 (1.8)	71 (1.7)
Second Group	64 (1.7)	37 (2.1)	64 (1.5)	73 (1.2)
Third Group	63 (1.3)	38 (1.4)	62 (0.9)	73 (0.8)
Largest Schools	67 (1.2)	38 (1.4)	66 (0.9)	75 (0.8)
Community Type				
Rural	65 (1.0)	34 (1.8)	63 (1.0)	75 (1.1)
Suburban	65 (0.9)	38 (1.0)	64 (0.6)	74 (0.7)
Urban	64 (1.6)	38 (1.6)	65 (1.4)	73 (1.2)
Region				
Midwest	67 (2.0)	36 (1.9)	66 (1.8)	75 (1.2)
Northeast	64 (1.4)	38 (1.5)	61 (0.8)	73 (0.9)
South	65 (0.9)	36 (1.1)	66 (0.7)	75 (0.9)
West	62 (1.4)	41 (2.4)	61 (1.2)	71 (1.2)

† The Preparedness to Teach Engineering composite was computed only for secondary science classes.

Table E-10 (Table 2.61)
Equity Analyses of Class Mean Scores for Mathematics Teachers' Perceptions of Preparedness Composites

	MEAN SCORE		
	CONTENT PREPAREDNESS	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class			
Mostly High	84 (0.8)	71 (0.9)	85 (0.8)
Average/Mixed	79 (0.5)	70 (0.6)	82 (0.6)
Mostly Low	78 (1.1)	69 (1.1)	79 (1.0)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	81 (0.7)	68 (0.7)	83 (0.7)
Second Quartile	80 (0.8)	70 (0.8)	83 (0.9)
Third Quartile	78 (0.7)	70 (1.0)	81 (1.1)
Highest Quartile	79 (0.9)	71 (0.8)	80 (0.7)
Percent of Students in School Eligible for FRL			
Lowest Quartile	82 (0.7)	71 (0.8)	84 (0.8)
Second Quartile	79 (0.8)	69 (0.8)	82 (1.0)
Third Quartile	79 (0.9)	68 (0.9)	80 (0.9)
Highest Quartile	79 (0.9)	71 (0.8)	80 (0.7)
School Size			
Smallest Schools	77 (1.4)	69 (1.5)	82 (1.4)
Second Group	80 (0.9)	70 (0.9)	81 (0.9)
Third Group	80 (0.8)	69 (0.8)	82 (0.8)
Largest Schools	80 (0.6)	70 (0.6)	82 (0.6)
Community Type			
Rural	79 (0.8)	69 (0.9)	83 (0.8)
Suburban	80 (0.5)	70 (0.6)	82 (0.5)
Urban	79 (0.8)	70 (0.8)	81 (0.8)
Region			
Midwest	81 (0.9)	69 (0.8)	83 (0.8)
Northeast	81 (1.0)	70 (0.8)	84 (0.9)
South	78 (0.6)	71 (0.7)	81 (0.6)
West	81 (0.9)	68 (0.8)	80 (0.9)

Table E-11 (Table 2.62)
Equity Analyses of Class Mean Scores for High School Computer Science Teachers' Perceptions of Preparedness Composites

	MEAN SCORE		
	CONTENT PREPAREDNESS	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Prior Achievement Level of Class			
Mostly High	68 (2.3)	67 (2.2)	73 (3.1)
Average/Mixed	67 (2.1)	71 (2.3)	72 (2.3)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	64 (3.9)	65 (2.7)	70 (3.4)
Second Quartile	72 (3.5)	74 (3.8)	72 (3.1)
Third Quartile	65 (3.8)	68 (2.9)	75 (2.6)
Highest Quartile	69 (2.8)	73 (2.6)	73 (4.2)
Percent of Students in School Eligible for FRL			
Lowest Quartile	68 (1.9)	69 (2.4)	75 (2.1)
Second Quartile	66 (2.4)	68 (2.5)	70 (4.0)
Third Quartile	66 (5.1)	70 (4.6)	72 (2.5)
Highest Quartile	71 (4.8)	75 (3.9)	70 (5.8)
School Size			
Smallest Schools	63 (4.8)	63 (4.1)	67 (8.6)
Second Group	75 (2.8)	74 (4.9)	76 (5.9)
Third Group	69 (3.7)	72 (3.5)	72 (2.4)
Largest Schools	65 (1.7)	68 (1.6)	72 (2.2)
Community Type			
Rural	64 (3.5)	70 (2.9)	71 (2.9)
Suburban	65 (1.7)	68 (1.7)	72 (1.9)
Urban	71 (2.9)	72 (3.5)	74 (3.4)
Region			
Midwest	67 (4.7)	68 (4.4)	69 (3.3)
Northeast	64 (2.9)	69 (3.5)	74 (3.1)
South	71 (2.0)	72 (2.2)	72 (3.1)
West	66 (2.5)	69 (2.8)	75 (3.7)

Table E-12 (Table 3.3)
Equity Analyses of Classes Taught by Teachers With More Than 35 Hours of Professional Development in the Last Three Years, by Subject

	PERCENT OF CLASSES	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	36 (2.6)	36 (2.6)
Average/Mixed	15 (0.8)	24 (1.1)
Mostly Low	15 (2.1)	34 (2.5)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	20 (1.5)	25 (1.9)
Second Quartile	18 (1.7)	26 (2.0)
Third Quartile	19 (1.6)	25 (1.8)
Highest Quartile	15 (1.7)	33 (2.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	20 (1.6)	26 (2.1)
Second Quartile	20 (2.1)	29 (2.3)
Third Quartile	16 (1.7)	25 (2.1)
Highest Quartile	18 (1.8)	32 (2.2)
School Size		
Smallest Schools	9 (1.4)	26 (2.9)
Second Group	17 (2.2)	27 (2.8)
Third Group	18 (1.4)	29 (2.0)
Largest Schools	21 (1.6)	29 (1.7)
Community Type		
Rural	15 (1.5)	27 (2.5)
Suburban	19 (1.0)	27 (1.4)
Urban	19 (2.0)	30 (2.2)
Region		
Midwest	15 (2.0)	27 (2.0)
Northeast	17 (1.6)	25 (2.4)
South	19 (1.1)	29 (1.7)
West	21 (2.4)	30 (2.1)

Table E-13 (Table 3.9)

