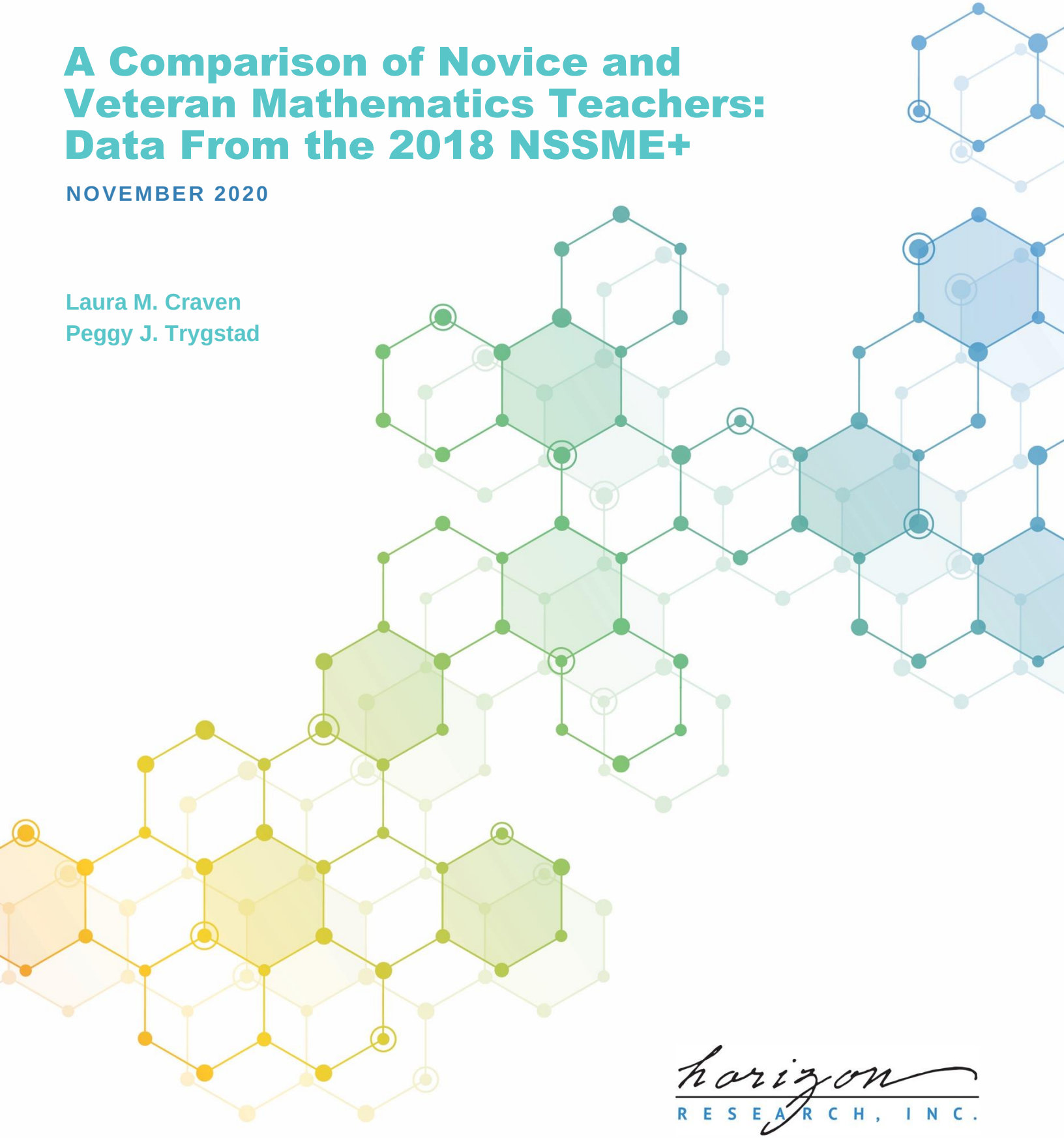
NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

A Comparison of Novice and Veteran Mathematics Teachers: Data From the 2018 NSSME+

NOVEMBER 2020

Laura M. Craven
Peggy J. Trygstad



Horizon RESEARCH, INC.

Disclaimer

A Comparison of Novice and Veteran Mathematics Teachers: Data From the 2018 NSSME+ 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. & Trygstad, P. J. (2020). *A Comparison of Novice and Veteran Mathematics Teachers: Data from the 2108 NSSME+*. 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

LIST OF TABLES

Page

School Contexts

Teacher Characteristics

Teacher Preparation

Teacher Beliefs and Perceptions of Preparedness

Instruction

CHAPTER 1

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 were:

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+ was 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 novice[1] and veteran mathematics teachers in the United States, with particular emphasis on the similarities and differences between these two groups. Although the focus of the 2018 NSSME+ was not on novice teachers, the dataset contains 863 teachers who reported being in their first five years of teaching mathematics, including 235 elementary grades teachers (defined as teaching any grade K–5 or teaching a self-contained 6th grade class), 285 middle grades teachers (teaching 6th grade non-self-contained or grades 7–8), and 343 high school teachers (grades 9–12). Because of the sample design and the use of design weights in analysis, results of the 2018 NSSME+ are nationally representative. Consequently, the results presented in this report should be interpreted as indicative of all novice and veteran mathematics teachers, not just those who participated in the study. The standard errors for the estimates presented in this report are included in parentheses in the tables. 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]

This report is divided into five main topic areas. Chapter 2 provides data about the school contexts in which teachers worked. Chapter 3 highlights characteristics of teachers themselves, including sex, race/ethnicity, age, and experience. The fourth chapter describes preparation for teaching mathematics, including college degrees, college-level mathematics coursework, and professional development experiences. Chapter 5 provides data about teachers' beliefs about teaching and learning and perceptions of preparedness to teach mathematics. The sixth chapter describes the nature of instruction in teachers' classrooms, including objectives for instruction, instructional strategies used, and availability of resources. The report concludes with a summary.

[1] For this report, novices are defined as teachers in their first five years of teaching mathematics.

[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., and Hayes, M. L. (2018). Report of the 2018 NSSME+. Horizon Research, Inc.

School Contexts

Although the focus of this report is on teachers and their mathematics instruction, the 2018 NSSME+ provided some information about the school contexts in which teachers worked, including factors that promote effective mathematics instruction and those that may get in the way. The data in this chapter come from a mathematics program questionnaire, a school-level survey that was completed by individuals familiar with their school's mathematics department (e.g., a lead teacher or department chair). Most tables in this chapter show the percentages of novices and veterans who worked in schools with various characteristics (e.g., the percentage of novice and veteran mathematics teachers who worked in rural, urban, and suburban schools). In these instances, the comparisons made are still between the two groups of teachers and should be interpreted as the relative likelihood of a teacher working in a school with a particular characteristic.

Table 1 shows the percentages of novice and veteran mathematics teachers who worked in schools with various characteristics. The distribution of school type (Catholic schools, non-Catholic private schools, and public schools) was roughly the same for novices as it was for veterans, with the vast majority working in public schools. Further, there was no difference in the distribution of teachers based on the percentage of students in school eligible for free or reduced-price lunch (FRL). However, looking at the distribution of novices and veterans among urban, suburban, and rural school settings, novice mathematics teachers appear to be more likely than veteran mathematics teachers to teach in urban schools and less likely to teach in suburban schools.

Table 1
School Characteristics

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
School Type		
Catholic	4 (1.0)	3 (0.5)
Non-Catholic Private	8 (1.5)	4 (0.7)
Public	88 (1.6)	92 (0..9)
Community Type*		
Rural	17 (1.6)	19 (1.1)
Suburban	48 (2.5)	53 (1.7)
Urban	35 (2.5)	28 (1.5)
Percent of Students in School Eligible for FRL		
Lowest Quartile	23 (3.1)	28 (2.4)
Second Quartile	23 (3.4)	24 (2.3)
Third Quartile	26 (3.4)	24 (2.3)
Highest Quartile	27 (3.2)	24 (2.4)

* There is a statistically significant difference in the distribution of responses between schools in which novice and veteran teachers tended to work (Chi-square test of independence, $p < 0.05$).

Another characteristic of schools is the amount of money spent per pupil on instructional resources for mathematics (including consumable supplies, non-consumable supplies, and

software) in a given year. As can be seen in Table 2, there are no significant differences in spending per pupil between schools where novices and veterans tended to work.

Table 2
School Spending Per Pupil†

	MEDIAN AMOUNT	
	NOVICE	VETERAN
Elementary	$4.98 (1.9)	$7.08 (1.4)
Middle	$3.49 (0.7)	$3.31 (0.6)
High	$2.78 (0.7)	$2.50 (0.2)

† There are no statistically significant differences between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p \geq 0.05$).

State standards can also influence school practices and affect mathematics instruction. As can be seen in Table 3, large percentages of novices and veterans across grade bands worked in schools where most teachers teach to their state mathematics standards, participate in school-wide efforts to align mathematics instruction with state mathematics standards, and discuss state mathematics standards with other mathematics teachers in their schools. There are no significant differences between schools where novices and veterans tended to work.

Table 3
Influence[a] of State Mathematics Standards in Schools[†]

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Most mathematics teachers in this school teach to the state standards.	93 (2.2)	94 (1.6)
There is a school-wide effort to align mathematics instruction with the state mathematics standards.	92 (2.6)	92 (1.8)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.	86 (3.6)	89 (2.4)
The school/district/diocese organizes mathematics professional development based on state standards.	81 (3.4)	83 (2.5)
Middle		
Most mathematics teachers in this school teach to the state standards.	94 (2.6)	96 (1.0)
There is a school-wide effort to align mathematics instruction with the state mathematics standards.	95 (2.5)	93 (2.1)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.	93 (2.7)	93 (2.1)
The school/district/diocese organizes mathematics professional development based on state standards.	72 (5.8)	79 (3.0)
High		
Most mathematics teachers in this school teach to the state standards.	87 (3.1)	91 (1.5)
There is a school-wide effort to align mathematics instruction with the state mathematics standards.	88 (2.8)	90 (1.7)
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.	90 (2.6)	88 (1.9)
The school/district/diocese organizes mathematics professional development based on state standards.	62 (4.4)	66 (2.6)

† There are no statistically significant differences between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p \geq 0.05$).

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

By combining these items into a composite variable, an overview of the influence of standards in schools can be seen. The mean scores for all grade bands indicate that teachers generally worked in schools where state mathematics standards wielded a great deal of influence (see Table 4). There are no significant differences on this outcome at any of the grade bands.

Table 4
Mean Scores for School Focus on State Mathematics Standards Composite[†]

	MEAN SCORE	
	NOVICE	VETERAN
Elementary	82 (1.8)	84 (1.3)
Middle	84 (2.2)	85 (1.2)
High	80 (1.8)	79 (1.2)

† There are no statistically significant differences between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p \geq 0.05$).

Several other school-level factors can also affect mathematics instruction. As can be seen in Table 5, novices and veterans at all three grade bands tended to work in schools where the

importance that the school places on mathematics, mathematics professional development policies and practices, and how mathematics instructional resources are managed promoted effective mathematics instruction. However, at the high school level, novices were less likely than veterans to work in schools where the amount of time provided for professional development in mathematics promoted effective mathematics instruction (43 vs. 53 percent). There are no differences on these factors at the elementary or middle school grade levels.

Table 5
Factors Promoting[a] Effective Mathematics Instruction

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
The importance that the school places on mathematics	76 (3.8)	79 (2.9)
The school/district/diocese mathematics professional development policies and practices	71 (4.2)	75 (3.0)
How mathematics instructional resources are managed (e.g., distributing and replacing materials)	58 (5.4)	64 (3.2)
The amount of time provided by the school/district/diocese for teacher professional development in mathematics	53 (5.0)	58 (3.8)
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction	51 (5.3)	54 (3.4)
Other school and/or district/diocese initiatives	50 (5.1)	53 (3.4)
Middle		
The importance that the school places on mathematics	78 (4.9)	80 (2.8)
The school/district/diocese mathematics professional development policies and practices	72 (6.0)	67 (3.7)
How mathematics instructional resources are managed (e.g., distributing and replacing materials)	55 (5.2)	48 (3.5)
The amount of time provided by the school/district/diocese for teacher professional development in mathematics	47 (5.7)	49 (4.4)
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction	62 (5.4)	54 (3.3)
Other school and/or district/diocese initiatives	45 (5.3)	46 (3.7)
High		
The importance that the school places on mathematics	76 (4.2)	76 (2.1)
The school/district/diocese mathematics professional development policies and practices	61 (4.8)	64 (2.6)
How mathematics instructional resources are managed (e.g., distributing and replacing materials)	59 (5.4)	61 (2.9)
The amount of time provided by the school/district/diocese for teacher professional development in mathematics*	43 (4.3)	53 (2.9)
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction	55 (5.2)	55 (3.2)
Other school and/or district/diocese initiatives	33 (3.7)	39 (2.3)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

[a] Includes schools that indicated 4 or 5 on a five-point scale ranging from 1 "inhibits effective instruction" to 5 "promotes effective instruction."

