NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

2018 NSSME+: Status of Middle School Mathematics

MAY 2019

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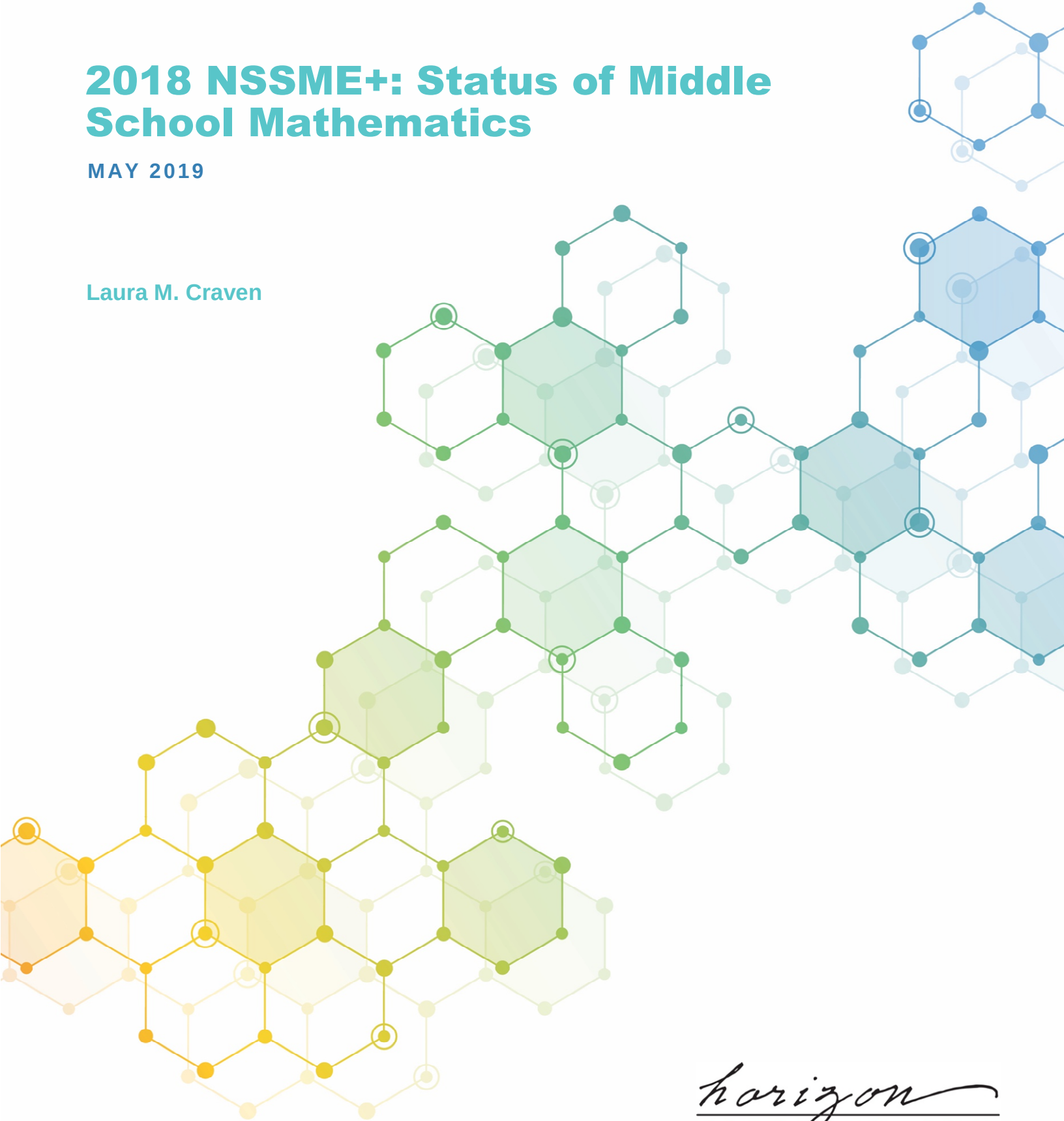

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The *2018 NSSME+: Status of Middle School Mathematics* was prepared with support from the National Science Foundation under grant number DGE-1642413. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Suggested Citation

Craven, L. M. (2019). *2018 NSSME+: Status of middle school mathematics.* Chapel Hill, NC: Horizon Research, Inc.

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/

TABLE OF CONTENTS

Page

LIST OF TABLES

Resources Available for Middle School Mathematics

Factors Affecting Middle School Mathematics Instruction

Introduction

In 2018, the National Science Foundation supported the sixth in a series of surveys through a grant to Horizon Research, Inc. 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?

The 2018 NSSME+ is based on a national probability sample of schools and computer science, mathematics, and 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. A total of 7,600 computer science, mathematics, and science teachers in 1,273 schools across the United States participated in this study, a response rate of 78 percent.

This report describes the status of middle school (grades 6–8) mathematics instruction based on the responses of 1,005 mathematics teachers.[1] For comparison purposes, some of the tables organize these data into three groups based upon the schedule of the mathematics teacher or the type of a randomly selected class: remedial, regular, and accelerated mathematics.

Details on the survey sample design, data collection and analysis procedures, and creation of composite variables[2] are included in the *Report of the 2018 NSSME+*.[3] 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 significant at the 0.05 level.[4]

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

- Middle school mathematics teachers' backgrounds and beliefs;
- Professional development of middle school mathematics teachers;
- Middle school mathematics instruction;
- Resources available for middle school mathematics instruction; and
- Factors affecting middle school mathematics instruction.

Middle School Mathematics Teachers' Backgrounds and Beliefs

A well-prepared teaching force is essential for an effective education system. This section provides data about the nation's middle school mathematics teachers, including their course backgrounds, perceptions of preparedness, and beliefs about teaching and learning.

Teacher Characteristics

As can be seen in Table 1, 7 out of 10 middle school mathematics teachers are female, and the vast majority are white. More than half of the middle school mathematics teaching force is over 40 years old, and about 1 in 5 are over 50. Over a third of middle school mathematics teachers have five or fewer years of experience teaching mathematics. In addition, nearly a quarter are responsible for teaching three or more different mathematics subjects (e.g., remedial mathematics 7, Algebra 1).