Equity Analyses of Class Mean Scores for Extent Professional Development Aligns With Elements of Effective Professional Development Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Prior Achievement Levels of Class			
Mostly High	57 (1.3)	56 (1.4)	55 (1.8)
Average/Mixed	52 (0.8)	58 (0.7)	58 (2.4)
Mostly Low	48 (1.6)	61 (1.5)	n/a
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	52 (1.4)	58 (1.2)	51 (3.2)
Second Quartile	50 (1.5)	54 (1.4)	59 (3.8)
Third Quartile	55 (1.4)	60 (1.3)	56 (2.6)
Highest Quartile	52 (1.5)	61 (1.2)	64 (3.3)
Percent of Students in School Eligible for FRL			
Lowest Quartile	53 (1.4)	57 (1.5)	54 (1.8)
Second Quartile	52 (1.5)	56 (1.3)	56 (1.9)
Third Quartile	52 (1.4)	60 (1.3)	60 (4.3)
Highest Quartile	54 (1.5)	60 (1.4)	64 (4.6)
School Size			
Smallest Schools	47 (2.6)	55 (2.2)	55 (5.5)
Second Group	51 (1.6)	59 (1.8)	61 (5.0)
Third Group	53 (1.1)	58 (0.9)	58 (4.0)
Largest Schools	54 (1.1)	59 (0.9)	56 (1.6)
Community Type			
Rural	50 (1.6)	57 (1.2)	59 (3.2)
Suburban	54 (0.9)	59 (0.9)	55 (2.0)
Urban	52 (1.4)	58 (1.2)	58 (3.5)
Region			
Midwest	50 (1.2)	60 (1.3)	62 (4.3)
Northeast	53 (1.9)	55 (1.3)	50 (2.7)
South	53 (1.0)	59 (0.9)	61 (2.6)
West	53 (1.8)	58 (1.5)	51 (2.5)

Table E-14 (Table 3.14)
Equity Analyses of Class Mean Scores for Extent Professional Development Supports Student-Centered Instruction Composite, by Subject

	MEAN SCORE		
	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Prior Achievement Levels of Class			
Mostly High	54 (1.4)	55 (1.4)	56 (3.0)
Average/Mixed	51 (1.0)	59 (0.7)	59 (2.6)
Mostly Low	49 (1.8)	60 (1.6)	n/a
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	51 (1.4)	59 (1.1)	54 (3.5)
Second Quartile	50 (1.4)	53 (1.2)	62 (5.5)
Third Quartile	52 (1.5)	59 (1.1)	60 (3.4)
Highest Quartile	51 (1.9)	62 (1.5)	61 (4.2)
Percent of Students in School Eligible for FRL			
Lowest Quartile	51 (1.5)	58 (1.3)	54 (2.3)
Second Quartile	52 (1.3)	55 (1.1)	58 (3.5)
Third Quartile	50 (1.5)	59 (1.1)	63 (4.7)
Highest Quartile	53 (2.0)	62 (1.7)	62 (6.3)
School Size			
Smallest Schools	47 (2.9)	61 (1.8)	59 (8.2)
Second Group	51 (1.7)	60 (1.6)	65 (5.2)
Third Group	52 (1.4)	59 (1.1)	59 (4.9)
Largest Schools	52 (1.1)	57 (1.0)	56 (2.4)
Community Type			
Rural	48 (1.4)	58 (1.2)	65 (4.3)
Suburban	53 (1.0)	58 (1.0)	57 (2.1)
Urban	51 (1.5)	59 (1.4)	57 (4.8)
Region			
Midwest	51 (1.2)	60 (1.3)	61 (5.5)
Northeast	54 (2.2)	55 (1.8)	53 (3.1)
South	52 (1.2)	59 (0.9)	65 (2.9)
West	49 (1.6)	59 (1.3)	48 (4.1)

Table E-15 (Table 3.33)
Equity Analyses of Locally Offered Science Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	44 (3.6)	33 (3.3)	26 (3.4)
Second Quartile	51 (5.0)	38 (4.3)	26 (4.3)
Third Quartile	51 (3.9)	36 (4.0)	26 (3.5)
Highest Quartile	56 (4.6)	38 (3.9)	35 (4.6)
School Size			
Smallest Schools	39 (4.9)	22 (4.3)	22 (4.7)
Second Group	57 (4.4)	36 (4.6)	31 (4.4)
Third Group	46 (4.3)	39 (3.1)	26 (3.4)
Largest Schools	62 (3.3)	49 (3.7)	34 (3.5)
Community Type			
Rural	37 (4.4)	32 (3.9)	20 (3.9)
Suburban	53 (2.8)	40 (2.6)	27 (2.5)
Urban	59 (4.6)	36 (3.5)	38 (4.5)
Region			
Midwest	35 (4.6)	34 (4.2)	23 (3.4)
Northeast	57 (5.3)	32 (5.2)	23 (4.4)
South	56 (3.0)	39 (2.9)	36 (3.6)
West	57 (5.0)	40 (4.3)	28 (4.7)

Table E-16 (Table 3.34)
Equity Analyses of Locally Offered Mathematics Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	61 (4.5)	56 (4.3)	29 (4.1)
Second Quartile	63 (4.6)	63 (4.9)	33 (4.7)
Third Quartile	67 (3.8)	57 (5.0)	49 (4.5)
Highest Quartile	73 (3.7)	56 (4.3)	54 (4.6)
School Size			
Smallest Schools	56 (5.8)	46 (5.0)	26 (4.9)
Second Group	67 (4.9)	61 (4.1)	40 (4.1)
Third Group	69 (3.9)	56 (4.7)	44 (3.3)
Largest Schools	73 (2.9)	69 (3.4)	54 (3.9)
Community Type			
Rural	62 (4.6)	56 (4.1)	25 (3.6)
Suburban	63 (2.9)	62 (3.5)	43 (3.1)
Urban	75 (3.6)	53 (3.9)	51 (4.0)
Region			
Midwest	54 (4.5)	51 (4.7)	35 (3.9)
Northeast	65 (5.1)	49 (5.6)	36 (5.0)
South	72 (3.2)	61 (2.9)	45 (2.9)
West	72 (4.3)	67 (4.8)	45 (5.6)

Table E-17 (Table 3.35)
Equity Analyses of Locally Offered Computer Science Professional Development Available to Teachers

	PERCENT OF SCHOOLS		
	WORKSHOPS	STUDY GROUPS	ONE-ON-ONE COACHING
Percent of Students in School Eligible for FRL			
Lowest Quartile	33 (4.1)	38 (4.6)	22 (3.5)
Second Quartile	33 (3.8)	50 (4.7)	34 (4.0)
Third Quartile	29 (3.5)	35 (3.5)	18 (2.8)
Highest Quartile	36 (4.4)	49 (4.1)	29 (4.0)
School Size			
Smallest Schools	19 (3.8)	33 (5.1)	22 (3.7)
Second Group	33 (4.0)	46 (5.4)	29 (3.8)
Third Group	35 (3.7)	44 (3.6)	25 (3.1)
Largest Schools	42 (3.4)	48 (3.4)	28 (2.9)
Community Type			
Rural	24 (3.1)	35 (4.7)	22 (3.3)
Suburban	33 (2.7)	43 (3.2)	29 (2.4)
Urban	39 (3.9)	48 (4.2)	25 (3.4)
Region			
Midwest	32 (3.3)	38 (4.1)	27 (5.2)
Northeast	28 (4.2)	42 (5.4)	28 (3.5)
South	34 (2.8)	44 (3.2)	25 (2.7)
West	34 (4.8)	47 (4.8)	25 (3.9)

Table E-18 (Table 3.38)
Equity Analyses of Schools Offering Formal Induction Programs

	PERCENT OF SCHOOLS†
Percent of Students in School Eligible for FRL	
Lowest Quartile	70 (3.6)
Second Quartile	79 (3.6)
Third Quartile	77 (4.1)
Highest Quartile	78 (3.8)
School Size	
Smallest Schools	62 (4.9)
Second Group	69 (3.7)
Third Group	84 (3.0)
Largest Schools	89 (1.8)
Community Type	
Rural	71 (4.0)
Suburban	79 (2.4)
Urban	75 (3.7)
Region	
Midwest	73 (3.6)
Northeast	81 (4.6)
South	76 (2.8)
West	74 (4.1)

† Includes only those schools that provide a formal induction program.