These items were combined into a composite variable to look at the effects of these factors on mathematics instruction more holistically (see Table 6). The modest mean scores (ranging from 65 to 71) suggest that novice and veteran teachers alike work in schools where the context was only moderately supportive of mathematics instruction.

Table 6
Mean Scores for School
Supportive Context for Mathematics Instruction Composite†

	MEAN SCORE	
	NOVICE	VETERAN
Elementary	68 (2.1)	71 (1.3)
Middle	68 (2.5)	66 (1.5)
High	65 (1.9)	66 (1.1)

† There are no statistically significant differences between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p \geq 0.05$).

Teacher issues (e.g., lack of interest, high turnover), student issues (e.g., low prior knowledge and skills, high absenteeism), and lack of resources (e.g., mathematics equipment, textbooks) are also school-level factors that can affect mathematics instruction. At the elementary level, some of these factors were problematic in schools where novices and veterans tended to work (see Table 7). More than half of all teachers were likely to work in schools where low student prior knowledge and skills, lack of parent/guardian support and involvement, and low student interest in mathematics were problematic. However, novice elementary teachers faced additional challenges. Novices were more likely than veterans to work in schools where low student prior knowledge and skills (77 vs. 66 percent), lack of parent/guardian support and involvement (70 vs. 58 percent), inappropriate student behavior (60 vs. 44 percent), large class sizes (55 vs. 41 percent), and high teacher turnover (39 vs. 24 percent) were problematic.

Table 7
Factors Reported by Schools as Problematic[a] for Elementary Mathematics Instruction

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Low student prior knowledge and skills*	77 (4.1)	66 (3.6)
Lack of parent/guardian support and involvement*	70 (3.4)	58 (3.8)
Low student interest in mathematics	61 (5.0)	53 (3.9)
Inappropriate student behavior*	60 (4.8)	44 (3.7)
Inadequate mathematics-related professional development opportunities	58 (4.4)	50 (4.0)
Inadequate materials for differentiating mathematics instruction	57 (4.7)	50 (3.8)
Large class sizes*	55 (5.3)	41 (4.2)
High student absenteeism	52 (5.2)	44 (3.7)
Community attitudes toward mathematics instruction	43 (4.9)	38 (3.9)
Insufficient instructional time to teach mathematics	42 (4.8)	37 (3.6)
Inadequate teacher preparation to teach mathematics	40 (5.5)	45 (3.8)
High teacher turnover*	39 (4.7)	24 (2.8)
Poor quality mathematics textbooks	32 (4.5)	27 (3.5)
Inadequate funds for purchasing mathematics equipment and supplies	31 (4.0)	30 (3.3)
Lack of teacher interest in mathematics	31 (4.7)	28 (3.5)
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 (5.0)	22 (2.8)
Lack of mathematics textbooks	21 (4.4)	17 (2.6)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

[a] Includes schools that indicated 2 or 3 on a three-point scale ranging from 1 "not a significant problem" to 3 "serious problem."

Three composite variables were created from these items: Extent to Which Student Issues are Problematic, Extent to Which Teacher Issues are Problematic, and Extent to Which a Lack of Resources is Problematic. The mean scores indicate that teacher issues and lack of resources were equally problematic at the elementary level in schools where novices and veterans tended to work (see Table 8). Student issues were more pronounced in schools where novice mathematics teachers tended to work than in those where veterans tended to work (mean scores of 38 vs. 31).

Table 8
Mean Scores for School Factors Affecting Elementary Mathematics Instruction Composites

	MEAN SCORE	
	NOVICE	VETERAN
Extent to Which Student Issues are Problematic*	38 (2.1)	31 (1.9)
Extent to Which Teacher Issues are Problematic	24 (2.2)	22 (1.4)
Extent to Which a Lack of Resources is Problematic	20 (1.9)	18 (1.5)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

At the middle and high school grade bands, several factors stand out as problematic in schools where novices and veterans worked. For example, low student prior knowledge and skills, low student interest, lack of parent/guardian support and involvement, and high student absenteeism were problematic at a majority of schools (see Tables 9 and 10).

A few factors were more likely to be problematic in schools where novice secondary teachers tended to work compared to schools where their veteran counterparts tended to work. At the middle school level, novices were more likely than veterans to work in schools where inadequate teacher preparation to teach mathematics was problematic (45 vs. 27 percent). At the high school level, novices were more likely than veterans to work in schools where low student prior knowledge and skills (87 vs. 80 percent) and inappropriate student behavior (55 vs. 44 percent) were problematic. And at both the middle school and high school grade bands, novices were more likely than veterans to work in schools where high teacher turnover was problematic (53 vs. 31 percent and 41 vs. 30 percent, respectively).

Table 9
Factors Reported by Schools as Problematic[a] for Middle School Mathematics Instruction

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Low student prior knowledge and skills	79 (4.4)	81 (2.4)
Low student interest in mathematics	75 (5.9)	72 (3.0)
Lack of parent/guardian support and involvement	71 (4.8)	72 (3.1)
High student absenteeism	63 (6.0)	58 (3.2)
Inappropriate student behavior	61 (5.8)	58 (3.5)
Large class sizes	56 (4.8)	56 (3.5)
Inadequate materials for differentiating mathematics instruction	54 (5.0)	51 (3.6)
High teacher turnover*	53 (5.7)	31 (3.0)
Inadequate mathematics-related professional development opportunities	48 (5.7)	51 (4.0)
Community attitudes toward mathematics instruction	47 (5.7)	51 (3.9)
Inadequate teacher preparation to teach mathematics*	45 (5.7)	27 (3.1)
Inadequate funds for purchasing mathematics equipment and supplies	39 (5.7)	36 (3.7)
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)	39 (5.2)	31 (3.3)
Insufficient instructional time to teach mathematics	36 (5.4)	46 (3.9)
Poor quality mathematics textbooks	33 (4.8)	37 (3.6)
Lack of teacher interest in mathematics	25 (5.3)	17 (2.8)
Lack of mathematics textbooks	21 (4.2)	23 (3.1)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

[a] Includes schools that indicated 2 or 3 on a three-point scale ranging from 1 "not a significant problem" to 3 "serious problem."

Table 10
Factors Reported by Schools as Problematic[a] for High School Mathematics Instruction

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Low student prior knowledge and skills*	87 (2.7)	80 (2.6)
Low student interest in mathematics*	84 (2.8)	78 (2.1)
Lack of parent/guardian support and involvement	71 (4.3)	63 (2.7)
High student absenteeism	64 (4.8)	56 (2.8)
Inappropriate student behavior*	55 (5.2)	44 (2.8)
Inadequate mathematics-related professional development opportunities	53 (4.7)	52 (2.8)
Community attitudes toward mathematics instruction	53 (4.6)	48 (2.6)
Large class sizes	51 (5.3)	56 (3.2)
Inadequate materials for differentiating mathematics instruction	50 (5.6)	51 (2.8)
Insufficient instructional time to teach mathematics	47 (5.5)	42 (2.9)
High teacher turnover*	41 (5.3)	30 (2.6)
Inadequate funds for purchasing mathematics equipment and supplies	38 (5.2)	41 (2.5)
Poor quality mathematics textbooks	36 (5.2)	41 (2.7)
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)	32 (4.7)	32 (2.7)
Lack of mathematics textbooks	28 (4.2)	31 (2.5)
Inadequate teacher preparation to teach mathematics	28 (5.9)	19 (2.3)
Lack of teacher interest in mathematics	14 (3.6)	13 (1.8)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

[a] Includes schools that indicated 2 or 3 on a three-point scale ranging from 1 "not a significant problem" to 3 "serious problem."

On the three composite variables created from these items, the modest mean scores suggest that student issues, teacher issues, and lack of resources did not affect instruction to a great extent at the middle or high school levels (see Table 11). Teacher issues and lack of resources were equally problematic at the secondary level in schools where novices and veterans tended to work. However, student issues were more pronounced in high schools where novice mathematics teachers tended to work than in those where veterans tended to work (mean scores of 48 vs. 40).

Table 11
Mean Scores for School Factors Affecting Secondary School Mathematics Instruction Composites

	MEAN SCORE	
	NOVICE	VETERAN
Middle		
Extent to Which Student Issues are Problematic	45 (3.7)	43 (1.9)
Extent to Which Teacher Issues are Problematic	24 (2.9)	20 (1.2)
Extent to Which a Lack of Resources is Problematic	22 (2.4)	22 (1.5)
High		
Extent to Which Student Issues are Problematic*	48 (3.6)	40 (1.5)
Extent to Which Teacher Issues are Problematic	21 (1.8)	18 (1.0)
Extent to Which a Lack of Resources is Problematic	22 (2.5)	24 (1.4)

* There is a statistically significant difference between schools in which novice and veteran teachers tended to work (two-tailed independent samples t-test, $p < 0.05$).

Another characteristic of schools that is particularly important for novices is the availability of induction programs. As can be seen in

Table 12, three-quarters or more of novice teachers at each grade band worked in schools with induction programs, ranging in duration from less than one year to more than three years.

Table 12
Duration of School Induction Program, by Grade Range

	PERCENT OF NOVICE TEACHERS		
	ELEMENTARY	MIDDLE	HIGH
School offers no formal induction program	22 (4.0)	20 (4.0)	22 (5.4)
School offers an induction program of one year or less	43 (4.8)	33 (4.6)	34 (4.6)
School offers an induction program of two years	21 (3.7)	33 (4.4)	25 (3.7)
School offers an induction program of three or more years	15 (2.9)	14 (2.9)	19 (4.2)

Within these induction programs, a number of supports were very common across grade bands. These supports included meetings to orient new teachers to school/district/diocese policies and practices, formally assigned school-based mentors, professional development opportunities on teaching in their subject, release time to observe other teachers in their grade/subject area, and common planning time with experienced teachers who teach the same subject or grade level (see Table 13).

Table 13
Supports Provided by Schools as Part of Formal Induction Programs, by Grade Range

	PERCENT OF NOVICE TEACHERS[a]		
	ELEMENTARY	MIDDLE	HIGH
A meeting to orient them to school/district/diocese policies and practices	90 (3.0)	88 (5.6)	94 (2.0)
Formally assigned school-based mentor teachers	82 (3.8)	84 (3.8)	85 (4.5)
Professional development opportunities on teaching their subject	47 (4.3)	88 (2.7)	76 (4.4)
Release time to observe other teachers in their grade/subject area	73 (4.6)	75 (4.5)	63 (3.8)
Common planning time with experienced teachers who teach the same subject or grade level	82 (3.9)	77 (5.7)	62 (4.6)
Professional development opportunities on providing instruction that meets the needs of students from the cultural backgrounds represented in your school	82 (4.0)	52 (5.8)	58 (4.2)
Release time to attend national, state, or local teacher conferences	35 (4.0)	42 (6.0)	45 (4.5)
Financial support to attend national, state, or local teacher conferences	21 (4.5)	22 (4.6)	35 (4.7)
Supplemental funding for classroom supplies	29 (5.8)	39 (5.4)	25 (3.1)
District/diocese-based or university-based mentors	28 (3.8)	32 (5.1)	25 (3.8)
Classroom aides/teaching assistants	17 (4.1)	15 (3.5)	14 (2.8)
Reduced number of teaching preps	0 (0.2)	13 (5.2)	14 (3.3)
Reduced course load	0 (0.2)	3 (2.0)	2 (0.9)
Reduced class size	1 (0.6)	1 (0.6)	1 (0.8)

[a] Includes only those schools that provide a formal induction program.

Teacher Characteristics

The 2018 NSSME+ provided information about the demographic characteristics of mathematics teachers. As can be seen in Table 14, large percentages of novices and veterans, across all three grade bands, were female. This pattern is particularly striking in the elementary level, where over 90 percent of novices and veterans were female.

Table 14
Teacher Sex†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Female	95 (1.5)	94 (1.2)
Male	5 (1.4)	6 (1.2)
Other	0 (0.4)	0 ---[a]
Middle		
Female	63 (4.5)	73 (2.6)
Male	37 (4.5)	27 (2.6)
Other	0 ---[a]	0 ---[a]
High		
Female	61 (4.4)	59 (1.5)
Male	39 (4.4)	41 (1.5)
Other	0 ---[a]	0 (0.1)

† There are no statistically significant differences in the distributions of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

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

Not surprisingly, novice mathematics teachers tend to be younger than veterans. As can be seen in Table 15, the modal age of novice teachers at each grade range was less than or equal to 30 years of age.

Table 15
Teacher Age

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary*		
≤ 30	63 (3.8)	5 (0.9)
31–40	21 (2.7)	30 (2.4)
41–50	9 (1.9)	37 (2.5)
51–60	7 (1.9)	22 (1.9)
61+	0 (0.4)	6 (0.9)
Middle*		
≤ 30	46 (4.9)	4 (0.9)
31–40	31 (4.7)	32 (2.3)
41–50	14 (2.9)	36 (2.9)
51–60	6 (1.4)	24 (2.5)
61+	3 (1.8)	5 (0.8)
High*		
≤ 30	61 (4.7)	6 (0.8)
31–40	25 (4.6)	28 (1.3)
41–50	9 (3.2)	34 (1.6)
51–60	4 (1.2)	25 (1.4)
61+	2 (1.1)	8 (0.9)

* There is a statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

In 2018, individuals from race/ethnicity groups historically underrepresented in the teaching profession continued to be underrepresented in mathematics classrooms. As can be seen in Table 16, approximately 90 percent of novice and veteran mathematics teachers at each grade band characterized themselves as white.