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 a mathematics-related field (e.g., accounting,

[1] A middle school mathematics teacher is defined as someone whose randomly selected class was a grades 6–8 mathematics course. Teachers of 6th grade self-contained classes are considered elementary grades teachers and are not included in these analyses.

[2] 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.

[3] Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). *Report of the 2018 NSSME+*. Chapel Hill, NC: Horizon Research, Inc.

[4] 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: Series B, 57*(1), 289–300.

engineering, computer programming) after completing their undergraduate degree and prior to teaching. Just over 1 in 10 middle school mathematics teachers have full-time job experience in a mathematics-related field prior to teaching.

Table 1
Characteristics of the Middle School Mathematics Teaching Force

	PERCENT OF TEACHERS
Sex	
Female	70 (2.2)
Male	30 (2.2)
Other	0 ---†
Hispanic or Latino	
Yes	8 (1.5)
No	92 (1.5)
Race	
White	89 (1.4)
Black or African American	8 (1.2)
Asian	3 (0.8)
American Indian or Alaskan Native	1 (0.5)
Native Hawaiian or Other Pacific Islander	1 (0.8)
Age	
≤ 30	17 (1.7)
31–40	31 (2.2)
41–50	29 (2.4)
51–60	18 (1.7)
61+	4 (0.8)
Experience Teaching Mathematics at the K–12 Level	
0–2 years	18 (2.2)
3–5 years	19 (2.1)
6–10 years	20 (1.9)
11–20 years	32 (2.3)
≥ 21 years	11 (1.1)
Number of Mathematics Preparations Taught	
1	33 (2.0)
2	44 (2.4)
3 or more	23 (2.1)
Full-Time Job in Mathematics Prior to Teaching	
Yes	12 (1.4)
No	88 (1.4)

† 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.

Nearly all middle school mathematics teachers have had formal preparation for teaching leading to a credential (see Table 2). Over half received their teaching credential as part of their undergraduate program, and a fifth received their credential as part of a master's program.

Table 2
Middle School Mathematics Teachers' Paths to Certification

	PERCENT OF TEACHERS
An undergraduate program leading to a bachelor's degree and a teaching credential	61 (2.6)
A master's program that also led to a teaching credential	20 (1.6)
A post-baccalaureate credentialing program (no master's degree awarded)	14 (1.9)
Has not earned a teaching credential	4 (1.1)

Content Preparedness

The survey asked teachers about the subject of their college degrees (undergraduate and graduate). About a quarter of middle school mathematics teachers have a college degree in mathematics, and a similar proportion has a degree in mathematics education; fewer than half have a degree in either subject (see Table 3).

Table 3
Middle School Mathematics Teacher Degrees

	PERCENT OF TEACHERS
Mathematics	26 (2.0)
Mathematics Education	28 (2.4)
Mathematics or Mathematics Education	45 (2.7)

Table 4 shows the percentage of middle school mathematics teachers with college coursework in each of a number of mathematics topics. About three-quarters have had a course in statistics, and two-thirds have had a course in calculus. Interestingly, 42 percent have taken a course in computer science. Relatively few middle school mathematics teachers have had coursework in advanced topics such as abstract algebra, analytic or axiomatic geometry, or discrete mathematics.

Table 4
Middle School Mathematics Teachers Completing Various College Courses

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

The National Council of Teachers of Mathematics (NCTM) has recommended that middle school mathematics teachers take college coursework in six different areas: number theory (for which "mathematics for middle school teachers" can serve as a proxy), algebra, geometry, probability, statistics, and calculus.[5] Although only 1 in 5 middle school mathematics teachers have had college courses in all of these areas, over half having completed at least courses in at least 4 of the recommended areas (see Table 5).

Table 5
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)

In addition to asking teachers about their college coursework, the 2018 NSSME+ asked how well prepared they feel to teach a number of mathematics topics. As can be seen in Table 6, a large majority of middle school mathematics teachers feel very well prepared to teach about the number system and operations (85 percent) and algebraic thinking (78 percent). About three-

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

fifths feel very well prepared to teach measurement, geometry, and functions. Fewer than half feel very well prepared to teach modeling or statistics and probability, and only about 1 in 10 feel very well prepared to teach discrete mathematics. A majority (59 percent) do not feel adequately prepared to teach computer science/programming at the middle school level.

Table 6
Middle School Mathematics Teachers' Perceptions of Their Preparedness to Teach Each of a Number of Topics

	PERCENT OF TEACHERS			
	NOT ADEQUATELY PREPARED	SOMEWHAT PREPARED	FAIRLY WELL PREPARED	VERY WELL PREPARED
The number system and operations	0 ---†	2 (0.9)	13 (1.2)	85 (1.4)
Algebraic thinking	0 ---†	3 (1.1)	18 (1.5)	78 (1.7)
Measurement	1 (0.2)	8 (1.3)	31 (1.8)	61 (2.0)
Geometry	2 (0.7)	7 (1.1)	32 (2.1)	59 (2.3)
Functions	3 (0.6)	12 (1.4)	28 (1.9)	57 (2.0)
Modeling	2 (0.4)	13 (1.6)	39 (2.4)	46 (2.4)
Statistics and probability	3 (1.0)	17 (1.7)	41 (2.5)	40 (2.4)
Discrete mathematics	28 (2.0)	34 (2.2)	25 (1.8)	12 (1.4)
Computer science/programming	59 (2.3)	26 (2.2)	11 (1.5)	4 (0.7)

† 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 mathematics items from Table 6 were combined into a composite variable named Perceptions of Content Preparedness. As can be seen in Table 7, middle school mathematics teachers feel fairly well prepared to teach middle school mathematics, with perceived preparedness increasing with the difficulty of the course.

Table 7
Mean Scores for Middle School Mathematics Teachers' Perceptions of Content Preparedness Composite

	MEAN SCORE
Overall	78 (0.7)
Remedial	74 (1.2)
Regular	77 (0.7)
Accelerated, including Pre-Algebra and Algebra 1	81 (0.7)

Pedagogical Preparedness

As can be seen in Table 8, around half of middle school mathematics teachers feel very well prepared to use formative assessment to monitor student learning, develop students' abilities to do mathematics, develop students' conceptual understanding, and encourage participation of all students in mathematics. About a third of middle school mathematics teachers feel very well prepared to encourage students' interest or differentiate instruction in mathematics. Only a small percentage feel very well prepared to incorporate students' ideas and cultural backgrounds into instruction, and only 1 in 10 teachers feel very well prepared to develop students' awareness of STEM careers.