Table E-19 (Table 3.40)
Equity Analyses of Schools Providing Formally Assigned School-Based Mentors

	PERCENT OF SCHOOLS†
Percent of Students in School Eligible for FRL	
Lowest Quartile	85 (3.4)
Second Quartile	87 (2.7)
Third Quartile	87 (2.5)
Highest Quartile	83 (3.4)
School Size	
Smallest Schools	87 (3.6)
Second Group	85 (3.1)
Third Group	82 (3.6)
Largest Schools	87 (2.5)
Community Type	
Rural	90 (3.1)
Suburban	87 (1.9)
Urban	78 (3.3)
Region	
Midwest	87 (2.6)
Northeast	89 (4.2)
South	88 (2.2)
West	75 (4.2)

† Includes only those schools that provide a formally assigned school-based mentor in its induction program.

Table E-20 (Table 4.7)
Equity Analyses of Average Number of AP Science Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	2.0 (0.3)
Second Quartile	2.2 (0.3)
Third Quartile	1.1 (0.2)
Highest Quartile	1.4 (0.2)
School Size	
Smallest Schools	0.5 (0.2)
Second Group	1.0 (0.2)
Third Group	1.7 (0.2)
Largest Schools	3.2 (0.2)
Community Type	
Rural	0.9 (0.1)
Suburban	2.3 (0.2)
Urban	1.9 (0.3)
Region	
Midwest	1.1 (0.2)
Northeast	2.6 (0.3)
South	1.8 (0.3)
West	1.7 (0.1)

Table E-21 (Table 4.11)
Equity Analyses of Average Percentage of 8^{th} Graders Completing Algebra 1 and Geometry Prior to 9^{th} Grade

	PERCENT OF STUDENTS	
	ALGEBRA 1	GEOMETRY
Percent of Students in School Eligible for FRL		
Lowest Quartile	48 (5.1)	17 (5.5)
Second Quartile	25 (4.1)	2 (0.8)
Third Quartile	20 (4.2)	2 (0.9)
Highest Quartile	29 (6.1)	7 (5.9)
School Size		
Smallest Schools	39 (6.4)	11 (5.7)
Second Group	29 (4.7)	9 (5.4)
Third Group	27 (3.1)	4 (1.2)
Largest Schools	36 (3.4)	6 (1.8)
Community Type		
Rural	19 (3.5)	1 (0.3)
Suburban	43 (3.7)	16 (5.3)
Urban	32 (4.9)	3 (1.0)
Region		
Midwest	30 (3.7)	3 (1.5)
Northeast	43 (5.5)	17 (10.0)
South	28 (4.4)	9 (4.6)
West	36 (6.2)	5 (2.3)

Table E-22 (Table 4.16)
Equity Analyses of Average Number of AP Mathematics Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	1.3 (0.2)
Second Quartile	1.6 (0.2)
Third Quartile	0.9 (0.1)
Highest Quartile	0.8 (0.1)
School Size	
Smallest Schools	0.3 (0.1)
Second Group	0.9 (0.2)
Third Group	1.4 (0.1)
Largest Schools	2.0 (0.1)
Community Type	
Rural	0.6 (0.1)
Suburban	1.5 (0.1)
Urban	1.5 (0.2)
Region	
Midwest	0.9 (0.1)
Northeast	1.6 (0.2)
South	1.1 (0.1)
West	1.3 (0.2)

Table E-23 (Table 4.20)
Equity Analyses of Schools Offering Computer Science Instruction

	PERCENT OF SCHOOLS
Percent of Students in School Eligible for FRL	
Lowest Quartile	44 (3.9)
Second Quartile	38 (3.8)
Third Quartile	26 (3.4)
Highest Quartile	26 (3.5)
School Size	
Smallest Schools	23 (4.6)
Second Group	33 (3.7)
Third Group	34 (3.0)
Largest Schools	43 (3.1)
Community Type	
Rural	29 (3.8)
Suburban	34 (2.7)
Urban	35 (3.6)
Region	
Midwest	30 (3.8)
Northeast	43 (5.2)
South	24 (2.2)
West	44 (4.9)

Table E-24 (Table 4.24)
Equity Analyses of Average Number of AP Computer Science Courses Offered at High Schools

	AVERAGE NUMBER OF COURSES
Percent of Students in School Eligible for FRL	
Lowest Quartile	0.5 (0.1)
Second Quartile	0.3 (0.1)
Third Quartile	0.2 (0.1)
Highest Quartile	0.2 (0.1)
School Size	
Smallest Schools	0.1 (0.1)
Second Group	0.2 (0.0)
Third Group	0.3 (0.0)
Largest Schools	0.6 (0.1)
Community Type	
Rural	0.1 (0.0)
Suburban	0.4 (0.0)
Urban	0.4 (0.1)
Region	
Midwest	0.5 (0.1)
Northeast	0.2 (0.0)
South	0.3 (0.0)
West	0.3 (0.1)

Table E-25 (Table 5.8)
Equity Analyses of Science Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	65 (1.9)	90 (1.0)
Average/Mixed	53 (1.4)	82 (0.9)
Mostly Low	46 (2.7)	79 (2.2)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	63 (1.8)	87 (1.1)
Second Quartile	56 (1.8)	83 (1.3)
Third Quartile	47 (1.7)	82 (1.1)
Highest Quartile	49 (4.1)	79 (2.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	56 (1.8)	84 (1.4)
Second Quartile	56 (2.2)	85 (1.3)
Third Quartile	55 (3.1)	84 (1.4)
Highest Quartile	47 (1.8)	79 (1.5)
School Size		
Smallest Schools	64 (3.5)	89 (1.8)
Second Group	60 (3.3)	81 (2.0)
Third Group	52 (1.6)	81 (1.4)
Largest Schools	49 (1.4)	83 (0.9)
Community Type		
Rural	61 (1.6)	87 (1.0)
Suburban	52 (1.0)	81 (0.8)
Urban	52 (3.4)	82 (1.8)
Region		
Midwest	59 (1.9)	82 (1.4)
Northeast	58 (3.7)	82 (2.2)
South	46 (1.6)	82 (1.0)
West	58 (1.7)	84 (1.2)