Table 16
Teacher Race/Ethnicity†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
White	90 (2.5)	90 (1.4)
Hispanic/Latino	9 (1.9)	9 (1.6)
Black or African American	7 (1.9)	6 (1.2)
Asian	3 (1.4)	2 (0.7)
American Indian or Alaskan Native	1 (0.6)	2 (0.7)
Native Hawaiian or Other Pacific Islander	1 (0.6)	0 (0.3)
Middle		
White	87 (2.9)	90 (1.6)
Hispanic/Latino	14 (4.7)	5 (1.2)
Black or African American	9 (2.1)	8 (1.4)
Asian	6 (2.1)	2 (0.5)
American Indian or Alaskan Native	2 (1.3)	1 (0.5)
Native Hawaiian or Other Pacific Islander	1 (0.5)	1 (1.1)
High		
White	90 (2.0)	92 (0.9)
Hispanic/Latino	8 (1.9)	7 (1.2)
Black or African American	5 (1.5)	5 (0.7)
Asian	6 (1.3)	4 (0.6)
American Indian or Alaskan Native	1 (0.4)	2 (0.4)
Native Hawaiian or Other Pacific Islander	1 (1.1)	0 (0.2)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Many novice mathematics teachers were new to the teaching profession in general, not just mathematics. As can be seen in Table 17, a large majority of novices at each grade range had five or fewer years' experience teaching any subject at the K–12 level.

Table 17
Experience Teaching Any Subject at the K–12 Level

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary*		
0–2 years	47 (3.6)	0 ---[a]
3–5 years	49 (3.7)	6 (1.0)
6–10 years	3 (1.2)	22 (1.7)
11–20 years	2 (0.8)	46 (2.2)
≥ 21 years	1 (0.5)	26 (2.4)
Middle*		
0–2 years	41 (4.7)	0 ---[a]
3–5 years	45 (4.8)	3 (0.7)
6–10 years	9 (2.6)	26 (2.7)
11–20 years	4 (1.6)	50 (3.0)
≥ 21 years	1 (0.8)	21 (2.4)
High*		
0–2 years	37 (3.9)	0 ---[a]
3–5 years	60 (4.0)	5 (1.0)
6–10 years	2 (0.7)	22 (1.5)
11–20 years	1 (0.2)	44 (1.8)
≥ 21 years	0 (0.4)	28 (1.8)

* There is a statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

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

Teacher Preparation

The extent and nature of teacher preparation can greatly influence the quality of mathematics instruction. Thus, the 2018 NSSME+ collected data on a number of indicators of teacher preparation, including content background, certification pathway, and professional development experiences.

Content Background

One important aspect of teacher preparation is content knowledge. As can be seen in Table 18, large proportions of novice and veteran mathematics teachers at the elementary and middle school levels did not have a degree in mathematics or mathematics education. Considering that many middle schools are departmentalized and teaching mathematics requires specialized content knowledge, it is surprising that fewer than 50 percent of novices and veterans at the middle school level held degrees in mathematics or mathematics education. Although the majority of novices and veterans at the high school level held a degree in mathematics or mathematics education, novices were less likely than veterans to hold a mathematics-related degree.

Table 18
Teacher Degrees

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Mathematics	2 (0.7)	2 (0.6)
Mathematics Education	2 (1.3)	2 (0.8)
Mathematics or Mathematics Education	4 (1.5)	3 (1.1)
Middle		
Mathematics	23 (4.2)	28 (2.1)
Mathematics Education	25 (3.9)	30 (2.8)
Mathematics or Mathematics Education	39 (5.5)	47 (2.9)
High		
Mathematics*	47 (4.4)	58 (1.4)
Mathematics Education*	41 (4.6)	57 (2.0)
Mathematics or Mathematics Education*	70 (5.4)	82 (1.4)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Another indicator of content preparation is college coursework in the discipline. The National Council of Teachers of Mathematics (NCTM) has recommended that elementary mathematics teachers take college coursework in a number of different areas, including algebra, geometry, number and operations, probability, and statistics.[4] As can be seen in Table 19, fewer than half of novice and veteran elementary teachers had coursework in 3 or more of the 5 areas. There is no difference in the distribution of these data between novice and veteran elementary teachers.

[4] National Council of Teachers of Mathematics. (2012). *NCTM CAEP mathematics content for elementary mathematics specialist.* NCTM.

Table 19
Elementary Mathematics Teachers' Coursework Related to NCTM Preparation Standards†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Courses in algebra, geometry, number and operations, probability, and statistics	8 (1.8)	7 (1.0)
Courses in 3–4 of the 5 areas	41 (3.4)	38 (2.2)
Courses in 1–2 of the 5 areas	49 (3.4)	54 (2.2)
Courses in 0 of the 5 areas	3 (1.3)	2 (0.5)

† There is no statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

At the middle school level, NCTM recommends that teachers have more extensive college coursework, including courses in algebra, calculus, geometry, number theory, probability, and statistics.[5] As can be seen in Table 20, roughly 60 percent of novice and veteran middle school teachers had coursework in 4 or more of the 6 areas recommended by NCTM. There is no difference between novices and veterans on this indicator.

Table 20
Middle School Mathematics Teachers' Coursework Related to NCTM Preparation Standards†

	PERCENT OF TEACHERS*	
	NOVICE	VETERAN
Courses in algebra, calculus, geometry, number theory, probability, and statistics	23 (4.4)	20 (1.7)
Courses in 4–5 of the 6 areas	37 (5.3)	37 (2.5)
Courses in 2–3 of the 6 areas	28 (4.6)	26 (2.1)
Courses in 1 of the 6 areas	5 (1.6)	10 (1.8)
Courses in 0 of the 6 areas	7 (2.6)	6 (2.0)

† There is no statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

Table 21 provides analogous data for high school mathematics teachers. NCTM recommends that high school teachers have extensive college coursework in seven areas, including courses in algebra, calculus, discrete mathematics, geometry, number theory, probability, and statistics.[6] Almost 70 percent of novice teachers and 80 percent of veteran teachers at the high school level had coursework in five or more of the seven areas. There is no difference between novices and veterans in these coursework distributions.

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

[6] National Council of Teachers of Mathematics. (2012). *NCTM CAEP mathematics content for secondary*. NCTM.

Table 21
High School Mathematics Teachers' Coursework Related to NCTM Preparation Standards†

	PERCENT OF TEACHERS*	
	NOVICE	VETERAN
Courses in algebra, calculus, discrete mathematics, geometry, number theory, probability, and statistics	30 (3.7)	38 (1.7)
Courses in 5–6 of the 7 areas	39 (3.5)	41 (1.8)
Courses in 3–4 of the 7 areas	21 (5.0)	15 (1.2)
Courses in 1–2 of the 7 areas	7 (1.6)	6 (1.0)
Courses in 0 of the 7 areas	3 (2.2)	0 (0.2)

† There is no statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

Certification

Another aspect of teacher preparation is certification. Data from the 2018 NSSME+ show that the most common pathway to certification for mathematics teachers across all grade levels was an undergraduate program leading to a bachelor's degree and a teaching credential (see Table 22). A masters' program that led to a teaching credential was also a pathway for about one-quarter of novices and veterans at each grade band. However, there were differences in the distribution of these data between novices and veterans at the middle and high school levels. At these grade bands, novice teachers appear to be less likely than veteran teachers to have completed an undergraduate program and more likely to have not earned a teaching credential at all.

Table 22
Mathematics Teachers' Paths to Certification

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
An undergraduate program leading to a bachelor's degree and a teaching credential	61 (4.5)	65 (2.8)
A master's program that also led to a teaching credential	25 (4.1)	23 (2.6)
A post-baccalaureate credentialing program (no master's degree awarded)	10 (2.8)	11 (1.9)
Has not earned a teaching credential	4 (1.9)	1 (0.5)
Middle*		
An undergraduate program leading to a bachelor's degree and a teaching credential	50 (5.3)	65 (3.5)
A master's program that also led to a teaching credential	26 (4.1)	18 (2.1)
A post-baccalaureate credentialing program (no master's degree awarded)	14 (2.7)	15 (2.4)
Has not earned a teaching credential	10 (2.5)	2 (1.2)
High*		
An undergraduate program leading to a bachelor's degree and a teaching credential	50 (5.5)	59 (2.1)
A master's program that also led to a teaching credential	21 (3.9)	21 (1.8)
A post-baccalaureate credentialing program (no master's degree awarded)	13 (2.4)	17 (1.5)
Has not earned a teaching credential	16 (4.7)	4 (1.2)

* There is a statistically significant difference in the distribution of responses between novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

Teaching is not always an individual's first career. Table 23 shows the percentages of novices and veterans with full-time job experience in a mathematics-related field after completing their undergraduate degree but before teaching. Although the likelihood of mathematics teachers having prior mathematics-related job experience tends to increase with increasing grade band, few novices or veterans at any grade band had such a job before teaching.

Table 23
Mathematics Teachers With Full-Time Job Experience in Their Designated Field Prior to Teaching†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary	6 (2.2)	7 (1.3)
Middle	16 (3.5)	11 (1.7)
High	15 (2.4)	20 (1.6)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Professional Development Experiences

The 2018 NSSME+ asked teachers about opportunities they had for continued learning. As shown in Table 24, over three-quarters of novices and veterans at the elementary level had participated in mathematics-focused professional development in the previous three years. These percentages increase at the secondary level, as over 90 percent of middle and high school teachers had mathematics-focused professional development in the previous three years. However, only about 15 percent of elementary teachers and 40 percent of secondary teachers had what might be considered substantial professional development opportunities (more than 35 hours). There are no differences in mathematics-focused professional development participation between novices and veterans at any level.

Table 24
Participation in Mathematics-Focused Professional Development in the Previous Three Years†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Any mathematics-focused professional development	75 (3.7)	81 (1.9)
More than 35 hours of mathematics-focused professional development	13 (2.8)	14 (1.5)
Middle		
Any mathematics -focused professional development	91 (2.7)	92 (2.2)
More than 35 hours of mathematics-focused professional development	37 (4.4)	37 (2.5)
High		
Any mathematics-focused professional development	91 (2.0)	93 (1.1)
More than 35 hours of mathematics-focused professional development	41 (4.0)	41 (1.7)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Teachers who had recently participated in professional development were asked about the nature of those activities. As can be seen in Table 25, across grade bands, 88–96 percent of teachers who had professional development in the preceding three years attended a professional development program or workshop. However, at the middle school level, novice teachers were less likely than veteran teachers to have participated in this form of professional development (88 vs. 96 percent). Assistance or feedback from a formally designated coach or mentor was also a common mathematics-focused professional development activity, and novices at the elementary, middle, and high school levels were significantly more likely than veterans to receive this type of assistance (65 vs. 41, 72 vs. 50, and 69 vs. 36 percent, respectively). However, some of this coaching/mentoring was probably in the context of an induction program and, as such, may be unlikely to continue. At the high school level, novice teachers were also more likely than veteran teachers to have taken a formal class for college credit in the previous three years (26 vs. 16 percent), likely due to the fact that many novices were still college students at the time.

Table 25
Mathematics Teachers Participating in Various Professional Development Activities in Previous Three Years

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Attended a professional development program/workshop	91 (2.3)	95 (1.2)
Received assistance or feedback from a formally designated coach/mentor*	65 (4.6)	41 (2.9)
Participated in a professional learning community/lesson study/teacher study group	53 (5.6)	53 (2.8)
Completed an online course/webinar	21 (4.1)	19 (1.8)
Attended a national, state, or regional mathematics teacher association meeting	9 (2.9)	15 (2.3)
Took a formal course for college credit	8 (3.0)	4 (1.1)
Middle		
Attended a professional development program/workshop*	88 (3.3)	96 (0.9)
Received assistance or feedback from a formally designated coach/mentor*	72 (4.8)	50 (3.5)
Participated in a professional learning community/lesson study/teacher study group	65 (6.5)	69 (3.4)
Completed an online course/webinar	43 (5.8)	32 (3.2)
Attended a national, state, or regional mathematics teacher association meeting	19 (4.1)	29 (3.1)
Took a formal course for college credit	20 (4.0)	13 (2.2)
High		
Attended a professional development program/workshop	91 (2.9)	91 (1.5)
Received assistance or feedback from a formally designated coach/mentor*	69 (4.8)	36 (2.3)
Participated in a professional learning community/lesson study/teacher study group	68 (4.7)	62 (2.4)
Completed an online course/webinar	28 (4.8)	32 (1.8)
Attended a national, state, or regional mathematics teacher association meeting	40 (5.9)	32 (2.2)
Took a formal course for college credit*	26 (3.9)	16 (1.8)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Teachers who had participated in professional development in the previous three years were also asked about the characteristics of those experiences, specifically the extent to which they aligned

with what is known about effective professional development.[7] As can be seen in Table 26, more than half of novices and veterans at each grade band had opportunities to work closely during professional development with other mathematics teachers from their schools or mathematics teachers in their grade level and/or subject, whether or not they were from the same school. Other common professional development characteristics, experienced by roughly 40–50 percent of teachers, included experiencing lessons as their students would, engaging in mathematics investigations, examining classroom artifacts, and applying what they learned in their classroom and then coming back to talk about it. There are no differences between novices and veterans at the elementary or middle grade levels related to the characteristics of their professional development experiences. At the high school level, novices were more likely than veterans to have worked closely with other teachers from their school (75 vs. 64 percent) and less likely to have had opportunities to engage in mathematics investigations (31 vs. 46 percent) during professional development.