Table 8
Middle School Mathematics Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	PERCENT OF TEACHERS
Use formative assessment to monitor student learning	57 (2.2)
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	55 (2.1)
Develop students' conceptual understanding	49 (2.2)
Encourage participation of all students in mathematics	49 (2.1)
Encourage students' interest in mathematics	37 (2.0)
Differentiate mathematics instruction to meet the needs of diverse learners	36 (2.2)
Provide mathematics instruction that is based on students' ideas	23 (1.7)
Incorporate students' cultural backgrounds into mathematics instruction	13 (1.1)
Develop students' awareness of STEM careers	10 (0.9)

Table 9 shows the percentage of classes taught by teachers who feel very well prepared for each of a number of tasks related to instruction in a specific mathematics unit. In the majority of middle school mathematics classes, teachers feel very well prepared to assess student understanding at the end of a unit, monitor student understanding during the unit, and implement the designated instructional materials. Although teachers in half of middle school mathematics classes feel very well prepared to anticipate student difficulties, in only 38 percent of classes do teachers feel very well prepared to find out what their students think or already know about the key mathematical ideas.

Table 9
Middle School Mathematics Classes in Which Teachers Feel Very Well Prepared for Each of a Number of Tasks in the Most Recent Unit in a Designated Class

	PERCENT OF CLASSES
Assess student understanding at the conclusion of this unit	62 (2.3)
Monitor student understanding during this unit	57 (1.9)
Implement the instructional materials to be used during this unit	55 (2.0)
Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit	50 (2.1)
Find out what students thought or already knew about the key mathematical ideas	38 (2.2)

Data from these two sets of items were combined into composite variables. As can be seen in Table 10, middle school mathematics teachers feel fairly well prepared to teach middle school mathematics. In addition, teachers of all course types feel better prepared to carry out tasks related to a specific unit than they do to use student-centered pedagogies more generally.

Table 10
Mean Scores for Middle School Mathematics Teachers' Perceptions of General and Unit-Specific Pedagogical Preparedness Composites

	MEAN SCORE	
	PEDAGOGICAL PREPAREDNESS	PREPAREDNESS TO IMPLEMENT INSTRUCTION IN PARTICULAR UNIT
Overall	69 (0.8)	80 (1.0)
Remedial	67 (1.5)	79 (1.3)
Regular	69 (0.8)	81 (0.9)
Accelerated, including Pre-Algebra and Algebra 1	70 (0.8)	82 (0.9)

Pedagogical Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning in mathematics. As can be seen in Table 11, middle school mathematics teachers hold a number of views that are in alignment with what is known about effective mathematics instruction. For example, nearly all middle school mathematics teachers agree that: (1) teachers should ask students to justify their mathematical thinking, (2) students should learn mathematics by doing mathematics, and (3) most class periods should provide opportunities for students to share their thinking and reasoning.

However, many middle school mathematics teachers also hold views that are inconsistent with effective mathematics instruction. For example, 78 percent believe that students should be provided with definitions for new vocabulary at the beginning of instruction on a mathematical idea, and 66 percent believe that students learn best in classes with students of similar abilities. Furthermore, 43 percent believe that hands-on/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned, and 31 percent believe teachers should explain an idea to students before having them investigate the idea.

Table 11
Middle School Mathematics Teachers Agreeing† With Various Statements About Teaching and Learning

	PERCENT OF TEACHERS
Reform-Oriented Beliefs	
Teachers should ask students to justify their mathematical thinking.	99 (0.4)
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 (0.6)
Most class periods should provide opportunities for students to share their thinking and reasoning.	95 (0.7)
Students learn best when instruction is connected to their everyday lives.	93 (1.8)
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	92 (1.1)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	89 (1.5)
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.	78 (3.1)
Students learn mathematics best in classes with students of similar abilities.	66 (2.7)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.	43 (2.7)
Teachers should explain an idea to students before having them investigate the idea.	31 (2.9)

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

These items were combined into two composite variables: Traditional Teaching Beliefs and Reform-Oriented Teaching Beliefs. The composite scores shown in Table 12 suggest that middle school mathematics teachers, across course levels, have relatively strong reform-oriented beliefs. However, traditional beliefs are also fairly prevalent.

Table 12
Mean Scores for Middle School Mathematics Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	TRADITIONAL BELIEFS	REFORM-ORIENTED BELIEFS
Overall	60 (1.1)	84 (0.5)
Remedial	61 (1.4)	83 (1.0)
Regular	60 (0.9)	83 (0.8)
Accelerated, including Pre-Algebra and Algebra 1	60 (0.9)	84 (0.7)

Leadership Roles and Responsibilities

In addition to asking teachers about their education background, beliefs, and preparedness, the survey asked teachers whether they have served in various leadership roles in the profession in the last three years. Although fewer than half have had any one of these roles, middle school mathematics teachers are most likely to have (1) observed another teacher's mathematics lesson for the purpose of giving feedback, (2) served on a school or district-wide mathematics committee, and (3) taught a mathematics lesson for other teachers in their school to observe (see Table 13).

Table 13
Middle School Mathematics Teachers Having Various Leadership Responsibilities Within the Last Three Years

	PERCENT OF TEACHERS
Observed another teacher's mathematics lesson for the purpose of giving them feedback	47 (3.0)
Served on a school or district/diocese-wide mathematics committee	45 (2.9)
Taught a mathematics lesson for other teachers in their school to observe	43 (2.9)
Served as a lead teacher or department chair in mathematics	31 (2.3)
Led or co-led a workshop or professional learning community for other teachers focused on mathematics or mathematics teaching	23 (2.2)
Served as a formal mentor or coach for a mathematics teacher	21 (1.9)
Supervised a student teacher in their classroom	21 (2.1)

Professional Development of Middle School Mathematics Teachers

Mathematics 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 mathematics content. The 2018 NSSME+ collected data on teachers' participation in professional development, as well as characteristics of the 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 14, a majority of middle school mathematics teachers have participated in mathematics-focused professional development (i.e., focused on mathematics content or the teaching of mathematics) in the last three years.