Table E-26 (Table 5.9)
Equity Analyses of Mathematics Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	59 (1.7)	88 (1.1)
Average/Mixed	45 (1.1)	81 (0.6)
Mostly Low	45 (1.8)	81 (1.0)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	56 (1.5)	85 (1.0)
Second Quartile	50 (1.8)	83 (0.9)
Third Quartile	41 (1.7)	81 (1.3)
Highest Quartile	42 (1.8)	79 (1.3)
Percent of Students in School Eligible for FRL		
Lowest Quartile	51 (1.9)	82 (0.8)
Second Quartile	49 (1.9)	84 (1.1)
Third Quartile	47 (1.6)	82 (1.2)
Highest Quartile	43 (2.0)	80 (1.3)
School Size		
Smallest Schools	61 (3.0)	84 (1.4)
Second Group	53 (2.3)	83 (1.0)
Third Group	46 (1.5)	81 (1.2)
Largest Schools	43 (1.4)	82 (0.7)
Community Type		
Rural	57 (1.7)	85 (1.0)
Suburban	45 (1.2)	81 (0.8)
Urban	45 (1.8)	81 (1.2)
Region		
Midwest	51 (1.9)	82 (1.2)
Northeast	50 (2.3)	82 (1.1)
South	43 (1.4)	82 (0.9)
West	50 (1.9)	83 (1.2)

Table E-27 (Table 5.10)
Equity Analyses of High School Computer Science
Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM	PEDAGOGY
Prior Achievement Level of Class		
Mostly High	78 (2.7)	90 (2.2)
Average/Mixed	78 (2.3)	89 (1.8)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	76 (3.3)	93 (1.6)
Second Quartile	78 (4.0)	87 (3.5)
Third Quartile	75 (4.1)	89 (2.7)
Highest Quartile	83 (2.9)	89 (3.1)
Percent of Students in School Eligible for FRL		
Lowest Quartile	78 (2.5)	90 (1.9)
Second Quartile	78 (3.8)	89 (2.8)
Third Quartile	77 (3.8)	88 (3.6)
Highest Quartile	80 (4.1)	90 (2.3)
School Size		
Smallest Schools	88 (5.3)	96 (2.1)
Second Group	79 (4.8)	93 (2.4)
Third Group	77 (2.6)	87 (3.4)
Largest Schools	78 (2.3)	89 (1.7)
Community Type		
Rural	72 (4.3)	85 (4.0)
Suburban	77 (2.1)	92 (1.3)
Urban	82 (3.3)	88 (2.6)
Region		
Midwest	77 (3.2)	89 (3.1)
Northeast	77 (3.5)	90 (2.1)
South	75 (3.5)	89 (2.0)
West	85 (2.9)	89 (2.6)

Table E-28 (Table 5.14)
Equity Analyses of Science Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	68 (0.9)
Average/Mixed	63 (0.6)
Mostly Low	57 (1.3)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	64 (0.8)
Second Quartile	62 (1.0)
Third Quartile	62 (0.8)
Highest Quartile	64 (1.6)
Percent of Students in School Eligible for FRL	
Lowest Quartile	64 (0.8)
Second Quartile	62 (1.0)
Third Quartile	62 (1.5)
Highest Quartile	63 (0.9)
School Size	
Smallest Schools	62 (1.2)
Second Group	65 (1.6)
Third Group	61 (0.9)
Largest Schools	63 (0.7)
Community Type	
Rural	62 (0.8)
Suburban	63 (0.7)
Urban	64 (1.4)
Region	
Midwest	61 (0.7)
Northeast	66 (1.8)
South	63 (0.6)
West	63 (1.2)

Table E-29 (Table 5.17)
Equity Analyses of Mathematics Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	83 (0.6)
Average/Mixed	78 (0.4)
Mostly Low	77 (0.9)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	78 (0.5)
Second Quartile	78 (0.7)
Third Quartile	78 (0.6)
Highest Quartile	79 (0.8)
Percent of Students in School Eligible for FRL	
Lowest Quartile	80 (0.6)
Second Quartile	78 (0.6)
Third Quartile	77 (0.7)
Highest Quartile	80 (0.9)
School Size	
Smallest Schools	77 (1.1)
Second Group	79 (0.8)
Third Group	78 (0.6)
Largest Schools	78 (0.6)
Community Type	
Rural	77 (0.7)
Suburban	78 (0.6)
Urban	80 (0.8)
Region	
Midwest	77 (0.7)
Northeast	77 (0.9)
South	80 (0.6)
West	78 (0.9)

Table E-30 (Table 5.19)
Equity Analyses of High School Computer Science Class
Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	81 (1.6)
Average/Mixed	81 (1.3)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	75 (1.9)
Second Quartile	80 (2.1)
Third Quartile	81 (1.7)
Highest Quartile	86 (2.2)
Percent of Students in School Eligible for FRL	
Lowest Quartile	78 (1.4)
Second Quartile	80 (1.8)
Third Quartile	82 (2.7)
Highest Quartile	85 (2.9)
School Size	
Smallest Schools	80 (3.8)
Second Group	86 (2.8)
Third Group	81 (2.0)
Largest Schools	79 (1.2)
Community Type	
Rural	83 (2.2)
Suburban	80 (1.1)
Urban	80 (2.9)
Region	
Midwest	80 (2.4)
Northeast	79 (1.8)
South	83 (1.6)
West	79 (2.3)

Table E-31 (Table 5.25)
Equity Analyses of Science Class Mean Scores for Engaging Students in the Practices of Science Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	51 (1.1)
Average/Mixed	43 (0.5)
Mostly Low	42 (1.5)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	43 (0.9)
Second Quartile	42 (0.9)
Third Quartile	43 (1.0)
Highest Quartile	47 (1.3)
Percent of Students in School Eligible for FRL	
Lowest Quartile	44 (0.9)
Second Quartile	43 (0.9)
Third Quartile	44 (1.3)
Highest Quartile	45 (1.1)
School Size	
Smallest Schools	43 (1.8)
Second Group	45 (1.4)
Third Group	43 (1.0)
Largest Schools	45 (0.7)
Community Type	
Rural	43 (0.9)
Suburban	44 (0.6)
Urban	47 (1.2)
Region	
Midwest	41 (0.9)
Northeast	47 (1.4)
South	45 (0.8)
West	42 (1.1)

Table E-32 (Table 5.34)
Equity Analyses of Mathematics Class Mean Scores for Engaging Students in Practices of Mathematics Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	75 (0.8)
Average/Mixed	73 (0.5)
Mostly Low	72 (0.9)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	73 (0.5)
Second Quartile	72 (0.9)
Third Quartile	73 (0.8)
Highest Quartile	74 (0.9)
Percent of Students in School Eligible for FRL	
Lowest Quartile	73 (0.7)
Second Quartile	73 (0.7)
Third Quartile	72 (0.8)
Highest Quartile	74 (0.8)
School Size	
Smallest Schools	72 (1.0)
Second Group	74 (0.9)
Third Group	73 (0.7)
Largest Schools	73 (0.6)
Community Type	
Rural	72 (0.6)
Suburban	73 (0.5)
Urban	73 (0.8)
Region	
Midwest	82 (2.0)
Northeast	65 (2.9)
South	77 (1.8)
West	76 (2.7)