[7] 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. 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.

Table 26
Mathematics Teachers Whose Professional Development in the Previous Three Years Had Each of a Number of Characteristics to a Substantial Extent[a]

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Worked closely with other teachers from their school	69 (5.4)	69 (2.9)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	62 (4.8)	53 (3.0)
Had opportunities to experience lessons, as their students would, from the textbook/ units they use in their classroom	50 (5.4)	47 (2.6)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	47 (4.5)	42 (2.9)
Had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	45 (5.5)	45 (2.8)
Had opportunities to engage in mathematics investigations	43 (4.6)	47 (2.7)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect of those practices)	34 (5.1)	35 (2.6)
Middle		
Worked closely with other teachers from their school	70 (5.3)	73 (3.3)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	59 (7.1)	58 (3.6)
Had opportunities to experience lessons, as their students would, from the textbook/ units they use in their classroom	51 (5.3)	42 (4.0)
Had opportunities to engage in mathematics investigations	50 (5.9)	46 (3.5)
Had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	55 (5.2)	46 (3.8)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	48 (7.2)	46 (3.5)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect of those practices)	37 (6.6)	33 (3.0)
High		
Worked closely with other teachers from their school*	75 (4.3)	64 (2.3)
Worked closely with other teachers who taught the same grade and/or subject whether or not they were from their school	59 (5.4)	56 (2.0)
Had opportunities to experience lessons, as their students would, from the textbook/ units they use in their classroom	48 (5.8)	40 (2.3)
Had opportunities to engage in mathematics investigations*	31 (4.1)	46 (1.9)
Had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction)	49 (5.5)	42 (2.0)
Had opportunities to apply what they learned to their classroom and then come back and talk about it as part of the professional development	53 (5.5)	43 (2.4)
Had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect of those practices)	41 (6.4)	28 (1.8)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

The survey also asked teachers about the focus of professional development opportunities they had in the previous three years, particularly the extent to which these experiences focused on student-centered instruction. As can be seen in Table 27, common areas of emphasis across grade bands were on learning how to use hands-on activities/manipulatives (38–66 percent),

deepening teachers' understanding of how mathematics is done (47–60 percent), deepening teachers' own mathematics content knowledge (39–57 percent), and differentiating instruction to meet the needs of diverse learners (52–56 percent). However, there were differences between novices and veterans at the elementary and middle grade levels in the emphases of professional development opportunities. At the elementary level, novice mathematics teachers were more likely than veterans to have attended professional development that focused on incorporating students' cultural backgrounds into mathematics instruction (26 vs. 17 percent). At the middle school level, novice mathematics teachers were more likely than veterans to have attended professional development that focused on deepening their own mathematics content knowledge (53 vs. 40 percent) and finding out what students think or already know prior to instruction on a topic (50 vs. 34 percent).

Table 27
Mathematics Teachers Reporting That Their Professional Development in the Previous Three Years Gave Heavy Emphasis[a] to Various Areas

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Learning how to use hands-on activities/manipulatives for mathematics instruction	66 (4.4)	57 (3.1)
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)	60 (4.7)	58 (2.6)
Deepening their own mathematics content knowledge	57 (5.6)	49 (3.0)
Differentiating mathematics instruction to meet the needs of diverse learners	55 (5.2)	56 (3.0)
Monitoring student understanding during mathematics instruction	53 (4.6)	57 (2.5)
Learning about difficulties that students may have with particular mathematical ideas and procedures	50 (5.7)	46 (2.4)
Finding out what students think or already know prior to instruction on a topic	50 (4.7)	44 (2.8)
Implementing the mathematics textbook to be used in their classroom	37 (4.2)	42 (2.9)
Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	29 (5.1)	18 (2.3)
Incorporating students' cultural backgrounds into mathematics instruction*	26 (3.7)	17 (2.3)
Middle		
Learning how to use hands-on activities/manipulatives for mathematics instruction	51 (5.5)	41 (3.5)
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)	57 (5.5)	54 (4.0)
Deepening their own mathematics content knowledge*	53 (5.1)	40 (3.7)
Differentiating mathematics instruction to meet the needs of diverse learners	56 (6.8)	54 (3.7)
Monitoring student understanding during mathematics instruction	59 (5.2)	53 (3.2)
Learning about difficulties that students may have with particular mathematical ideas and procedures	55 (5.5)	50 (3.9)
Finding out what students think or already know prior to instruction on a topic*	50 (5.3)	34 (3.3)
Implementing the mathematics textbook to be used in their classroom	45 (6.9)	36 (3.6)
Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	23 (7.0)	18 (2.4)
Incorporating students' cultural backgrounds into mathematics instruction	24 (6.3)	17 (2.6)
High		
Learning how to use hands-on activities/manipulatives for mathematics instruction	45 (4.8)	38 (2.3)
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)	47 (5.4)	50 (2.4)
Deepening their own mathematics content knowledge	40 (4.6)	39 (2.1)
Differentiating mathematics instruction to meet the needs of diverse learners	56 (4.8)	52 (2.1)
Monitoring student understanding during mathematics instruction	54 (5.3)	52 (1.9)
Learning about difficulties that students may have with particular mathematical ideas and procedures	51 (5.2)	44 (2.2)
Finding out what students think or already know prior to instruction on a topic	42 (6.3)	36 (2.2)
Implementing the mathematics textbook to be used in their classroom	27 (6.4)	24 (1.6)
Learning how to provide mathematics instruction that integrates engineering, science, and/or computer science	24 (4.6)	20 (1.7)
Incorporating students' cultural backgrounds into mathematics instruction	31 (6.3)	23 (2.0)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

These two sets of items were combined into two composite variables: Extent Professional Development Aligns with Elements of Effective Professional Development and Extent Professional Development Supports Student-Centered Instruction. As can be seen in Table 28, the modest composite mean scores suggest that mathematics teachers' professional development opportunities were not well aligned with elements of effective professional development and only moderately supported student-centered instruction. The mean scores on these composites were similar for novices and veterans across grade bands, indicating that professional development opportunities were relatively consistent.

Table 28
Teacher Mean Scores for Professional Development Composites†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Extent Professional Development Aligns With Elements of Effective Professional Development	57 (2.4)	57 (1.2)
Extent Professional Development Supports Student-Centered Instruction	61 (2.3)	60 (1.2)
Middle		
Extent Professional Development Aligns With Elements of Effective Professional Development	60 (2.2)	58 (1.6)
Extent Professional Development Supports Student-Centered Instruction	59 (2.5)	57 (1.3)
High		
Extent Professional Development Aligns With Elements of Effective Professional Development	60 (2.2)	56 (0.9)
Extent Professional Development Supports Student-Centered Instruction	56 (1.8)	54 (1.0)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Teacher Beliefs and Perceptions of Preparedness

Teachers' beliefs about effective instruction and perceptions of preparedness to teach mathematics are a result of many factors, including their own experiences learning mathematics, their pre-service education coursework, and their ongoing professional learning opportunities. Because beliefs and feelings of preparedness influence instruction, the 2018 NSSME+ asked teachers about their beliefs about effective mathematics instruction, their feelings of preparedness to teach the mathematics content they are expected to cover, and their pedagogical preparedness.

Teacher Beliefs

Teachers were asked about their beliefs regarding effective teaching and learning. As can be seen in Tables 29–31, the survey revealed a number of areas in which mathematics teachers' beliefs were aligned with the research on effective mathematics instruction.[8] For example, over 90 percent of novices and veterans at each grade band agreed that students should learn mathematics by doing mathematics, teachers should ask students to justify their mathematical thinking, and most class periods should provide opportunities for students to share their thinking and reasoning. Further, only one difference in teacher beliefs about effective teaching and learning emerges when comparing novices to veterans. At the elementary level, novices were less likely than veterans to agree that it is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics (68 vs. 80 percent).

However, many mathematics teachers also held beliefs inconsistent with what is known from research on learning. For example, roughly 80 percent of novice and veteran teachers at each grade band agreed that students should be provided with definitions for new mathematics vocabulary at the beginning of instruction on a mathematical idea.

Novices at the elementary level were more likely than their veteran counterparts to hold a several traditional beliefs. For example, novices were more likely than veterans to agree that students should be provided with definitions for new mathematics vocabulary at the beginning of instruction on a mathematical idea (88 vs. 80 percent), hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned (69 vs. 45 percent), and teachers should explain an idea to students before having them consider evidence that relates to the idea (43 vs. 30 percent). At the high school level, novices were less likely than veterans to agree that students learn mathematics best in classes with students of similar abilities (65 vs. 72 percent) and more likely to agree that hands-on activities/ manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned (57 vs. 40 percent).

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

Table 29
Elementary Mathematics Teachers Agreeing[a] With Various Statements About Teaching and Learning

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Reform-Oriented Beliefs		
Students should learn mathematics by doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models).	98 (1.1)	97 (1.0)
Teachers should ask students to justify their mathematical thinking.	97 (1.6)	97 (0.6)
Most class periods should provide opportunities for students to share their thinking and reasoning.	97 (1.6)	95 (1.2)
Students learn best when instruction is connected to their everyday lives.	95 (1.7)	98 (0.7)
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	93 (2.1)	93 (1.3)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.*	68 (4.3)	80 (2.1)
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.*	88 (2.5)	80 (2.1)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.*	69 (4.2)	45 (2.9)
Students learn mathematics best in classes with students of similar abilities.	53 (4.5)	49 (2.7)
Teachers should explain an idea to students before having them investigate the idea.*	43 (4.5)	30 (2.4)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

Table 30
Middle School Mathematics Teachers Agreeing[a] With Various Statements About Teaching and Learning[†]

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Reform-Oriented Beliefs		
Teachers should ask students to justify their mathematical thinking.	99 (0.8)	99 (0.5)
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 (1.0)	97 (0.7)
Most class periods should provide opportunities for students to share their thinking and reasoning.	96 (1.7)	95 (0.9)
Students learn best when instruction is connected to their everyday lives.	96 (1.4)	91 (2.4)
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	94 (2.2)	91 (1.4)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	87 (2.4)	90 (1.7)
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.	77 (5.9)	78 (2.8)
Students learn mathematics best in classes with students of similar abilities.	65 (5.4)	67 (3.2)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.	50 (5.5)	41 (3.0)
Teachers should explain an idea to students before having them investigate the idea.	26 (4.6)	33 (3.3)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

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

Table 31
High School Mathematics Teachers Agreeing[a] With Various Statements About Teaching and Learning

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Reform-Oriented Beliefs		
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 (1.1)	96 (1.1)
Teachers should ask students to justify their mathematical thinking.	96 (1.8)	98 (0.5)
Most class periods should provide opportunities for students to share their thinking and reasoning.	95 (1.6)	93 (1.0)
Students learn best when instruction is connected to their everyday lives.	90 (2.9)	83 (1.8)
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.	83 (4.7)	77 (1.8)
It is better for mathematics instruction to focus on ideas in depth, even if that means covering fewer topics.	81 (4.5)	84 (1.7)
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.	79 (3.6)	78 (2.0)
Students learn mathematics best in classes with students of similar abilities.*	65 (4.3)	72 (1.9)
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.*	57 (4.8)	40 (2.2)
Teachers should explain an idea to students before having them investigate the idea.	29 (4.8)	33 (2.4)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

The belief items were combined into two composite variables: Reform-Oriented Teaching Beliefs and Traditional Teaching Beliefs. The mean scores shown in Table 32 suggest that elementary, middle, and high school mathematics teachers had relatively strong reform-oriented beliefs. However, traditional beliefs were also fairly prevalent across all grades. Further, there were some differences between novices and veterans. At the middle grades level, novices were more likely than veterans to hold reform-oriented beliefs about teaching and learning. However, novice elementary teachers were more likely than veterans to hold traditional beliefs about teaching and learning.