Table 14
Middle School Mathematics Teachers' Most Recent Participation in Mathematics-Focused Professional Development

	PERCENT OF TEACHERS
In the last 12 months	71 (2.5)
1–3 years ago	19 (2.0)
4–6 years ago	5 (1.1)
7–10 years ago	2 (0.6)
More than 10 years ago	1 (0.3)
Never	4 (0.8)

Although some involvement in professional development is better than none, brief exposure of a few hours over several years is not likely to enhance teachers' knowledge and skills in meaningful ways. Accordingly, teachers were asked about the total amount of time they have spent on professional development related to mathematics teaching in the last three years. Just over a third of middle school mathematics teachers have had more than 35 hours of mathematics-related professional development; further, about 1 in 5 teachers have had less than 6 hours (see Table 15).

Table 15
Time Spent by Middle School Mathematics Teachers on Mathematics-Focused Professional Development in the Last Three Years

	PERCENT OF TEACHERS
None	11 (1.7)
Less than 6 hours	8 (1.6)
6–15 hours	20 (2.2)
16–35 hours	24 (1.7)
36–80 hours	22 (1.9)
More than 80 hours	15 (1.2)

As to how this time is spent, the workshop is the most common form of professional development, with 93 percent of middle school mathematics teachers participating in professional development having attended one in the previous three years (see Table 16). Two-thirds have participated in a professional learning community or other type of teacher study group, and over half have received assistance or feedback on their mathematics teaching from a formally assigned coach or mentor.

Table 16
Middle School Mathematics Teachers Participating in Various Mathematics-Focused Professional Development Activities in the Last Three Years

	PERCENT OF TEACHERS†
Attended a professional development program/workshop	93 (1.4)
Participated in a professional learning community/lesson study/teacher study group	68 (3.1)
Received assistance or feedback from a formally designated coach/mentor	56 (3.2)
Completed an online course/webinar	35 (2.9)
Attended a national, state, or regional mathematics teacher association meeting	26 (2.4)
Took a formal course for college credit	15 (2.1)

† Only middle school mathematics teachers indicating that they participated in mathematics-focused professional development in the last three years are included in these analyses.

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 providing opportunities for teachers to engage in investigations, both to learn disciplinary content and to experience inquiry-oriented learning; examine student work and other classroom artifacts for evidence of what students do and do not understand; and apply what they have learned in their classrooms and subsequently discuss how it went.[6] 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.

[6] 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.

As can be seen in Table 17, 72 percent of middle school mathematics teachers who have participated in professional development in the last three years have had substantial opportunity to work closely with other teachers from their school, and 58 percent have had substantial opportunity to work with others who teach the same subject or grade. Roughly half have had substantial opportunities in their professional development to examine classroom artifacts, engage in mathematics investigations, apply what they learned to their classroom and then talk about it as part of the professional development, and experience lessons as their students would from the textbooks/units they use in their classroom. Only one-third of middle school mathematics teachers have had opportunities to rehearse instructional practices during the professional development.

Table 17
Middle School Mathematics Teachers Whose Professional Mathematics-Focused Development in the Last Three Years Had Each of a Number of Characteristics to a Substantial Extent†

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

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

‡ Only middle school mathematics teachers indicating that they participated in mathematics-focused professional development in the last three years are included in these analyses.

Another series of items asked about the focus of professional development opportunities teachers have had in the last three years. For over half of middle school mathematics teachers, professional growth opportunities have given heavy emphasis to deepening their understanding of how mathematics is done, differentiating instruction to meet the needs of diverse learners, monitoring student understanding, and learning about difficulties students may have with particular mathematical ideas and procedures (see Table 18). Relatively few teachers have had professional growth opportunities with a heavy emphasis on learning how to provide mathematics instruction that integrates engineering, science, and/or computer science, or incorporating students' cultural backgrounds into mathematics instruction.

Table 18
Middle School Mathematics Teachers Reporting That Their Mathematics-Focused Professional Development in the Last Three Years Gave Heavy Emphasis† to Various Areas

	PERCENT OF TEACHERS‡
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)	55 (3.1)
Differentiating mathematics instruction to meet the needs of diverse learners	55 (3.2)
Monitoring student understanding during mathematics instruction	55 (2.7)
Learning about difficulties that students may have with particular mathematical ideas and procedures	51 (3.1)
Learning how to use hands-on activities/manipulatives for mathematics instruction	45 (3.4)
Deepening their own mathematics content knowledge	44 (3.4)
Finding out what students think or already know prior to instruction on a topic	39 (3.4)
Implementing the mathematics textbook to be used in their classroom	38 (3.1)
Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	20 (2.5)
Incorporating students' cultural backgrounds into mathematics instruction	19 (3.0)

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

‡ Only middle school mathematics teachers indicating that they participated in mathematics-focused professional development in the last three years are included in these analyses.

Data from these two sets of items were combined into composite variables, one measuring the extent to which teachers' professional development aligns with what is known about effective professional development and a second that measures the extent to which the professional development focuses on supporting student-centered instruction. The scores shown in Table 19 indicate that middle school mathematics teachers' professional development is only somewhat aligned with the elements of effective professional development and only somewhat supportive of student-centered instruction, regardless of course level.

Table 19
Middle School Mathematics Teacher Mean Scores for Professional Development Composites

	MEAN SCORE	
	EXTENT PROFESSIONAL DEVELOPMENT ALIGNS WITH ELEMENTS OF EFFECTIVE PROFESSIONAL DEVELOPMENT	EXTENT PROFESSIONAL DEVELOPMENT SUPPORTS STUDENT-CENTERED INSTRUCTION
Overall	59 (1.3)	58 (1.2)
Remedial	61 (1.6)	57 (2.1)
Regular	59 (1.4)	58 (1.1)
Accelerated, including Pre-Algebra and Algebra 1	60 (1.4)	59 (1.6)

Middle School Mathematics Instruction

The 2018 NSSME+ collected data on Algebra and Geometry enrollment in middle schools, as well as the composition of classes (e.g., gender, race/ethnicity, and prior achievement levels of students). Data were also collected about middle school mathematics teachers' perceptions of their autonomy in making curricular and instructional decisions, as well as their instructional objectives and class activities they use in accomplishing these objectives.