Table E-33 (Table 5.42)
Equity Analyses of High School Computer Science Class Mean Scores for Engaging Students in Practices of Computer Science Composite

	MEAN SCORE
Prior Achievement Level of Class	
Mostly High	55 (1.7)
Average/Mixed	56 (1.7)
Percent of Historically Underrepresented Students in Class	
Lowest Quartile	53 (2.0)
Second Quartile	54 (4.1)
Third Quartile	57 (3.0)
Highest Quartile	59 (2.9)
Percent of Students in School Eligible for FRL	
Lowest Quartile	54 (1.9)
Second Quartile	57 (2.4)
Third Quartile	54 (3.4)
Highest Quartile	60 (4.1)
School Size	
Smallest Schools	59 (4.4)
Second Group	57 (5.1)
Third Group	56 (3.3)
Largest Schools	54 (1.5)
Community Type	
Rural	59 (2.7)
Suburban	53 (1.5)
Urban	57 (3.2)
Region	
Midwest	56 (3.7)
Northeast	52 (2.9)
South	59 (2.3)
West	53 (2.1)

Table E-34 (Table 5.47)
Equity Analyses of Classes Required to Take External Assessments Two or More Times Per Year, by Subject

	PERCENT OF CLASSES	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	35 (3.2)	66 (2.4)
Average/Mixed	29 (1.5)	78 (1.6)
Mostly Low	39 (4.2)	78 (2.7)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	21 (2.1)	70 (2.2)
Second Quartile	28 (2.6)	73 (2.2)
Third Quartile	36 (3.1)	78 (2.3)
Highest Quartile	38 (4.0)	81 (2.7)
Percent of Students in School Eligible for FRL		
Lowest Quartile	20 (2.3)	68 (2.7)
Second Quartile	32 (3.2)	77 (2.2)
Third Quartile	36 (3.6)	83 (2.2)
Highest Quartile	36 (3.1)	77 (2.8)
School Size		
Smallest Schools	24 (4.4)	69 (4.5)
Second Group	22 (2.8)	73 (2.7)
Third Group	29 (2.9)	79 (2.3)
Largest Schools	37 (2.2)	77 (1.8)
Community Type		
Rural	30 (2.9)	73 (2.2)
Suburban	32 (1.8)	78 (1.6)
Urban	30 (3.6)	74 (2.5)
Region		
Midwest	32 (3.3)	82 (2.0)
Northeast	20 (2.8)	65 (2.9)
South	42 (2.0)	77 (1.8)
West	19 (3.1)	76 (2.7)

Table E-35 (Table 6.27)
Equity Analyses of Median Amount Schools Spent Per Pupil on Science Equipment and Consumable Supplies

	MEDIAN AMOUNT		
	EQUIPMENT	CONSUMABLE SUPPLIES	TOTAL†
Percent of Students in School Eligible for FRL			
Lowest Quartile	\$1.26 (0.3)	\$2.24 (0.2)	\$5.62 (0.8)
Second Quartile	\$0.90 (0.2)	\$1.59 (0.4)	\$3.44 (0.7)
Third Quartile	\$0.46 (0.3)	\$1.14 (0.2)	\$2.55 (0.6)
Highest Quartile	\$0.42 (0.2)	\$1.09 (0.2)	\$2.05 (0.7)
School Size			
Smallest Schools	\$0.90 (0.4)	\$1.75 (0.4)	\$4.61 (1.2)
Second Group	\$0.98 (0.3)	\$1.98 (0.3)	\$3.62 (0.6)
Third Group	\$0.66 (0.2)	\$1.23 (0.2)	\$2.48 (0.6)
Largest Schools	\$0.65 (0.2)	\$1.17 (0.2)	\$2.34 (0.4)
Community Type			
Rural	\$1.03 (0.2)	\$1.85 (0.5)	\$4.06 (0.7)
Suburban	\$0.84 (0.2)	\$1.49 (0.2)	\$3.25 (0.5)
Urban	\$0.48 (0.2)	\$1.14 (0.3)	\$2.06 (0.6)
Region			
Midwest	\$1.06 (0.3)	\$2.00 (0.6)	\$4.41 (0.7)
Northeast	\$1.41 (0.4)	\$2.92 (0.7)	\$6.62 (1.9)
South	\$0.39 (0.1)	\$1.06 (0.2)	\$1.70 (0.3)
West	\$0.98 (0.3)	\$1.27 (0.3)	\$3.11 (1.0)

† The “Total” column includes spending on software.

Table E-36 (Table 6.28)
Equity Analyses of Median Amount Schools Spent Per Pupil on Mathematics Equipment and Consumable Supplies

	MEDIAN AMOUNT		
	EQUIPMENT	CONSUMABLE SUPPLIES	TOTAL†
Percent of Students in School Eligible for FRL			
Lowest Quartile	$0.68 (0.1)	$1.10 (0.3)	$4.20 (1.1)
Second Quartile	$1.11 (0.2)	$0.98 (0.4)	$4.59 (1.2)
Third Quartile	$1.03 (0.2)	$1.13 (0.2)	$4.87 (1.1)
Highest Quartile	$1.16 (0.3)	$0.95 (0.3)	$5.38 (1.3)
School Size			
Smallest Schools	$1.36 (0.3)	$1.50 (0.5)	$7.39 (1.5)
Second Group	$0.93 (0.2)	$0.79 (0.3)	$4.79 (1.1)
Third Group	$0.98 (0.2)	$1.06 (0.3)	$3.91 (0.9)
Largest Schools	$0.76 (0.1)	$0.75 (0.2)	$3.85 (0.6)
Community Type			
Rural	$0.98 (0.3)	$0.69 (0.2)	$4.68 (1.1)
Suburban	$0.97 (0.2)	$1.35 (0.2)	$5.39 (0.8)
Urban	$0.83 (0.3)	$0.75 (0.3)	$3.94 (1.0)
Region			
Midwest	$0.95 (0.2)	$0.86 (0.3)	$4.22 (1.2)
Northeast	$1.23 (0.6)	$1.90 (0.5)	$7.16 (1.4)
South	$0.82 (0.2)	$0.81 (0.2)	$4.94 (0.8)
West	$0.86 (0.2)	$0.92 (0.2)	$2.93 (1.1)

† The “Total” column includes spending on software.