Table 32
Mean Scores for Mathematics Teachers' Beliefs About Teaching and Learning Composites

	MEAN SCORE	
	NOVICE	VETERAN
Elementary		
Reform-Oriented Beliefs	86 (1.1)	84 (0.7)
Traditional Beliefs*	66 (1.6)	57 (1.1)
Middle		
Reform-Oriented Beliefs*	86 (0.8)	83 (1.0)
Traditional Beliefs	59 (2.3)	60 (1.2)
High		
Reform-Oriented Beliefs	80 (1.2)	79 (0.5)
Traditional Beliefs	62 (1.8)	61 (1.0)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Teacher Perceptions of Content Preparedness

Elementary teachers are typically assigned to teach multiple subjects to a single group of students. As can be seen in Table 33, about three-quarters of novice and veteran teachers felt very well prepared to teach mathematics at the elementary level. Fewer than half felt very well prepared to teach social studies, science, or computer science/programming.

Table 33
Elementary Teachers' Perceptions of Their Preparedness to Teach Each Subject

	PERCENT OF TEACHERS[a]	
	NOVICE	VETERAN
Reading/Language arts*		
Not adequately prepared	0 (0.2)	0 (0.2)
Somewhat prepared	6 (1.4)	2 (0.5)
Fairly well prepared	27 (2.2)	17 (1.3)
Very well prepared	68 (2.6)	80 (1.3)
Mathematics		
Not adequately prepared	0 (0.4)	0 (0.0)
Somewhat prepared	5 (1.5)	4 (0.9)
Fairly well prepared	27 (3.8)	21 (2.0)
Very well prepared	68 (3.9)	75 (2.0)
Social studies*		
Not adequately prepared	5 (1.2)	2 (0.4)
Somewhat prepared	19 (2.3)	14 (1.1)
Fairly well prepared	41 (2.7)	39 (1.5)
Very well prepared	35 (2.2)	45 (1.6)
Science		
Not adequately prepared	6 (2.1)	4 (0.8)
Somewhat prepared	22 (3.2)	22 (1.8)
Fairly well prepared	43 (3.7)	42 (2.3)
Very well prepared	29 (3.5)	29 (3.5)
Computer science/programming		
Not adequately prepared	46 (3.6)	46 (2.0)
Somewhat prepared	37 (2.9)	34 (1.8)
Fairly well prepared	12 (1.6)	14 (1.2)
Very well prepared	5 (1.1)	6 (0.8)

* There is a statistically significant difference in the distributions of responses between novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

[a] Only includes teachers assigned to teach multiple subjects to a single class of students in grades K–6.

As can be seen in Table 34, modest percentages of elementary teachers felt very well prepared to teach select mathematics topics. Number and operations stands out as an area where novices and veterans felt particularly well prepared (67 and 77 percent, respectively). Comparing novices to veterans, there is a significant difference in the distribution of responses for the topics of geometry and measurement and data representation, with novices feeling less well prepared than veterans to teach both topics.

Table 34
Elementary Teachers' Perceptions of Their Preparedness to Teach Various Mathematics Topics

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Number and operations		
Not Adequately Prepared	0 (0.1)	0 (0.1)
Somewhat Prepared	3 (1.3)	2 (0.7)
Fairly Well Prepared	30 (3.7)	21 (2.0)
Very Well Prepared	67 (3.9)	77 (1.9)
Early algebra		
Not Adequately Prepared	6 (1.9)	5 (1.0)
Somewhat Prepared	17 (3.0)	17 (1.6)
Fairly Well Prepared	37 (4.3)	36 (2.3)
Very Well Prepared	40 (4.2)	42 (2.5)
Geometry*		
Not Adequately Prepared	3 (1.3)	3 (0.8)
Somewhat Prepared	19 (3.1)	10 (1.5)
Fairly Well Prepared	36 (3.9)	34 (2.1)
Very Well Prepared	42 (4.1)	52 (2.6)
Measurement and data representation*		
Not Adequately Prepared	4 (1.4)	2 (0.6)
Somewhat Prepared	11 (2.1)	6 (1.2)
Fairly Well Prepared	39 (3.3)	37 (2.2)
Very Well Prepared	46 (3.6)	56 (2.1)

* There is a statistically significant difference in the distributions of responses between novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

As can be seen in Table 35, there was a great deal of variation at both the middle and high school levels in teachers' perceptions of preparedness to teach several mathematics topics. For example, 71–92 percent of secondary teachers felt very well prepared to teach the number system and operations and algebraic thinking. Conversely, fewer than 25 percent felt very well prepared to teach discrete mathematics, and fewer than 10 percent felt very well prepared to teach computer science/programming. At both grade bands, novices were less likely than veterans to feel very well prepared in several areas. For example, novice middle school teachers were less likely than veterans to feel very well prepared to teach the number system and operations (81 vs. 87 percent), algebraic thinking (71 vs. 81 percent), measurement (52 vs. 64 percent), functions (47 vs. 61 percent), and geometry (43 vs. 65 percent). At the high school level, novice teachers were less likely than veterans to feel very well prepared to teach the number system and operations (83 vs. 91 percent), algebraic thinking (83 vs. 92 percent), functions (71 vs. 89 percent), modeling (48 vs. 62 percent), and discrete mathematics (16 vs. 23 percent).

Table 35
Secondary Mathematics Teachers Considering Themselves Very Well Prepared to Teach Each of a Number of Topics

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Middle		
The number system and operations*	81 (2.7)	87 (1.8)
Algebraic thinking*	71 (3.2)	81 (2.0)
Measurement*	52 (3.9)	64 (2.4)
Functions*	47 (3.3)	61 (2.6)
Geometry*	43 (4.3)	65 (2.4)
Modeling	42 (3.9)	49 (2.8)
Statistics and probability	36 (4.3)	41 (2.8)
Discrete mathematics	13 (2.5)	12 (1.5)
Computer science/programming	3 (0.8)	4 (0.8)
High		
The number system and operations*	83 (2.1)	91 (1.0)
Algebraic thinking*	83 (2.4)	92 (0.8)
Measurement	70 (3.4)	75 (1.5)
Functions*	71 (4.8)	89 (1.1)
Geometry	60 (4.0)	67 (1.7)
Modeling*	48 (4.3)	62 (1.8)
Statistics and probability	32 (5.0)	31 (1.4)
Discrete mathematics*	16 (2.5)	23 (1.5)
Computer science/programming	6 (1.4)	5 (0.9)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Table 36 displays mean scores for the Perceptions of Content Preparedness composite variable created from these items. The data indicate that teachers at all three grade bands felt fairly well prepared to teach mathematics content. However, novices at the elementary and high school levels felt somewhat less well prepared to teach mathematics content than their veteran counterparts.

Table 36
Mean Scores for Mathematics Teachers' Perceptions of Content Preparedness Composite

	MEAN SCORE	
	NOVICE	VETERAN
Elementary*	76 (1.6)	80 (0.9)
Middle	76 (1.4)	79 (0.9)
High*	78 (1.6)	83 (0.5)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Teacher Perceptions of Pedagogical Preparedness

Two sets of survey items focused on teacher preparedness for several tasks associated with mathematics instruction. One set of items asked teachers how well prepared they felt to carry out a number of instructional tasks. Table 37 shows that teacher preparedness to carry out these tasks was low across grade bands. Notably, fewer than 30 percent of teachers at each grade band felt very well prepared to provide mathematics instruction based on students' ideas, incorporate students' cultural backgrounds into mathematics instruction, or develop students' awareness of STEM careers.

Several differences on these items exist between novices and veterans at each grade band. Novices at the elementary, middle, and high school levels were less likely than veterans to feel very well prepared to develop students' abilities to do mathematics (39 vs. 48, 41 vs. 61, and 51 vs. 71 percent, respectively) and to develop students' conceptual understanding (36 vs. 50, 34 vs. 56, and 48 vs. 66 percent, respectively). Further, novices at the middle and high school level were less likely than veterans to feel very well prepared to use formative assessment to monitor student learning (48 vs. 62 percent and 49 vs. 60 percent, respectively). However, novice elementary teachers were more likely than veteran elementary teachers to feel very well prepared to develop awareness of STEM careers (15 vs. 6 percent).

Table 37
Mathematics Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Elementary		
Encourage participation of all students in mathematics	52 (3.8)	57 (1.8)
Use formative assessment to monitor student learning	49 (3.7)	55 (1.9)
Encourage students' interest in mathematics	40 (4.2)	42 (2.0)
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)*	39 (3.5)	48 (1.9)
Differentiate mathematics instruction to meet the needs of diverse learners	38 (3.8)	42 (2.1)
Develop students' conceptual understanding*	36 (3.5)	50 (1.8)
Provide mathematics instruction that is based on students' ideas	19 (2.7)	19 (1.8)
Incorporate students' cultural backgrounds into mathematics instruction	17 (2.7)	15 (1.8)
Develop students' awareness of STEM careers*	15 (2.6)	6 (1.1)
Middle		
Encourage participation of all students in mathematics	42 (4.3)	52 (2.5)
Use formative assessment to monitor student learning*	48 (4.2)	62 (2.6)
Encourage students' interest in mathematics	34 (3.6)	39 (2.5)
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)*	41 (4.3)	61 (2.5)
Differentiate mathematics instruction to meet the needs of diverse learners	31 (3.6)	38 (2.4)
Develop students' conceptual understanding*	34 (4.3)	56 (2.5)
Provide mathematics instruction that is based on students' ideas	24 (3.7)	23 (1.9)
Incorporate students' cultural backgrounds into mathematics instruction	12 (1.5)	13 (1.4)
Develop students' awareness of STEM careers	10 (2.2)	9 (1.2)
High		
Encourage participation of all students in mathematics	43 (4.7)	47 (1.7)
Use formative assessment to monitor student learning*	49 (4.9)	60 (1.5)
Encourage students' interest in mathematics	35 (3.9)	38 (1.6)
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)*	51 (5.0)	71 (1.6)
Differentiate mathematics instruction to meet the needs of diverse learners	37 (4.8)	31 (1.5)
Develop students' conceptual understanding*	48 (5.1)	66 (1.6)
Provide mathematics instruction that is based on students' ideas	23 (4.4)	27 (1.4)
Incorporate students' cultural backgrounds into mathematics instruction	20 (4.7)	15 (1.1)
Develop students' awareness of STEM careers	17 (3.1)	15 (1.2)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

These items were combined into a composite variable to examine mathematics teachers' overall perceptions of pedagogical preparedness (see Table 38). Despite the differences on some of the items comprising this composite, the mean scores indicate that novices and veterans at all grade levels held similar perceptions of pedagogical preparedness overall.

Table 38
Mean Scores for Mathematics Teachers' Perceptions of Pedagogical Preparedness Composite†

	MEAN SCORE	
	NOVICE	VETERAN
Elementary	68 (1.5)	69 (0.7)
Middle	67 (1.5)	70 (0.9)
High	70 (1.3)	71 (0.5)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

A second set of survey items asked teachers how well prepared they felt to monitor and address student understanding, focusing on a specific unit in a randomly selected class. As can be seen in Table 39, fewer than 60 percent of classes across grade bands were taught by novice teachers who felt very well prepared in these areas. Finding out what students thought or knew about key mathematical ideas and anticipating difficulties students may have with mathematical ideas and procedures stand out as two areas where novice teachers were least well prepared (27–42 percent of classes). Further, classes at each grade band were taught by novices who felt less prepared in each area than veterans. This lack of preparedness is concerning given these tasks are critical components of high-quality mathematics teaching.

Table 39
Mathematics Classes in Which Teachers Feel Very Well Prepared for Various Tasks in the Most Recent Unit

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Assess student understanding at the conclusion of this unit*	53 (3.5)	68 (2.2)
Monitor student understanding during this unit*	47 (3.4)	64 (1.9)
Implement the instructional materials to be used during this unit*	42 (3.7)	60 (2.0)
Find out what students thought or already knew about the key mathematical ideas*	34 (3.4)	45 (2.4)
Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit*	30 (3.5)	48 (2.1)
Middle		
Assess student understanding at the conclusion of this unit*	49 (4.7)	67 (2.3)
Monitor student understanding during this unit*	43 (4.1)	63 (2.0)
Implement the instructional materials to be used during this unit*	45 (4.1)	59 (2.4)
Find out what students thought or already knew about the key mathematical ideas*	27 (3.5)	43 (2.5)
Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit*	35 (3.8)	56 (2.3)
High		
Assess student understanding at the conclusion of this unit*	58 (4.1)	71 (1.6)
Monitor student understanding during this unit*	48 (4.2)	64 (1.8)
Implement the instructional materials to be used during this unit*	49 (4.4)	65 (1.6)
Find out what students thought or already knew about the key mathematical ideas*	37 (4.5)	51 (1.7)
Anticipate difficulties that students may have with particular mathematical ideas and procedures in this unit*	42 (4.1)	64 (1.6)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

These items were combined to create a composite variable named Perceptions of Preparedness to Implement Instruction in Particular Unit. As can be seen in Table 40, novices at the elementary, middle, and high school levels considered themselves less well prepared than veterans in this area.