Enrollment in Algebra and Geometry

As can be seen in Table 20, about three-fourths of middle schools have had some students complete Algebra 1, though only a quarter have 51 percent or more of their students completing Algebra 1 prior to 9th grade. In contrast, just over one-fourth of schools have any students completing Geometry prior to 9th grade, though generally only a small percentage of students do so.

Table 20
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)

Class Characteristics

The typical middle school mathematics class has approximately 22 students; two-thirds of classes have between 17 and 29 students. Female students are equally represented in accelerated middle school mathematics courses; however, these courses only contain slightly more than a third of students from race/ethnicity groups historically underrepresented in STEM[7] (see Table 21).

Table 21
Demographics of Students in Middle School Mathematics Courses

	PERCENT OF STUDENTS	
	FEMALE	HISTORICALLY UNDERREPRESENTED
Overall	47 (0.7)	44 (2.0)
Remedial	43 (2.1)	43 (6.5)
Regular	46 (0.9)	47 (2.4)
Accelerated, including Pre-Algebra and Algebra 1	50 (1.2)	36 (3.8)

[7] Includes students identified as American Indian or Alaskan Native, Black or African American, Hispanic or Latino, or Native Hawaiian or Other Pacific Islander.

About a third of middle school mathematics classes are heterogeneously grouped, containing students with a mixture of prior achievement levels (see Table 22). The remaining classes are grouped by prior achievement level of the students.

Table 22
Prior Achievement Grouping in Middle School Mathematics Classes

	PERCENT OF CLASSES
Mostly low achievers	26 (1.8)
Mostly average achievers	24 (1.7)
Mostly high achievers	22 (1.8)
A mixture of levels	29 (2.0)

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.

In middle school mathematics classes, teachers are likely to perceive themselves as having strong control over pedagogical decisions such as determining the amount of homework to be assigned, selecting teaching techniques, and choosing criteria for grading student performance (see Table 23). In relatively few middle school mathematics classes do teachers feel strong control over determining course goals and objectives; selecting curriculum materials; and selecting content, topics, and skills to be taught.

Table 23
Middle School Mathematics 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	71 (2.4)
Selecting teaching techniques	68 (2.5)
Choosing criteria for grading student performance	52 (2.9)
Determining the amount of instructional time to spend on each topic	37 (2.7)
Selecting the sequence in which topics are covered	31 (2.6)
Determining course goals and objectives	28 (2.4)
Selecting content, topics, and skills to be taught	21 (2.1)
Selecting curriculum materials (e.g., textbooks)	18 (2.1)

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; and
- Selecting the sequence in which topics are covered.

For Pedagogy Control, the items are:

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

The mean score on the Pedagogy Control composite is much higher than on the Curriculum Control composite, an indication that middle school mathematics teachers feel substantially more in control of pedagogical decisions than curricular decisions (see Table 24). Teachers of regular mathematics classes feel less in control of curricular decisions than their counterparts in remedial and accelerated classes.

Table 24
Middle School Mathematics Class Mean Scores for Curriculum Control and Pedagogy Control Composites

	MEAN SCORE	
	CURRICULUM CONTROL	PEDAGOGY CONTROL
Overall	51 (1.5)	86 (0.9)
Remedial	62 (5.1)	84 (3.9)
Regular	47 (1.9)	86 (1.2)
Accelerated, including Pre-Algebra and Algebra 1	56 (2.4)	89 (1.2)

Instructional Objectives

The survey provided a list of possible objectives of instruction and asked teachers how much emphasis each would receive over the entire year in a particular, randomly selected class. As can be seen in Table 25, most middle school mathematics classes have a heavy emphasis on students' understanding mathematical ideas, learning how to do mathematics, and learning mathematical procedures and/or algorithms. Fewer than half of middle school mathematics classes have a heavy emphasis on developing students' confidence that they can successfully pursue careers in mathematics, learning about real-life applications of mathematics, or increasing students' interest in mathematics. Interestingly, despite mathematics being included in most states' accountability systems, fewer than a quarter of classes have a heavy emphasis on learning test-taking skills or learning to perform computations with speed and accuracy.

Table 25
Middle School Mathematics Classes With Heavy Emphasis on Various Instructional Objectives

	PERCENT OF CLASSES
Understanding mathematical ideas	71 (1.9)
Learning how to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	61 (2.1)
Learning mathematical procedures and/or algorithms	53 (2.6)
Developing students' confidence that they can successfully pursue careers in mathematics	41 (2.0)
Learning about real-life applications of mathematics	37 (1.9)
Increasing students' interest in mathematics	34 (2.0)
Learning mathematics vocabulary	27 (1.9)
Learning test-taking skills/strategies	23 (1.5)
Learning to perform computations with speed and accuracy	20 (1.6)

The objectives related to reform-oriented instruction (understanding mathematical ideas, learning how to do mathematics, learning about real-life applications of mathematics, increasing students' interest in mathematics, and developing students' confidence that they can successfully pursue careers in mathematics) were combined into a composite variable. The mean composite score indicates that middle school mathematics classes are fairly likely to emphasize these objectives, with accelerated mathematics classes emphasizing them the most (see Table 26).

Table 26
Middle School Mathematics Class Mean Scores for the Reform-Oriented Instructional Objectives Composite

	MEAN SCORE
Overall	80 (0.6)
Remedial	79 (1.8)
Regular	78 (0.8)
Accelerated, including Pre-Algebra and Algebra 1	84 (1.0)

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 mathematics 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.

As can be seen in Table 27, the vast majority of middle school mathematics classes include the teacher explaining mathematical ideas and whole class discussions at least once a week. Students working in small groups also occurs on a weekly basis in about three-quarters of classes. It is somewhat striking that, in contrast to what is known from learning theory about the importance of reflection, only 30 percent of middle school mathematics classes have students write reflections on what they are learning.