Table E-37 (Table 6.32)
Equity Analyses of Class Mean Scores for the Adequacy of Resources for Instruction Composite, by Subject

	MEAN SCORE	
	SCIENCE	MATHEMATICS
Prior Achievement Level of Class		
Mostly High	74 (1.6)	82 (1.0)
Average/Mixed	60 (1.1)	79 (0.8)
Mostly Low	54 (2.5)	76 (1.4)
Percent of Historically Underrepresented Students in Class		
Lowest Quartile	65 (1.7)	81 (1.0)
Second Quartile	64 (1.7)	82 (1.0)
Third Quartile	60 (1.4)	78 (1.2)
Highest Quartile	56 (2.9)	76 (1.4)
Percent of Students in School Eligible for FRL		
Lowest Quartile	66 (2.1)	81 (1.1)
Second Quartile	63 (2.0)	81 (0.9)
Third Quartile	61 (2.8)	79 (1.2)
Highest Quartile	54 (1.6)	76 (1.2)
School Size		
Smallest Schools	57 (2.7)	81 (1.8)
Second Group	62 (3.4)	77 (1.2)
Third Group	59 (1.8)	80 (1.2)
Largest Schools	63 (1.2)	79 (0.8)
Community Type		
Rural	62 (1.6)	81 (1.0)
Suburban	61 (1.0)	80 (0.8)
Urban	61 (2.5)	77 (1.1)
Region		
Midwest	60 (1.8)	79 (1.2)
Northeast	69 (3.0)	82 (1.2)
South	60 (1.2)	78 (1.0)
West	57 (1.7)	78 (1.1)

Table E-38 (Table 7.10)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Science/Engineering, by Percentage of Students Eligible for Free/Reduced-Price Lunch

	PERCENT OF SCHOOLS			
	PERCENT OF STUDENTS IN SCHOOL ELIGIBLE FOR FRL			
	Lowest Quartile	Second Quartile	Third Quartile	Highest Quartile
Family nights	35 (3.9)	38 (4.0)	37 (3.9)	43 (4.9)
After-school help	39 (3.6)	44 (4.8)	43 (4.0)	55 (4.4)
After-school programs for enrichment	38 (4.5)	33 (3.8)	32 (3.9)	39 (4.2)
Science clubs	47 (3.9)	40 (4.2)	44 (4.1)	38 (4.9)
Engineering clubs	39 (3.6)	33 (3.8)	30 (3.8)	26 (3.5)
Participation in local or regional science/engineering fair	39 (4.3)	45 (4.3)	38 (3.9)	44 (4.8)
Participation in science competitions	25 (2.8)	27 (3.3)	26 (3.4)	20 (3.9)
Participation in engineering competitions	36 (3.6)	39 (4.3)	25 (3.3)	25 (3.7)
Encourage students to participate in summer programs/camps	70 (4.0)	77 (3.6)	67 (4.3)	70 (4.4)
Visits to business, industry, and/or research sites	36 (3.9)	48 (4.4)	41 (4.1)	45 (5.4)
Meetings with mentors who work in science/engineering fields	26 (3.5)	32 (4.6)	33 (3.9)	28 (4.3)
Internships in science/engineering fields†	28 (4.8)	27 (4.0)	23 (5.2)	19 (4.3)

† Includes only those schools with high school students.

Table E-39 (Table 7.10)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Science/Engineering, by School Size

	PERCENT OF SCHOOLS			
	SCHOOL SIZE			
	Smallest Schools	Second Group	Third Group	Largest Schools
Family nights	25 (4.9)	34 (4.5)	46 (3.5)	45 (3.6)
After-school help	40 (5.6)	49 (4.6)	40 (3.6)	52 (3.3)
After-school programs for enrichment	26 (4.5)	35 (5.3)	36 (3.5)	43 (3.0)
Science clubs	27 (4.3)	44 (4.8)	44 (4.3)	53 (3.6)
Engineering clubs	19 (3.6)	27 (4.4)	35 (3.7)	45 (3.3)
Participation in local or regional science/engineering fair	34 (5.1)	50 (5.3)	34 (3.5)	51 (3.3)
Participation in science competitions	13 (3.0)	25 (3.9)	27 (3.1)	32 (3.3)
Participation in engineering competitions	20 (4.2)	24 (3.3)	35 (3.4)	45 (3.6)
Encourage students to participate in summer programs/camps	68 (4.7)	77 (3.5)	69 (4.3)	71 (3.5)
Visits to business, industry, and/or research sites	36 (4.8)	44 (5.2)	43 (4.2)	46 (3.7)
Meetings with mentors who work in science/engineering fields	24 (4.5)	26 (3.5)	34 (4.3)	34 (3.4)
Internships in science/engineering fields†	6 (3.1)	24 (5.8)	30 (4.8)	34 (3.6)

† Includes only those schools with high school students.

Table E-40 (Table 7.10)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Science/Engineering, by Community Type

	PERCENT OF SCHOOLS		
	COMMUNITY TYPE		
	Rural	Suburban	Urban
Family nights	23 (3.8)	42 (2.9)	44 (4.8)
After-school help	47 (4.2)	44 (3.1)	46 (4.2)
After-school programs for enrichment	28 (4.1)	36 (3.6)	40 (3.8)
Science clubs	36 (3.8)	45 (3.4)	44 (4.9)
Engineering clubs	28 (3.8)	31 (2.6)	35 (4.1)
Participation in local or regional science/engineering fair	42 (4.4)	42 (3.3)	41 (4.3)
Participation in science competitions	23 (3.2)	24 (2.1)	27 (3.9)
Participation in engineering competitions	32 (3.3)	32 (2.7)	29 (3.9)
Encourage students to participate in summer programs/camps	73 (4.5)	69 (2.7)	74 (4.1)
Visits to business, industry, and/or research sites	45 (4.4)	35 (3.0)	52 (5.1)
Meetings with mentors who work in science/engineering fields	28 (4.1)	27 (2.8)	36 (4.3)
Internships in science/engineering fields†	17 (3.7)	26 (3.6)	31 (5.5)

† Includes only those schools with high school students.

Table E-41 (Table 7.10)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Science/Engineering, by Region

	PERCENT OF SCHOOLS			
	REGION			
	Midwest	Northeast	South	West
Family nights	27 (4.2)	45 (5.3)	36 (3.1)	47 (5.3)
After-school help	40 (4.2)	40 (5.0)	50 (3.4)	47 (5.4)
After-school programs for enrichment	33 (3.8)	47 (6.2)	31 (3.1)	36 (4.8)
Science clubs	34 (3.9)	53 (4.9)	43 (3.4)	43 (5.9)
Engineering clubs	25 (3.3)	40 (4.5)	32 (2.9)	34 (4.7)
Participation in local or regional science/engineering fair	33 (4.3)	43 (5.7)	47 (3.3)	45 (5.4)
Participation in science competitions	23 (2.5)	36 (4.4)	23 (2.2)	20 (4.0)
Participation in engineering competitions	29 (3.5)	34 (4.5)	32 (3.0)	29 (4.9)
Encourage students to participate in summer programs/camps	71 (4.5)	76 (4.2)	71 (3.3)	69 (4.7)
Visits to business, industry, and/or research sites	45 (4.6)	46 (6.2)	42 (3.5)	37 (5.4)
Meetings with mentors who work in science/engineering fields	26 (3.9)	41 (5.6)	28 (3.0)	29 (4.3)
Internships in science/engineering fields†	31 (5.1)	33 (5.9)	21 (3.7)	16 (4.2)

† Includes only those schools with high school students.