Table 40
Class Mean Scores for Mathematics Teachers' Perceptions of Preparedness to Implement Instruction in Particular Unit Composite

	MEAN SCORE	
	NOVICE	VETERAN
Elementary*	75 (1.5)	83 (0.8)
Middle*	76 (1.6)	83 (0.8)
High*	78 (1.6)	86 (0.5)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Instruction

The 2018 NSSME+ included several sets of items about mathematics instruction. As can be seen in Table 41, almost all elementary grades classes received mathematics instruction all or most days of the school year. These data did not differ between classes taught by novice and veteran teachers.

Table 41
Frequency With Which Self-Contained Elementary Classes Receive Mathematics Instruction†

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Grades K–3		
All/most days, every week	99 (0.4)	99 (0.3)
Three or fewer days, every week	0 ---[a]	1 (0.3)
Some weeks, but not every week	0 (0.4)	0 ---[a]
Grades 4–6		
All/most days, every week	99 (1.3)	99 (0.2)
Three or fewer days, every week	1 (1.3)	0 (0.2)
Some weeks, but not every week	0 ---[a]	0 ---[a]

† There are no significant differences in the distributions of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

[a] No 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 elementary teachers in self-contained classrooms to indicate how much time was spent on each core subject (see Table 42). Elementary classes taught by novices and veterans spent about an hour per day on mathematics. There is no difference in the time spent on mathematics between classes taught by novices and veterans.

Table 42
Average Number of Minutes Per Day Teachers Spend Teaching Each Subject in Self-Contained Classes[a]

	NUMBER OF MINUTES	
	NOVICE	VETERAN
Grades K–3		
Reading/Language Arts*	83 (2.9)	92 (1.9)
Mathematics	56 (1.5)	57 (1.0)
Science	17 (0.8)	18 (0.6)
Social Studies	15 (0.7)	16 (0.5)
Grades 4–6		
Reading/Language Arts	85 (4.2)	81 (2.7)
Mathematics	67 (2.9)	61 (1.9)
Science	27 (1.5)	26 (1.1)
Social Studies	23 (1.4)	20 (1.0)

* There is a statistically significant difference between novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

Research shows that ongoing support is extremely important for developing and retaining novice teachers.[9] One means of supporting novices is providing them with fewer course preparations, which affords extra time for preparation and reflection. The NSSME+ asked secondary teachers to list each mathematics course they taught. These data were used to compute the number of different mathematics preparations secondary teachers had. (The survey did not collect data on non-mathematics courses that might also be taught by mathematics teachers.) As can be seen in Table 43, the majority of novice and veteran mathematics teachers at the middle and high school level were responsible for only one or two types of mathematics courses. These data suggest that most novices at the secondary level are generally not responsible for an excessive number of preparations.

Table 43
Number of Preparations of Secondary Mathematics Teachers†

	PERCENT OF TEACHERS	
	NOVICE	VETERAN
Middle		
1	33 (4.2)	32 (2.5)
2	48 (4.9)	43 (2.8)
3 or more	19 (4.3)	25 (2.4)
High		
1	30 (4.5)	26 (1.7)
2	46 (4.5)	45 (1.8)
3 or more	24 (3.5)	29 (1.5)

† There are no significant differences in the distributions of responses between novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

Teacher Perceptions of Their Decision-Making Autonomy

The survey asked several series of items about mathematics instruction, including teachers' perceptions of autonomy in making decisions about curriculum and instruction, instructional objectives, class activities, and homework. Teachers across grade bands were generally more likely to perceive themselves as having strong control over pedagogical decisions than curricular decisions (see Table 44). For example, in elementary classes, 55 percent of novices and 63 percent of veterans perceived themselves as having strong control in determining the amount of homework to be assigned. At the secondary level, over half of classes were taught by novices and veterans perceiving themselves as having strong control in determining the amount of homework to be assigned, selecting teaching techniques, and choosing criteria for grading student performance. In contrast, mathematics teachers in far fewer classes perceived themselves as having strong control over curricular decisions such as selecting content, topics, and skills to be taught (11–27 percent) or selecting curriculum materials (9–28 percent).

[9] Podolsky, A., Kini, T., Bishop, J., and Darling-Hammond, L. (2016). *Solving the teacher shortage: How to attract and retain excellent educators*. Learning Policy Institute.

Table 44
Mathematics Classes in Which Teachers Report Having Strong Control Over Various Curricular and Instructional Decisions

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Determining the amount of homework to be assigned	55 (5.4)	63 (2.4)
Selecting teaching techniques	48 (4.8)	53 (2.8)
Choosing criteria for grading student performance	39 (5.2)	32 (2.1)
Determining the amount of instructional time to spend on each topic	21 (3.2)	21 (2.2)
Selecting the sequence in which topics are covered	21 (3.5)	19 (1.8)
Determining course goals and objectives	16 (3.1)	16 (1.9)
Selecting content, topics, and skills to be taught	11 (2.5)	11 (1.4)
Selecting curriculum materials (e.g., textbooks)	9 (2.2)	12 (1.8)
Middle		
Determining the amount of homework to be assigned	72 (4.2)	71 (2.9)
Selecting teaching techniques	68 (3.6)	68 (3.1)
Choosing criteria for grading student performance	53 (4.9)	52 (3.1)
Determining the amount of instructional time to spend on each topic	38 (4.6)	37 (3.2)
Selecting the sequence in which topics are covered	32 (4.3)	31 (2.8)
Determining course goals and objectives	33 (5.1)	25 (2.7)
Selecting content, topics, and skills to be taught	24 (4.8)	20 (2.5)
Selecting curriculum materials (e.g., textbooks)	16 (3.3)	19 (2.5)
High		
Determining the amount of homework to be assigned	73 (4.2)	75 (1.7)
Selecting teaching techniques	68 (4.2)	72 (1.7)
Choosing criteria for grading student performance*	46 (4.8)	56 (2.0)
Determining the amount of instructional time to spend on each topic	46 (4.5)	50 (2.2)
Selecting the sequence in which topics are covered	44 (4.9)	46 (1.9)
Determining course goals and objectives	27 (3.6)	31 (1.9)
Selecting content, topics, and skills to be taught	25 (3.6)	27 (1.7)
Selecting curriculum materials (e.g., textbooks)	25 (4.3)	28 (1.7)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Several of these items were combined into two composite variables: Curriculum Control and Pedagogy Control. As can be seen in Table 45, although teachers at all three grade bands perceived more control over decisions related to pedagogy than curriculum, there are no differences when comparing novices to veterans.

Table 45
Class Mean Scores for Curriculum Control and Pedagogy Control Composites†

	MEAN SCORE	
	NOVICE	VETERAN
Elementary		
Pedagogy Control	78 (1.9)	78 (1.1)
Curriculum Control	42 (2.6)	38 (1.6)
Middle		
Pedagogy Control	86 (1.5)	86 (1.1)
Curriculum Control	51 (2.5)	50 (2.0)
High		
Pedagogy Control	85 (1.6)	87 (0.7)
Curriculum Control	58 (2.6)	61 (1.2)

† There are no statistically significant differences between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Instructional Objectives

Teachers were provided a list of possible instructional objectives and asked how much emphasis each would receive over the entire course of a randomly selected class. As can be seen in Table 46, learning how to do mathematics and understanding mathematical ideas were heavily emphasized in at least 60 percent of classes taught by novices and veterans in each grade band. However, at the elementary and high school level, classes taught by novices were less likely than classes taught by veterans to have a heavy emphasis on understanding mathematical ideas (60 vs. 70 percent and 61 vs. 71 percent, respectively). In contrast, teachers of classes at all three grade bands were unlikely to heavily emphasize learning to perform computations with speed and accuracy, learning test-taking skills/strategies, and learning mathematics vocabulary. Further, at the elementary level, classes taught by novices were even less likely than classes taught by veterans to have a heavy emphasis on and learning mathematics vocabulary (30 vs. 38 percent).

Table 46
Mathematics Classes Taught by Teachers With Heavy Emphasis on Various Instructional Objectives

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Learning how to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	61 (3.6)	63 (2.3)
Understanding mathematical ideas*	60 (3.6)	70 (1.9)
Learning mathematical procedures and/or algorithms	50 (3.3)	52 (2.3)
Increasing students' interest in mathematics	40 (3.6)	41 (2.3)
Learning to perform computations with speed and accuracy	37 (3.4)	31 (2.3)
Developing students' confidence that they can successfully pursue careers in mathematics	36 (3.2)	37 (2.1)
Learning about real-life applications of mathematics	33 (3.9)	33 (2.0)
Learning test-taking skills/strategies	32 (3.1)	29 (2.0)
Learning mathematics vocabulary*	30 (3.2)	38 (2.0)
Middle		
Learning how to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	60 (4.1)	61 (2.3)
Understanding mathematical ideas	68 (3.4)	73 (2.1)
Learning mathematical procedures and/or algorithms	56 (4.7)	52 (2.9)
Increasing students' interest in mathematics	31 (3.8)	34 (2.1)
Learning to perform computations with speed and accuracy	21 (3.3)	20 (1.8)
Developing students' confidence that they can successfully pursue careers in mathematics	38 (4.1)	41 (2.2)
Learning about real-life applications of mathematics	36 (3.2)	37 (2.3)
Learning test-taking skills/strategies	19 (3.0)	23 (1.6)
Learning mathematics vocabulary	23 (3.0)	29 (2.1)
High		
Learning how to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)	64 (3.6)	62 (1.8)
Understanding mathematical ideas*	61 (3.3)	71 (1.7)
Learning mathematical procedures and/or algorithms	50 (4.2)	57 (1.7)
Increasing students' interest in mathematics	28 (3.6)	25 (1.4)
Learning to perform computations with speed and accuracy	17 (2.9)	22 (1.4)
Developing students' confidence that they can successfully pursue careers in mathematics	38 (3.5)	36 (1.6)
Learning about real-life applications of mathematics	38 (4.1)	30 (1.5)
Learning test-taking skills/strategies	25 (3.5)	25 (1.3)
Learning mathematics vocabulary	28 (3.8)	30 (1.5)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

These items related to reform-oriented instruction were combined into a composite variable (see Table 47). Overall, scores on this composite were fairly high, indicating that mathematics classes were generally likely to emphasize reform-oriented instructional objectives. There are no significant differences between novices and veterans at any of the grade bands.

Table 47
Class Mean Scores for the Reform-Oriented Instructional Objectives Composite†

	MEAN SCORE	
	NOVICE	VETERAN
Elementary	78 (1.2)	79 (0.7)
Middle	79 (1.2)	80 (0.7)
High	77 (0.9)	77 (0.5)

† There are no statistically significant differences between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Class Activities

Teachers were given a list of activities and asked how often they did each in a randomly selected class. Table 48 shows the percentage of classes in which various activities were used at least once a week. Over 70 percent of classes at each grade band included the teacher explaining mathematical ideas to the whole class, whole class discussions, and students working in small groups. In contrast, having students practice for standardized tests and using flipped instruction were less common. There were few differences in activities between classes taught by novices and those taught by veterans. At the elementary level, novices were less likely than veterans to have students write their reflections in class or for homework (32 vs. 44 percent). At the high school level, novices were more likely than veterans to have students focus on literacy skills (24 vs. 15 percent).

Table 48
Mathematics Classes in Which Teachers Report Using Various Activities at Least Once a Week

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Explain mathematical ideas to the whole class	94 (2.2)	96 (1.1)
Engage the whole class in discussions	92 (2.1)	95 (1.0)
Have students work in small groups	90 (2.1)	87 (1.4)
Provide manipulatives for students to use in problem-solving/investigations	76 (3.1)	79 (1.7)
Focus on literacy skills (e.g., informational reading or writing strategies)	37 (3.8)	41 (2.6)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework*	32 (3.7)	44 (2.2)
Have students read from a textbook or other material in class, either aloud or to themselves	24 (3.3)	29 (2.1)
Have students practice for standardized tests	23 (3.1)	26 (2.3)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	11 (2.6)	13 (1.7)
Middle		
Explain mathematical ideas to the whole class	93 (2.3)	96 (1.0)
Engage the whole class in discussions	90 (2.9)	91 (1.1)
Have students work in small groups	71 (5.3)	80 (2.0)
Provide manipulatives for students to use in problem-solving/investigations	31 (3.8)	29 (2.3)
Focus on literacy skills (e.g., informational reading or writing strategies)	18 (2.6)	21 (2.2)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	30 (3.3)	30 (2.0)
Have students read from a textbook or other material in class, either aloud or to themselves	20 (3.3)	25 (2.5)
Have students practice for standardized tests	32 (3.6)	32 (3.4)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	9 (2.2)	11 (1.8)
High		
Explain mathematical ideas to the whole class	96 (1.2)	94 (0.9)
Engage the whole class in discussions	85 (2.6)	83 (1.2)
Have students work in small groups	73 (4.0)	70 (1.5)
Provide manipulatives for students to use in problem-solving/investigations	25 (3.6)	19 (1.4)
Focus on literacy skills (e.g., informational reading or writing strategies)*	24 (3.7)	15 (1.3)
Have students write their reflections (e.g., in their journals, on exit tickets) in class or for homework	22 (3.2)	18 (1.4)
Have students read from a textbook or other material in class, either aloud or to themselves	20 (3.6)	15 (1.5)
Have students practice for standardized tests	28 (3.1)	29 (1.5)
Use flipped instruction (have students watch lectures/demonstrations outside of class to prepare for in-class activities)	12 (3.0)	10 (1.2)

* There is a statistically significant difference between classes of novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Teachers were also asked how often they engage students in the practices of mathematics described in the *Common Core State Standards—Mathematics*[10] such as making sense of problems, constructing arguments, critiquing the reasoning of others, and modeling with mathematics. As can be seen in Tables 49–51, over 50 percent of elementary, middle, and high school classes engaged with each of the mathematical practices weekly. Elementary classes were especially engaged in representing aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it (88 percent) and providing mathematical reasoning to explain, justify, or prove their thinking (83–86 percent). At the middle and high school level, classes were likely to determine whether their answer makes sense (84–86 percent) and continue working through a mathematics problem when they reach points of difficulty, challenge, or error (79–84 percent) weekly.