Table 27
Middle School Mathematics Classes in Which Teachers Report Using Various Activities at Least Once a Week

	PERCENT OF CLASSES
Explain mathematical ideas to the whole class	95 (1.0)
Engage the whole class in discussions	91 (1.1)
Have students work in small groups	77 (2.2)
Have students practice for standardized tests	32 (2.1)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	30 (1.8)
Provide manipulatives for students to use in problem-solving/investigations	29 (2.1)
Have students read from a textbook or other material in class, either aloud or to themselves	24 (2.1)
Focus on literacy skills (e.g., informational reading or writing strategies)	20 (1.6)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	10 (1.2)

Teachers were also asked how often they engage students in the practices of mathematics described in the *Common Core State Standards for Mathematics*,[8] such as making sense of problems, constructing arguments, critiquing the reasoning of others, and modeling with mathematics. Table 28 shows the percentage of middle school mathematics classes that engage students in various aspects of these practices at least once a week. In more than 80 percent of classes, students are asked to determine whether their answer makes sense; provide mathematical reasoning to explain, justify, or prove their thinking; and continue working through mathematics problems when they reach points of difficulty, challenge, or error. Given the emphasis in recent years on the importance of students critiquing different approaches to solving mathematics problems, it is somewhat surprising that fewer than two-thirds of classes have students analyze the mathematical thinking of others or compare and contrast different solution strategies on a weekly basis.

Table 28
Middle School Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices at Least Once a Week

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

These items were combined into a composite variable titled Engaging Students in the Practices of Mathematics. The mean scores on this composite indicate that middle school students are, on average, engaged in these aspects of the mathematical practices once or twice a week, with accelerated mathematics classes engaging in them the most (see Table 29).

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

Table 29
Middle School Mathematics Class Mean Scores for Engaging Students in Practices of Mathematics Composite

	MEAN SCORE
Overall	73 (0.6)
Remedial	70 (2.0)
Regular	73 (0.7)
Accelerated, including Pre-Algebra and Algebra 1	77 (1.0)

Given recent trends to incorporate computer science into the K–12 curriculum across the subjects, the 2018 NSSME+ asked teachers how frequently they do so. Very few middle school mathematics classes incorporate coding into instruction; only 14 percent of classes do so at all (see Table 30).

Table 30
Middle School Mathematics Classes in Which Teachers Report Incorporating Coding Into Instruction

	PERCENT OF CLASSES
Never	86 (2.1)
Rarely (e.g., a few times per year)	11 (1.6)
Sometimes (e.g., once or twice a month)	3 (1.3)
Often (e.g., once or twice a week)	0 (0.3)
All or almost all mathematics lessons	0 (0.1)

In addition to asking about class activities in the course as a whole, the 2018 NSSME+ asked teachers about activities that took place during their most recent mathematics lesson in the randomly selected class. The large majority of middle school mathematics lessons include the teacher explaining a mathematical idea to the whole class, students working in small groups, whole class discussion, and students completing textbook/worksheet (see Table 31). Students doing hands-on/manipulative activities occurs in only about a quarter of middle school mathematics lessons.

Table 31
Middle School Mathematics Classes Participating in Various Activities in Most Recent Lesson

	PERCENT OF CLASSES
Teacher explaining a mathematical idea to the whole class	88 (1.6)
Students working in small groups	83 (1.7)
Whole class discussion	78 (1.5)
Students completing textbook/worksheet problems	76 (1.7)
Teacher conducting a demonstration while students watched	65 (2.1)
Students doing hands-on/manipulative activities	24 (1.8)
Students writing about mathematics	19 (1.6)
Practicing for standardized tests	17 (1.5)
Students reading about mathematics	15 (1.5)
Test or quiz	15 (1.5)

The survey also asked teachers to estimate the time spent on each of a number of types of activities in the most recent mathematics lesson. As can be seen in Table 32, on average, 39 percent of middle school mathematics class time is spent on whole class activities, 28 percent on small group work, and 22 percent on students working individually. Non-instructional activities, including attendance taking and interruptions, account for 11 percent of mathematics class time.

Table 32
Average Percentage of Time Spent on Different Activities in the Most Recent Middle School Mathematics Lesson

	AVERAGE PERCENT OF CLASS TIME
Whole class activities (e.g., lectures, explanations, discussions)	39 (0.8)
Small group work	28 (1.0)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	22 (0.7)
Non-instructional activities (e.g., attendance taking, interruptions)	11 (0.3)

Homework and Assessment Practices

Teachers were asked about the amount of homework assigned per week in the randomly selected class. As can be seen in Table 33, most assign 60 minutes or less of homework each week.

Table 33
Amount of Homework Assigned in Middle School Mathematics Classes Per Week

	PERCENT OF CLASSES
None	5 (1.5)
1–15 minutes per week	7 (1.3)
16–30 minutes per week	16 (2.1)
31–60 minutes per week	34 (2.4)
61–90 minutes per week	21 (2.2)
91–120 minutes per week	13 (2.0)
More than 2 hours per week	4 (1.3)

The survey also asked how often students in the randomly selected class were required to take assessments the teachers did not develop, such as state or district benchmark assessments. Almost all middle school mathematics classes are required to take such an assessment at least once a year, and more than three-fourths of classes are required to take three or more such tests a year (see Table 34).

Table 34
Frequency of Required External Testing in Middle School Mathematics Classes

	PERCENT OF CLASSES
Never	1 (0.4)
Once a year	12 (2.1)
Twice a year	11 (1.6)
Three or four times a year	43 (2.7)
Five or more times a year	33 (2.7)

Resources Available for Middle School Mathematics

The quality and availability of instructional resources is a major factor in mathematics teaching. The 2018 NSSME+ included a series of items on instructional materials—which ones teachers use and how teachers use them, as well as their perceptions of the adequacy of resources available for instruction.

Instructional Materials

The 2018 NSSME+ collected data on the use of various instructional materials, including commercially published textbooks or programs, both print and electronic. Of particular interest is how much latitude teachers have in selecting instructional resources. Table 35 shows that for 80 percent of middle school mathematics classes, instructional materials are designated by the district. Of the classes that have designated materials, a vast majority have a commercially published textbook as the designated material. State-, county-, or district-developed materials; online units or courses that students work through at their own pace; and lessons from free websites are each designated in about a third of these classes.