Table E-42 (Table 7.11)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Mathematics, by Percentage of Students Eligible for Free/Reduced-Price Lunch

	PERCENT OF SCHOOLS			
	PERCENT OF STUDENTS IN SCHOOL ELIGIBLE FOR FRL			
	Lowest Quartile	Second Quartile	Third Quartile	Highest Quartile
Family nights	20 (3.9)	23 (4.2)	34 (4.0)	45 (4.1)
After-school help	65 (4.1)	70 (4.2)	76 (3.7)	81 (3.6)
After-school programs for enrichment	30 (3.8)	25 (4.0)	20 (3.5)	36 (4.1)
Mathematics clubs	30 (3.8)	26 (3.6)	27 (3.6)	24 (3.4)
Participation in local or regional mathematics fair	20 (3.2)	18 (3.7)	12 (2.5)	19 (3.2)
Participation in mathematics competitions	39 (4.3)	32 (3.9)	36 (4.0)	26 (3.7)
Encourage students to participate in summer programs/camps	49 (4.2)	38 (4.9)	46 (4.6)	64 (4.2)
Visits to business, industry, and/or research sites	16 (3.1)	11 (2.6)	16 (2.8)	23 (4.4)
Meetings with mentors who work in mathematics fields	11 (2.5)	10 (2.1)	14 (2.7)	22 (3.8)
Internships in mathematics fields†	11 (3.3)	5 (2.1)	3 (1.2)	7 (2.3)

† Includes only those schools with high school students.

Table E-43 (Table 7.11)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Mathematics, by School Size

	PERCENT OF SCHOOLS			
	SCHOOL SIZE			
	Smallest Schools	Second Group	Third Group	Largest Schools
Family nights	23 (4.8)	30 (4.2)	33 (3.4)	34 (3.6)
After-school help	67 (5.0)	75 (4.2)	74 (3.6)	76 (3.4)
After-school programs for enrichment	26 (5.2)	20 (4.0)	34 (4.0)	31 (3.5)
Mathematics clubs	13 (3.6)	25 (4.2)	29 (3.0)	41 (3.5)
Participation in local or regional mathematics fair	8 (3.1)	20 (3.7)	18 (2.9)	24 (2.8)
Participation in mathematics competitions	23 (4.5)	31 (4.3)	35 (3.1)	44 (3.6)
Encourage students to participate in summer programs/camps	45 (5.5)	55 (4.4)	45 (4.3)	53 (3.3)
Visits to business, industry, and/or research sites	16 (4.1)	18 (3.5)	17 (3.6)	15 (2.2)
Meetings with mentors who work in mathematics fields	14 (3.5)	14 (3.5)	11 (2.2)	18 (2.6)
Internships in mathematics fields†	4 (2.1)	6 (2.7)	7 (2.1)	9 (1.8)

† Includes only those schools with high school students.

Table E-44 (Table 7.11)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Mathematics, by Community Type

	PERCENT OF SCHOOLS		
	COMMUNITY TYPE		
	Rural	Suburban	Urban
Family nights	17 (3.1)	31 (2.7)	40 (4.2)
After-school help	74 (4.2)	69 (2.4)	77 (4.1)
After-school programs for enrichment	21 (3.6)	27 (3.1)	35 (4.3)
Mathematics clubs	25 (3.3)	29 (3.1)	25 (2.9)
Participation in local or regional mathematics fair	18 (3.7)	19 (2.3)	14 (2.6)
Participation in mathematics competitions	34 (4.0)	34 (2.9)	32 (3.7)
Encourage students to participate in summer programs/camps	45 (4.3)	49 (3.3)	55 (4.4)
Visits to business, industry, and/or research sites	16 (3.0)	14 (2.1)	19 (4.2)
Meetings with mentors who work in mathematics fields	12 (2.7)	13 (2.3)	18 (3.3)
Internships in mathematics fields†	4 (1.4)	7 (1.7)	8 (2.8)

† Includes only those schools with high school students.

Table E-45 (Table 7.11)
Equity Analyses of School Programs/Practices to Enhance Students' Interest in Mathematics, by Region

	PERCENT OF SCHOOLS			
	REGION			
	Midwest	Northeast	South	West
Family nights	23 (3.7)	27 (4.6)	37 (3.3)	30 (4.6)
After-school help	67 (4.3)	72 (5.5)	78 (3.5)	72 (4.2)
After-school programs for enrichment	23 (3.9)	34 (5.6)	29 (3.1)	27 (3.9)
Mathematics clubs	18 (2.6)	32 (4.1)	32 (3.1)	25 (4.5)
Participation in local or regional mathematics fair	14 (2.9)	15 (3.1)	22 (2.5)	17 (4.4)
Participation in mathematics competitions	32 (3.6)	37 (5.5)	37 (3.3)	27 (4.7)
Encourage students to participate in summer programs/camps	44 (4.5)	52 (5.7)	52 (3.4)	50 (5.5)
Visits to business, industry, and/or research sites	14 (3.2)	15 (3.3)	20 (2.9)	14 (3.9)
Meetings with mentors who work in mathematics fields	5 (1.4)	22 (5.4)	19 (2.6)	13 (3.5)
Internships in mathematics fields†	4 (2.0)	10 (3.0)	9 (2.4)	3 (1.4)

† Includes only those schools with high school students.

Table E-46 (Table 7.22)
Equity Analyses of School Mean Scores for Factors Affecting Science Instruction Composites

	MEAN SCORE		
	EXTENT TO WHICH A LACK OF RESOURCES IS PROBLEMATIC	EXTENT TO WHICH STUDENT ISSUES ARE PROBLEMATIC	EXTENT TO WHICH TEACHER ISSUES ARE PROBLEMATIC
Percent of Students in School Eligible for FRL			
Lowest Quartile	32 (2.5)	16 (1.5)	33 (2.1)
Second Quartile	31 (2.3)	24 (1.6)	30 (2.2)
Third Quartile	38 (2.8)	33 (1.8)	35 (2.3)
Highest Quartile	40 (2.1)	38 (2.1)	41 (2.5)
School Size			
Smallest Schools	33 (2.7)	25 (2.1)	31 (2.8)
Second Group	37 (2.9)	24 (2.0)	33 (2.4)
Third Group	35 (1.9)	29 (1.5)	37 (2.1)
Largest Schools	36 (2.1)	30 (1.5)	37 (1.7)
Community Type			
Rural	34 (2.2)	28 (1.8)	30 (2.2)
Suburban	36 (1.6)	25 (1.1)	34 (1.6)
Urban	35 (2.4)	31 (1.7)	38 (2.3)
Region			
Midwest	31 (2.0)	26 (1.6)	33 (2.1)
Northeast	31 (2.8)	21 (2.5)	31 (3.1)
South	36 (1.5)	31 (1.5)	34 (1.7)
West	43 (2.8)	28 (1.9)	39 (2.3)

Table E-47 (Table 7.22)
Equity Analyses of School Mean Scores for Factors Affecting Mathematics Instruction Composites