Although there were differences in engagement with the mathematical practices between classes taught by novices and those taught by veterans, particularly at the middle and high school levels, there do not seem to be any striking patterns in these differences. Middle school classes taught by novices were less likely than classes taught by veterans to represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it (69 vs. 78 percent) or reflect on their solution strategies as they work through a mathematics problem and revise as needed (57 vs. 68 percent) weekly. Similarly, high school classes taught by novices were less likely than classes taught by veterans to develop a mathematical model to solve a mathematics problem (57 vs. 66 percent). Conversely, high school classes taught by novices were more likely than classes taught by veterans to pose questions to clarify, challenge, or improve the mathematical reasoning of others (69 vs. 61 percent); analyze the mathematical reasoning of others (61 vs. 50 percent); and compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations (60 vs. 52 percent).

[10] National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). *Common core state standards for mathematics*. Author.

Table 49
Elementary Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices at Least Once a Week†

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	88 (2.4)	88 (1.1)
Provide mathematical reasoning to explain, justify, or prove their thinking	83 (3.2)	86 (1.4)
Determine whether their answer makes sense	81 (3.0)	85 (1.5)
Figure out what a challenging problem is asking	81 (3.2)	77 (2.0)
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	80 (3.6)	82 (1.5)
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	74 (3.1)	79 (1.7)
Develop a mathematical model to solve a mathematics problem	74 (2.5)	75 (2.0)
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	73 (3.7)	74 (2.2)
Identify relevant information and relationships that could be used to solve a mathematics problem	71 (3.4)	72 (2.0)
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	70 (3.3)	76 (1.8)
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	70 (3.8)	69 (2.4)
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	69 (3.2)	73 (2.1)
Determine what tools are appropriate for solving a mathematics problem	69 (3.4)	72 (2.1)
Analyze the mathematical reasoning of others	64 (3.5)	64 (2.3)
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	60 (3.2)	63 (2.1)
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	58 (3.9)	61 (2.2)
Work on generating a rule or formula	54 (4.3)	60 (2.1)

† There are no statistically significant differences between classes of novice teachers and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Table 50
Middle School Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices at Least Once a Week

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Determine whether their answer makes sense	84 (2.9)	85 (2.3)
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	84 (3.0)	79 (2.2)
Provide mathematical reasoning to explain, justify, or prove their thinking	81 (3.0)	84 (2.1)
Identify relevant information and relationships that could be used to solve a mathematics problem	80 (3.1)	78 (2.5)
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	76 (2.9)	74 (2.0)
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	75 (3.4)	78 (2.0)
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	72 (4.8)	77 (2.1)
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it*	69 (4.0)	78 (2.3)
Figure out what a challenging problem is asking	69 (4.8)	75 (2.1)
Work on generating a rule or formula	67 (3.4)	70 (2.1)
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	66 3.4()	70 (2.2)
Develop a mathematical model to solve a mathematics problem	64 (3.5)	72 (2.5)
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	64 (3.5)	66 (2.5)
Determine what tools are appropriate for solving a mathematics problem	60 (3.5)	63 (2.8)
Analyze the mathematical reasoning of others	59 (5.0)	62 (2.3)
Reflect on their solution strategies as they work through a mathematics problem and revise as needed*	57 (4.6)	68 (2.3)
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	55 (4.9)	55 (2.4)

* There is a statistically significant difference between classes of novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Table 51
High School Mathematics Classes in Which Teachers Report Students Engaging in Various Aspects of Mathematical Practices at Least Once a Week

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Determine whether their answer makes sense	86 (2.4)	84 (1.6)
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	81 (3.2)	79 (1.4)
Provide mathematical reasoning to explain, justify, or prove their thinking	79 (3.0)	76 (1.8)
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	75 (3.9)	76 (1.7)
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	75 (2.9)	74 (1.5)
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	75 (3.1)	70 (1.4)
Identify relevant information and relationships that could be used to solve a mathematics problem	73 (4.1)	73 (1.8)
Pose questions to clarify, challenge, or improve the mathematical reasoning of others*	69 (3.6)	61 (1.6)
Figure out what a challenging problem is asking	68 (3.6)	61 (1.8)
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	65 (3.6)	60 (2.1)
Work on generating a rule or formula	65 (4.1)	60 (1.5)
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	63 (3.7)	69 (1.7)
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	61 (3.9)	62 (2.0)
Determine what tools are appropriate for solving a mathematics problem	61 (3.7)	59 (1.8)
Analyze the mathematical reasoning of others*	61 (4.0)	50 (1.5)
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations*	60 (4.1)	52 (1.6)
Develop a mathematical model to solve a mathematics problem*	57 (4.0)	66 (1.8)

* There is a statistically significant difference between classes of novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

These items were combined into a composite variable called Engaging Students in the Practices of Mathematics (see Table 52). The mean scores indicate that students engage in this set of practices to a moderate extent. Although there were some item level differences, the mean scores for novices and veterans are not significantly different at any of the grade bands.

Table 52
Class Mean Scores for Engaging Students in the Practices of Mathematics Composite†

	MEAN SCORE	
	NOVICE	VETERAN
Elementary	73 (1.3)	74 (0.7)
Middle	72 (1.3)	74 (0.6)
High	72 (1.2)	71 (0.6)

† There are no statistically significant differences between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

The 2018 NSSME+ asked teachers how frequently they incorporate coding into mathematics instruction. As can be seen in Table 53

Table 53 The overwhelming majority of classes, regardless of grade band, never include coding as part of their mathematics instruction.

Table 53
Mathematics Classes in Which Teachers Report Incorporating Coding into Mathematics Instruction†

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Never	76 (4.2)	74 (2.7)
Rarely (e.g., a few times per year)	14 (3.5)	16 (2.2)
Sometimes (e.g., once or twice a month)	8 (2.3)	6 (1.3)
Often (e.g., once or twice a week)	3 (1.4)	3 (0.9)
All or almost all mathematics lessons	0 (0.0)	0 (0.4)
Middle		
Never	83 (3.7)	87 (2.3)
Rarely (e.g., a few times per year)	11 (2.7)	10 (1.9)
Sometimes (e.g., once or twice a month)	4 (3.6)	3 (0.8)
Often (e.g., once or twice a week)	1 (0.9)	0 (0.0)
All or almost all mathematics lessons	0 (0.0)	0 (0.2)
High		
Never	88 (2.7)	89 (1.0)
Rarely (e.g., a few times per year)	11 (2.6)	8 (0.9)
Sometimes (e.g., once or twice a month)	1 (0.4)	1 (0.4)
Often (e.g., once or twice a week)	1 (0.4)	1 (0.3)
All or almost all mathematics lessons	1 (0.5)	0 (0.1)

† There are no significant differences in the distributions of responses between classes taught by novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

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 mathematics lesson in the randomly selected class. As can be seen in Table 54, the teacher explaining mathematical ideas to the whole class (87–91 percent of classes) and small group work (76–88 percent) were very common at all three grade bands. Whole class discussions were also quite common (68–87 percent), particularly in elementary classes. There were no differences in activities between classes taught by novices and those taught by veterans at the elementary and high school levels. However, at the middle school level, where there tends to be a substantial focus on literacy, classes taught by novices were less likely than classes taught by veterans to write about mathematics (13 vs. 21 percent) or read about mathematics (10 vs. 16 percent).

Table 54
Mathematics Classes Participating in Various Activities in Most Recent Lesson

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Teacher explaining a mathematical idea to the whole class	90 (2.5)	88 (1.6)
Students working in small groups	85 (3.1)	88 (1.5)
Whole class discussion	84 (3.2)	87 (1.5)
Teacher conducting a demonstration while students watched	77 (3.3)	79 (2.3)
Students completing textbook/worksheet problems	75 (3.4)	79 (1.7)
Students doing hands-on/manipulative activities	65 (3.8)	65 (2.6)
Students writing about mathematics	23 (3.4)	28 (1.9)
Test or quiz	18 (2.3)	17 (2.2)
Students reading about mathematics	14 (2.7)	17 (1.6)
Practicing for standardized tests	12 (2.5)	14 (1.9)
Middle		
Teacher explaining a mathematical idea to the whole class	89 (2.9)	87 (1.8)
Students working in small groups	79 (3.8)	85 (1.7)
Whole class discussion	72 (3.9)	80 (1.8)
Teacher conducting a demonstration while students watched	72 (4.2)	63 (2.3)
Students completing textbook/worksheet problems	79 (2.9)	75 (2.1)
Students doing hands-on/manipulative activities	21 (3.3)	24 (2.0)
Students writing about mathematics*	13 (2.1)	21 (2.2)
Test or quiz	16 (2.6)	15 (1.9)
Students reading about mathematics*	10 (2.2)	16 (1.8)
Practicing for standardized tests	14 (2.8)	19 (1.9)
High		
Teacher explaining a mathematical idea to the whole class	91 (2.1)	91 (1.1)
Students working in small groups	81 (3.4)	76 (1.3)
Whole class discussion	68 (3.8)	71 (1.2)
Teacher conducting a demonstration while students watched	68 (3.3)	63 (1.6)
Students completing textbook/worksheet problems	76 (3.1)	78 (1.6)
Students doing hands-on/manipulative activities	21 (4.3)	15 (1.4)
Students writing about mathematics	16 (2.7)	14 (1.1)
Test or quiz	19 (3.5)	19 (1.2)
Students reading about mathematics	13 (3.2)	15 (1.3)
Practicing for standardized tests	13 (2.3)	16 (1.0)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

The survey also asked teachers to estimate the time spent on each of a number of types of activities in their most recent mathematics lesson. As can be seen in Table 55, the majority of class time, across grade bands, was spent on whole class activities (34–43 percent) and small group work (25–33 percent). However, classes taught by novices at each grade band had slightly different distributions of time than classes taught by veterans. These differences appear to be

due to novice teachers spending slightly more time on non-instructional activities than veteran teachers.

Table 55
Average Percentage of Time Spent on Different Activities in the Most Recent Lesson

	PERCENT OF CLASS TIME	
	NOVICE	VETERAN
Elementary*		
Whole class activities (e.g., lectures, explanations, discussions)	34 (1.5)	36 (0.8)
Small group work	32 (1.8)	33 (1.0)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	25 (1.2)	24 (0.7)
Non-instructional activities (e.g., attendance taking, interruptions)	9 (0.6)	7 (0.3)
Middle*		
Whole class activities (e.g., lectures, explanations, discussions)	40 (1.6)	39 (0.9)
Small group work	25 (1.7)	29 (1.0)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	23 (1.1)	22 (0.8)
Non-instructional activities (e.g., attendance taking, interruptions)	12 (0.6)	10 (0.3)
High*		
Whole class activities (e.g., lectures, explanations, discussions)	41 (1.7)	43 (0.7)
Small group work	27 (1.7)	25 (0.8)
Students working individually (e.g., reading textbooks, completing worksheets, taking a test or quiz)	22 (1.5)	22 (0.7)
Non-instructional activities (e.g., attendance taking, interruptions)	11 (0.5)	9 (0.2)

* There is a statistically significant difference between classes taught by novice and veteran teachers (Chi-square test of independence, $p < 0.05$).

Homework Practices

Teachers were asked about the amount of homework assigned per week. At the elementary level, the majority of classes were assigned 30 minutes or less of homework per week, (see Table 56). At the middle and high school grade bands, most classes were assigned more than 30 minutes of homework per week. However, it appears that middle and high school classes taught by novice teachers were assigned less homework per week than secondary classes taught by veteran teachers.