Table 35
Middle School Mathematics Classes for Which Various Types of Instructional Materials Are Designated

	PERCENT OF CLASSES
District Designates Instructional Materials	
No	20 (2.2)
Yes	80 (2.2)
Types of Designated Instructional Materials†	
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	88 (1.9)
State, county, district, or diocese-developed units or lessons	37 (2.5)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	33 (2.9)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	30 (2.5)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	22 (2.0)

† Only middle school mathematics classes for which instructional materials are designated by the state, district, or diocese are included in these analyses.

Regardless of whether instructional materials had been designated for their class, teachers were asked how often instruction was based on various types of materials. Commercially published textbooks and units or lessons created by the teacher are the most common basis for instruction, each used by two-thirds of classes at least once a week (see Table 36).

Table 36
Middle School Mathematics Classes Basing Instruction on Various Instructional Resources at Least Once a Week

	PERCENT OF CLASSES
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	65 (2.5)
Units or lessons you created (either by yourself or with others)	65 (2.5)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	39 (2.4)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	34 (2.4)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	31 (1.9)
State, county, district, or diocese-developed units or lessons	26 (1.9)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	24 (1.9)

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. Table 37 lists the most commonly used mathematics textbooks for each middle school mathematics course type.

Table 37
Most Commonly Used Middle School Mathematics Textbooks, by Course

COURSE	PUBLISHER	TITLE
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*

Table 38 shows the publication year of commercially published instructional materials used. Two-thirds of classes use materials published since 2013; the remainder use materials published prior to 2013.

Table 38
Publication Year of Textbooks/Programs Used in Middle School Mathematics Classes

	PERCENT OF CLASSES†
2009 or earlier	15 (2.5)
2010–2012	21 (2.7)
2013–2015	51 (3.0)
2016–2018	13 (2.5)

† Only middle school mathematics classes using commercially published textbooks/programs are included in these analyses.

The survey also asked teachers whether their most recent unit was based on a textbook or state/district-developed materials. If so, they were then asked to describe how they used these materials. As can be seen in Table 39, 70 percent of middle school mathematics classes based their most recent lesson on a commercially published textbook or material developed by the district/state. In a large majority of these classes, teachers used the materials to guide the structure and content emphasis of their units. Still, in more than half of classes, teachers incorporate materials from other sources, modify activities, and pick what is important from the materials (skipping the rest).

Table 39
Middle School Mathematics Teachers' Use of Instructional Materials in Most Recent Unit

	PERCENT OF CLASSES
Most Recent Unit Based on Commercially Published or State/District-Developed Material	
No	30 (2.3)
Yes	70 (2.3)
Ways Textbook is Substantially† Used‡	
I used these materials to guide the structure and content emphasis of the unit.	82 (1.9)
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	65 (3.1)
I modified activities from these materials.	62 (2.9)
I picked what is important from these materials and skipped the rest.	52 (2.8)

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

‡ Only middle school mathematics classes in which the most recent unit was based on commercially published or state/district-developed materials are included in these analyses.

When teachers reported skipping activities, they were asked why. As can be seen in Table 40, teachers in 80 percent of these classes skip activities because they have other ones that they think work better. In just over 70 percent of these classes, teachers skip activities because the ideas are not in their pacing guides/state standards or they do not have the instructional time for the activities.

Table 40
Reasons Why Parts of Middle School Mathematics Materials Are Skipped

	PERCENT OF CLASSES†
I have different activities for those mathematical ideas that work better than the ones I skipped.	80 (2.5)
The mathematical ideas addressed in the activities I skipped are not included in my pacing guide/ standards.	72 (3.1)
I did not have enough instructional time for the activities I skipped.	71 (3.1)
My students already knew the mathematical ideas or were able to learn them without the activities I skipped.	59 (3.5)
The activities I skipped were too difficult for my students.	44 (3.6)
I did not have the materials needed to implement the activities I skipped.	27 (3.0)
I did not have the knowledge needed to implement the activities I skipped.	11 (2.4)

† Only middle school mathematics classes in which (1) the most recent unit was based on commercially published or state/district-developed materials and (2) teachers reported skipping some activities are included in these analyses.

Given that teachers often skip activities in their materials because they know of better ones, it is perhaps not surprising that teachers in almost two-thirds of middle school mathematics classes supplement their materials. Of the middle school mathematics classes in which teachers supplement their textbook/program, nearly all do so to help students at different levels of achievement learn targeted ideas and to provide students with additional practice (see Table 41). In 85 percent of classes, teachers supplement with activities they prefer, and in 72 percent of classes, teachers supplement to prepare students for standardized tests.

Table 41
Reasons Why Middle School Mathematics Materials Are Supplemented

	PERCENT OF CLASSES†
Supplemental activities were needed so students at different levels of achievement could increase their understanding of the ideas targeted in each activity.	97 (1.0)
Supplemental activities were needed to provide students with additional practice.	94 (1.3)
I had additional activities that I liked.	85 (2.3)
Supplemental activities were needed to prepare students for standardized tests.	72 (3.4)
My pacing guide indicated that I should use supplemental activities.	37 (3.7)

† Only middle school mathematics classes in which (1) the most recent unit was based on commercially published or state/district-developed materials and (2) teachers reported supplementing some activities are included in these analyses.

When teachers reported that they modified their published material, they rated each of several factors that may have contributed to their decision (see Table 42). In over two-thirds of these middle school mathematics classes, teachers modify activities because they do not have enough instructional time to implement activities as designed, and in over half of them, because the original activities were too difficult for students.

Table 42
Reasons Why Middle School Mathematics Materials Are Modified

	PERCENT OF CLASSES†
I did not have enough instructional time to implement the activities as designed.	68 (2.7)
The original activities were too difficult conceptually for my students.	55 (3.2)
The original activities were too easy conceptually for my students.	44 (3.2)
The original activities were not structured enough for my students.	39 (3.1)
The original activities were too structured for my students.	35 (3.2)
I did not have the necessary materials/supplies for the original activities.	29 (3.0)

† Only middle school mathematics classes in which (1) the most recent unit was based on commercially published or state/district-developed materials and (2) teachers reported modifying some activities are included in these analyses.