	MEAN SCORE		
	EXTENT TO WHICH A LACK OF RESOURCES IS PROBLEMATIC	EXTENT TO WHICH STUDENT ISSUES ARE PROBLEMATIC	EXTENT TO WHICH TEACHER ISSUES ARE PROBLEMATIC
Percent of Students in School Eligible for FRL			
Lowest Quartile	20 (1.5)	23 (2.1)	21 (2.0)
Second Quartile	18 (1.8)	32 (2.3)	18 (1.9)
Third Quartile	20 (1.7)	46 (1.9)	20 (1.6)
Highest Quartile	26 (2.3)	48 (2.3)	25 (2.0)
School Size			
Smallest Schools	23 (2.4)	34 (2.7)	18 (2.0)
Second Group	19 (1.7)	35 (2.4)	21 (2.1)
Third Group	19 (1.5)	38 (2.1)	21 (1.5)
Largest Schools	22 (2.0)	39 (2.0)	23 (1.3)
Community Type			
Rural	22 (1.9)	36 (2.4)	19 (1.8)
Suburban	20 (1.2)	34 (1.5)	22 (1.4)
Urban	22 (2.1)	42 (2.2)	21 (2.0)
Region			
Midwest	19 (2.1)	36 (2.0)	20 (2.1)
Northeast	17 (2.0)	31 (2.5)	20 (2.7)
South	23 (1.7)	39 (1.7)	21 (1.6)
West	23 (1.9)	38 (2.6)	24 (2.0)

Table E-48 (Table 7.31)
Equity Analyses of Class Mean Scores for Factors Affecting Science Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	63 (1.2)	73 (1.3)	72 (1.9)
Average/Mixed	63 (0.8)	66 (0.9)	65 (1.2)
Mostly Low	58 (1.4)	52 (2.9)	58 (3.1)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	62 (1.4)	68 (1.1)	64 (1.8)
Second Quartile	61 (1.2)	68 (1.5)	64 (2.0)
Third Quartile	63 (1.3)	65 (1.9)	66 (2.1)
Highest Quartile	61 (1.5)	61 (2.6)	66 (2.6)
Percent of Students in School Eligible for FRL			
Lowest Quartile	63 (1.2)	71 (1.4)	68 (1.8)
Second Quartile	62 (1.4)	68 (1.2)	63 (1.9)
Third Quartile	62 (1.3)	63 (1.4)	63 (1.5)
Highest Quartile	60 (1.2)	60 (2.4)	65 (2.6)
School Size			
Smallest Schools	65 (2.2)	69 (2.6)	63 (3.3)
Second Group	61 (1.4)	63 (1.5)	64 (2.0)
Third Group	62 (1.3)	65 (1.6)	64 (1.7)
Largest Schools	62 (1.0)	66 (1.2)	67 (1.8)
Community Type			
Rural	64 (1.2)	65 (1.3)	63 (1.9)
Suburban	61 (0.9)	65 (1.1)	64 (1.3)
Urban	63 (1.6)	66 (2.0)	68 (2.2)
Region			
Midwest	61 (1.4)	65 (1.7)	61 (1.9)
Northeast	64 (1.6)	70 (1.9)	67 (2.7)
South	64 (1.0)	65 (1.2)	67 (1.6)
West	57 (1.3)	64 (2.3)	63 (2.4)

Table E-49 (Table 7.32)
Equity Analyses of Class Mean Scores for Factors Affecting Mathematics Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	66 (1.6)	71 (2.1)	71 (1.9)
Average/Mixed	67 (0.8)	67 (1.0)	71 (1.0)
Mostly Low	62 (1.4)	55 (2.2)	69 (2.1)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	67 (1.2)	69 (1.6)	70 (1.6)
Second Quartile	67 (1.0)	69 (1.4)	71 (1.6)
Third Quartile	64 (1.4)	65 (1.7)	71 (1.8)
Highest Quartile	64 (1.5)	59 (2.1)	71 (1.7)
Percent of Students in School Eligible for FRL			
Lowest Quartile	66 (1.0)	72 (1.4)	72 (1.7)
Second Quartile	65 (1.2)	66 (1.4)	71 (1.0)
Third Quartile	66 (1.2)	63 (1.5)	70 (1.6)
Highest Quartile	65 (1.3)	60 (1.7)	71 (1.5)
School Size			
Smallest Schools	71 (2.2)	66 (2.6)	70 (2.2)
Second Group	66 (1.6)	67 (1.8)	69 (1.8)
Third Group	66 (1.0)	65 (1.3)	73 (1.5)
Largest Schools	64 (0.9)	64 (1.4)	70 (1.2)
Community Type			
Rural	67 (1.3)	65 (1.9)	69 (1.6)
Suburban	66 (0.7)	66 (1.0)	71 (1.2)
Urban	64 (1.3)	65 (1.7)	71 (1.4)
Region			
Midwest	67 (1.0)	66 (1.4)	71 (1.3)
Northeast	66 (1.4)	66 (2.1)	70 (1.8)
South	66 (1.1)	64 (1.3)	73 (1.2)
West	63 (1.5)	67 (1.7)	68 (2.0)

Table E-50 (Table 7.33)
Equity Analyses of Class Mean Scores for Factors Affecting Computer Science Instruction Composites

	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
Prior Achievement Level of Class			
Mostly High	57 (2.4)	73 (2.0)	71 (2.9)
Average/Mixed	59 (3.0)	68 (2.2)	75 (2.3)
Percent of Historically Underrepresented Students in Class			
Lowest Quartile	56 (3.7)	67 (3.7)	64 (4.6)
Second Quartile	52 (4.8)	68 (3.1)	79 (3.9)
Third Quartile	56 (3.3)	67 (3.6)	75 (3.8)
Highest Quartile	66 (3.8)	75 (3.0)	76 (4.3)
Percent of Students in School Eligible for FRL			
Lowest Quartile	53 (2.9)	69 (2.6)	70 (2.5)
Second Quartile	58 (3.2)	69 (2.8)	75 (4.3)
Third Quartile	63 (2.9)	68 (5.4)	79 (4.6)
Highest Quartile	66 (6.6)	74 (4.4)	75 (4.1)
School Size			
Smallest Schools	75 (5.6)	68 (9.3)	86 (8.0)
Second Group	62 (6.4)	69 (5.5)	70 (4.4)
Third Group	54 (3.7)	70 (4.7)	78 (4.8)
Largest Schools	57 (2.4)	70 (1.7)	72 (2.4)
Community Type			
Rural	60 (4.5)	68 (2.9)	73 (4.8)
Suburban	56 (2.8)	71 (2.7)	72 (2.6)
Urban	61 (5.2)	69 (3.1)	76 (3.9)
Region			
Midwest	52 (2.7)	64 (5.2)	79 (4.8)
Northeast	54 (6.3)	65 (3.7)	65 (4.3)
South	62 (3.2)	71 (2.4)	73 (3.1)
West	61 (4.0)	75 (2.4)	76 (3.1)