Other Middle School Mathematics Instructional Resources

When asked about the adequacy of resources for instruction, teachers in the majority of middle school mathematics classes appear satisfied with their access to measurement tools, instructional technology, consumable supplies, and manipulatives (see Table 43). However, access to manipulatives is less likely to be considered adequate than access to the other resources.

Table 43
Adequacy† of Resources for Middle School Mathematics Instruction

	PERCENT OF CLASSES
Measurement tools (e.g., protractors, rulers)	82 (2.1)
Instructional technology (e.g., calculators, computers, probes/sensors)	79 (2.3)
Consumable supplies (e.g., graphing paper, batteries)	75 (2.4)
Manipulatives (e.g., pattern blocks, algebra tiles)	63 (2.8)

† Includes middle school 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 44, perceptions of the adequacy of resources are fairly high in middle school mathematics classes and similar across course types.

Table 44
Middle School Mathematics Class Mean Scores for the Adequacy of Resources for Instruction Composite

	MEAN SCORE
Overall	80 (1.0)
Remedial	74 (4.3)
Regular	80 (1.0)
Accelerated, including Pre-Algebra and Algebra 1	82 (2.2)

Factors Affecting Middle School Mathematics Instruction

Although the primary focus of the 2018 NSSME+ was on teachers and teaching, the study also collected information on the context of classroom practice. The survey included items asking teachers about the extent various factors promote or inhibit instruction in their randomly selected class.

Principal support, amount of time for planning, and current state standards are seen as promoting effective instruction in a large majority of middle school mathematics classes (see Table 45). Students' prior knowledge and skills, motivation, interest, and effort in mathematics, as well as parent/guardian expectations and involvement, are seen as inhibiting effective instruction in more than a quarter of middle school mathematics classes.

Table 45
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)

† Middle school mathematics 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.

These items were combined into three composite variables to summarize the extent to which various factors support effective mathematics instruction. The Extent to Which School Support Promotes Effective Instruction composite consists of the following items:

- Amount of time for you to plan, individually and with colleagues; and
- Amount of time available for your professional development.

The Extent to Which the Policy Environment Promotes Effective Instruction composite includes:

- Current state standards;
- District/Diocese/School pacing guides;
- Teacher evaluation policies;
- State/district/diocese testing/accountability policies; and
- Textbook selection policies.

Items for the Extent to Which Stakeholders Promote Effective Instruction composite are:

- Students' prior knowledge and skills;
- Students' motivation, interest, and effort in mathematics; and
- Parent/guardian expectations and involvement.

The mean scores for these composites are shown in Table 46. Overall, these data indicate that the climate is somewhat supportive for middle school mathematics instruction and does not vary substantially by the level of mathematics course.

Table 46
Middle School Mathematics Class Mean Scores for Factors Affecting Instruction Composites

	MEAN SCORE		
	EXTENT TO WHICH SCHOOL SUPPORT PROMOTES EFFECTIVE INSTRUCTION	EXTENT TO WHICH THE POLICY ENVIRONMENT PROMOTES EFFECTIVE INSTRUCTION	EXTENT TO WHICH STAKEHOLDERS PROMOTE EFFECTIVE INSTRUCTION
Overall	71 (1.4)	63 (1.2)	61 (1.8)
Remedial	72 (2.8)	65 (3.3)	61 (4.3)
Regular	72 (2.1)	63 (1.5)	58 (2.5)
Accelerated, including Pre-Algebra and Algebra 1	69 (1.8)	61 (2.3)	66 (2.6)

Summary

The overwhelming majority of middle school mathematics teachers are white, and 70 percent are female. About a third are in their first five years teaching mathematics. Almost half have a degree in mathematics or mathematics education, and more than half have had college courses in all or nearly all of areas of mathematics that NCTM recommends for middle school mathematics teachers. Middle school mathematics teachers generally feel well prepared to teach mathematics topics at the middle school level.

In terms of pedagogical preparedness, about half of middle school mathematics teachers feel very well prepared to use formative assessment, develop students' abilities to do mathematics, develop students' conceptual understanding, and encourage participation of all students in mathematics. Many fewer feel very well prepared to encourage students' interest in mathematics, differentiate instruction, or incorporate students' ideas and cultural backgrounds into instruction. In addition, data on middle school mathematics teachers' beliefs about effective teaching show a dichotomy. Although they hold a number of beliefs about teaching and learning that are in alignment with what is known about effective mathematics instruction (e.g., teachers should ask students to justify their mathematical thinking, students should learn mathematics by doing mathematics), they also hold views that are inconsistent with this research. For example, roughly 8 in 10 believe that students should be provided with definitions for new vocabulary at the beginning of instruction on an idea.

When asked about their professional development experiences, the vast majority of middle school mathematics teachers have participated in mathematics-focused professional development in the last three years. However, just over one-third have had sustained professional development (more than 35 hours) in that time period. In addition, although most middle school mathematics teachers have had opportunities to work closely with other mathematics teachers as part of their professional development in the last three years, fewer than half have had substantial opportunities to examine classroom artifacts or engage in mathematics investigations.

Data on middle school mathematics courses show that about three-fourths of middle schools have at least some students completing Algebra 1 prior to 9th grade, but only one-fourth of schools have any students completing Geometry. Data suggest that many middle school mathematics classes are tracked, with students assigned to them based on their prior achievement level. Further, despite constituting about half of the student population, students from

race/ethnicity groups historically underrepresented in STEM fields make up only about a third of the enrollment in accelerated middle school mathematics classes.

In terms of instruction, middle school mathematics classes rely heavily on lecture and discussion, with students often working in small groups and completing textbook/worksheet problems. The data also indicate that students engage in mathematical practices like determining whether their answer makes sense and providing mathematical reasoning to explain, justify, or prove their thinking fairly regularly.

Commercially published textbooks and teacher-developed lessons are the most commonly used instructional materials in middle school mathematics, each being the basis of instruction at least once a week in two-thirds of classes. In classes using textbooks, more than a third are using ones published prior to 2013. Further, when teachers use textbooks, they often modify the materials, supplementing and skipping elements for a variety of reasons. In terms of other resources for instruction, teachers in a majority of middle school mathematics classes think their instructional resources (i.e., manipulatives, measurement tools, instructional technology, and consumable supplies) are adequate.