Table 56
Amount of Homework Assigned in Classes Per Week

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
None	7 (2.4)	10 (1.7)
1–15 minutes per week	18 (3.2)	16 (2.0)
16–30 minutes per week	28 (4.5)	25 (2.0)
31–60 minutes per week	30 (4.6)	32 (2.4)
61–90 minutes per week	11 (2.7)	10 (1.5)
91–120 minutes per week	4 (1.8)	6 (1.1)
More than 2 hours per week	1 (0.8)	1 (0.5)
Middle*		
None	2 (1.2)	6 (2.1)
1–15 minutes per week	5 (1.7)	7 (1.6)
16–30 minutes per week	27 (5.1)	11 (1.6)
31–60 minutes per week	33 (4.1)	35 (3.1)
61–90 minutes per week	15 (3.5)	24 (2.6)
91–120 minutes per week	11 (3.4)	14 (2.4)
More than 2 hours per week	6 (2.7)	3 (1.0)
High*		
None	5 (2.0)	3 (0.8)
1–15 minutes per week	8 (2.3)	3 (0.6)
16–30 minutes per week	16 (4.9)	11 (1.5)
31–60 minutes per week	35 (4.4)	27 (1.6)
61–90 minutes per week	21 (3.3)	28 (2.0)
91–120 minutes per week	9 (2.2)	15 (1.5)
More than 2 hours per week	6 (2.0)	13 (1.8)

* There is a statistically significant difference in the distribution of responses between classes taught by novice and veteran teachers (Chi-square test of independence, $p \geq 0.05$).

Instructional Resources

The survey also collected data on teachers' use of various types of instructional resources. As can be seen in Table 57, commercially published textbooks and teacher-created units or lessons were likely to be used weekly in classes taught by novices and veterans. At the elementary level, lessons or resources from websites that have a subscription fee were also commonly used on a weekly basis. There were no differences in the type of instructional resources used by novice and veteran teachers at any grade level.

Table 57
Mathematics Classes Basing Instruction on Various Instructional Resources at Least Once a Week†

	PERCENT OF CLASSES[a]	
	NOVICE	VETERAN
Elementary		
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	71 (3.5)	78 (2.2)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	58 (4.1)	53 (2.5)
Units or lessons you created (either by yourself or with others)	47 (4.0)	42 (2.2)
State, county, district, or diocese-developed units or lessons	45 (3.5)	39 (2.4)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	36 (3.3)	38 (2.3)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	34 (3.3)	37 (2.5)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	30 (3.4)	30 (1.9)
Middle		
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	63 (4.3)	67 (2.8)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	33 (3.6)	34 (2.8)
Units or lessons you created (either by yourself or with others)	65 (4.6)	65 (2.8)
State, county, district, or diocese-developed units or lessons	29 (2.7)	24 (2.0)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	36 (4.4)	39 (2.6)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	26 (4.0)	24 (2.1)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	28 (3.2)	31 (2.4)
High		
Commercially published textbooks (printed or electronic), including the supplementary materials (e.g., worksheets) that accompany the textbooks	56 (4.1)	63 (1.7)
Lessons or resources from websites that have a subscription fee or per lesson cost (e.g., BrainPOP, Discovery Ed, Teachers Pay Teachers)	22 (3.4)	18 (1.2)
Units or lessons you created (either by yourself or with others)	79 (2.8)	77 (1.5)
State, county, district, or diocese-developed units or lessons	23 (3.1)	22 (1.3)
Lessons or resources from websites that are free (e.g., Khan Academy, Illustrative Math)	30 (3.8)	25 (1.5)
Online units or courses that students work through at their own pace (e.g., i-Ready, Edgenuity)	14 (2.4)	11 (1.2)
Units or lessons you collected from any other source (e.g., conferences, journals, colleagues, university or museum partners)	39 (4.0)	31 (2.4)

† There are no statistically significant differences between novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

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

Teachers were asked whether the instructional materials used in their most recent unit were based primarily on either a commercially published textbook or materials developed by the state or district. As can be seen in Table 58, more than two-thirds of classes across grade bands were based on such materials. Further, classes taught by novices and veterans were equally likely to use one of these types of materials in their most recent unit.

Table 58
Mathematics Classes in Which the Most Recent Unit Was Based on a Commercially Published Textbook or a Material Developed by the State or District†

	PERCENT OF CLASSES[b]	
	NOVICE	VETERAN
Elementary	78 (3.2)	82 (1.8)
Middle	68 (4.2)	71 (2.7)
High	71 (4.4)	74 (1.9)

† There are no statistically significant differences between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p \geq 0.05$).

Teachers who based their most recent unit on one of these types of materials were then asked how they used the materials. As can be seen in Table 59, teachers in over 80 percent of these classes across grade bands used these materials to substantially guide the overall structure and content emphasis of the unit. However, teachers also substantially modified these materials by incorporating activities from other sources, modifying activities, and skipping portions of the materials. It is worth noting that novices at the elementary and middle school levels were less likely than veterans to pick what was important from the materials and skip the rest (41 vs. 51 percent and 43 vs. 56 percent, respectively). Given that novices felt less well prepared than their veteran counterparts to teach mathematics content and utilize a number of pedagogical strategies, it is perhaps not surprising that they relied heavily on these materials and were more likely to use them as written.

Table 59
Ways Mathematics Teachers Substantially[a] Used Their Materials in Most Recent Unit

	PERCENT OF CLASSES[b]	
	NOVICE	VETERAN
Elementary		
I used these materials to guide the structure and content emphasis of the unit.	86 (3.3)	88 (1.6)
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	68 (3.9)	69 (2.4)
I modified activities from these materials.	58 (4.9)	62 (2.8)
I picked what is important from these materials and skipped the rest.*	41 (4.5)	51 (2.6)
Middle		
I used these materials to guide the structure and content emphasis of the unit.	86 (3.9)	81 (2.1)
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	59 (7.4)	67 (3.1)
I modified activities from these materials.	58 (7.1)	63 (2.9)
I picked what is important from these materials and skipped the rest.*	43 (6.0)	56 (3.0)
High		
I used these materials to guide the structure and content emphasis of the unit.	83 (3.9)	81 (1.7)
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.	68 (4.4)	63 (2.2)
I modified activities from these materials.	60 (4.6)	60 (1.9)
I picked what is important from these materials and skipped the rest.	43 (5.9)	54 (1.9)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

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

When teachers modified these materials (which roughly 60 percent at each grade band did), they were asked about factors that may have contributed to their decision to do so. As can be seen in Table 60, in at least half of classes at each grade band, teachers did not having enough time to implement the activities as designed. Teachers in 46–61 percent of classes also modified materials because they were too difficult for their students. However, novices at the elementary level were more likely than veterans to modify materials because they were too difficult for students (61 vs. 46 percent).

Table 60
Reasons Why Parts of Mathematics Materials Are Modified[a]

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
I did not have enough instructional time to implement the activities as designed.	62 (6.0)	51 (3.4)
The original activities were too difficult conceptually for my students.*	61 (5.8)	46 (3.8)
The original activities were too easy conceptually for my students.	47 (5.6)	54 (3.6)
The original activities were too structured for my students.	39 (5.5)	31 (2.8)
The original activities were not structured enough for my students.	38 (4.9)	29 (2.9)
I did not have the necessary materials/supplies for the original activities.	32 (5.1)	26 (3.0)
Middle		
I did not have enough instructional time to implement the activities as designed.	74 (5.3)	67 (3.2)
The original activities were too difficult conceptually for my students.	57 (6.6)	55 (3.6)
The original activities were too easy conceptually for my students.	40 (5.6)	46 (3.8)
The original activities were too structured for my students.	34 (6.1)	35 (3.6)
The original activities were not structured enough for my students.	44 (6.2)	37 (3.6)
I did not have the necessary materials/supplies for the original activities.	37 (5.3)	27 (3.5)
High		
I did not have enough instructional time to implement the activities as designed.	56 (6.1)	58 (2.8)
The original activities were too difficult conceptually for my students.	60 (7.6)	53 (2.6)
The original activities were too easy conceptually for my students.	42 (4.8)	37 (2.4)
The original activities were too structured for my students.	28 (4.4)	33 (2.5)
The original activities were not structured enough for my students.	41 (4.9)	33 (2.6)
I did not have the necessary materials/supplies for the original activities.	28 (5.1)	29 (2.1)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

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

When asked about the adequacy of resources for mathematics instruction, teachers of classes at all grade levels generally rated the availability of resources as adequate (see Table 61). Comparing novices to veterans, teachers of secondary classes generally rated the adequacy of resources similarly. The one exception was at the middle school level where classes taught by novice teachers were less likely to have adequate measurement tools than classes taught by veteran teachers (74 vs. 85 percent). Novice teachers of elementary school classes were less likely than their veteran counterparts to think their access to measurement tools (71 vs. 82 percent), instructional technology (55 vs. 71 percent), and consumable supplies (54 vs. 68 percent) was adequate.

Table 61
Adequacy[a] of Resources for Mathematics Instruction

	PERCENT OF CLASSES	
	NOVICE	VETERAN
Elementary		
Manipulatives (e.g., pattern blocks, algebra tiles)	84 (3.2)	88 (1.9)
Measurement tools (e.g., protractors, rulers)*	71 (3.8)	82 (2.1)
Instructional technology (e.g., calculators, computers, probes/sensors)*	55 (4.4)	71 (2.6)
Consumable supplies (e.g., graphing paper, batteries)*	54 (4.9)	68 (2.9)
Middle		
Manipulatives (e.g., pattern blocks, algebra tiles)	63 (4.3)	63 (3.4)
Measurement tools (e.g., protractors, rulers)*	74 (4.0)	85 (2.5)
Instructional technology (e.g., calculators, computers, probes/sensors)	77 (4.6)	80 (2.8)
Consumable supplies (e.g., graphing paper, batteries)	72 (4.6)	77 (3.0)
High		
Manipulatives (e.g., pattern blocks, algebra tiles)	46 (5.9)	52 (2.4)
Measurement tools (e.g., protractors, rulers)	73 (4.6)	82 (1.8)
Instructional technology (e.g., calculators, computers, probes/sensors)	81 (4.4)	86 (1.6)
Consumable supplies (e.g., graphing paper, batteries)	73 (4.2)	78 (1.9)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

[a] 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 called Adequacy of Resources for Mathematics Instruction (see Table 62). Mean scores indicate that teachers generally felt they had adequate resources for mathematics instruction. However, novice teachers of elementary and high school classes were less likely to have positive views about the adequacy of resources than their veteran counterparts (mean scores of 72 vs. 82 and 73 vs. 79, respectively).

Table 62
Class Mean Scores for the Adequacy of Resources for Mathematics Instruction Composite

	MEAN SCORE	
	NOVICE	VETERAN
Elementary*	72 (2.0)	82 (1.2)
Middle	77 (2.3)	81 (1.0)
High*	73 (2.5)	79 (0.9)

* There is a statistically significant difference between classes taught by novice and veteran teachers (two-tailed independent samples t-test, $p < 0.05$).

Summary

Novice and veteran mathematics teachers primarily worked in public school settings and were relatively evenly distributed among schools based on the percentage of students in school eligible for free or reduced-price lunch. However, novice mathematics teachers appear to be more likely than veteran mathematics teachers to teach in urban schools and less likely to teach in suburban schools.

When considering school context, large percentages of novices and veterans tended to work in schools where state standards wield a great deal of influence over mathematics instruction. Other school-level factors (e.g., the importance that the school places on mathematics, mathematics professional development policies and practices) were viewed as only moderately supportive of effective mathematics instruction. Further, teacher issues, lack of resources, and student issues were somewhat problematic in schools at all three grade bands.

Looking at teacher characteristics, large percentages of novices and veterans are female (particularly at the elementary level) and white. In terms of teaching experience, most novices were new to the teaching profession in general, not just new to mathematics teaching. Although the majority of teachers across grade bands had earned a teaching credential, novices at the secondary level appeared to be less likely to have a credential than their veteran counterparts.

Very few elementary teachers had a degree in mathematics or mathematics education, and only about one-half had coursework in algebra, geometry, number and operations, probability, and statistics. Substantially more novice and veteran teachers at the secondary level had a degree in mathematics or mathematics education. At the high school level, novices were less likely to have these degrees than veterans.

Over 75 percent of novice and veteran elementary teachers participated in mathematics-focused professional development in the previous three years; this percentage increased to over 90 percent at the secondary level. Across grade bands, professional development opportunities for novices and veterans were only moderately aligned with elements of effective professional development and moderately supportive of student-centered instruction.

Novice and veteran mathematics teachers at the elementary, middle, and high school grade bands held several reform-oriented beliefs aligned with current thinking about effective mathematics instruction (e.g., the teacher should ask students to justify their mathematical thinking, students learn best when instruction is connected to their everyday lives). However, novices were more likely to hold traditional beliefs than their veteran counterparts. At the elementary level, novices were more likely than veterans to agree that students should be provided with definitions for new vocabulary at the beginning of instruction, that hands-on activities/manipulatives should be used primarily to reinforce a mathematics idea that students have already learned, and that teachers should explain an idea to students before having them consider evidence that relates to the idea. Similarly, at the high school level, novices were more likely than veterans to agree that hands-on activities should be primarily used for reinforcement, but less likely to believe that students learn mathematics best in classes with students of similar abilities.

A majority of elementary mathematics teachers felt at least fairly well prepared to teach various mathematics topics, including number and operations, early algebra, geometry, and measurement

and data representation. At the secondary level, modest percentages of middle school teachers felt well prepared to teach mathematics concepts across content areas; feelings of preparedness increased among novices and veterans at the high school level. However, across all grade levels, novices were less likely than veterans to consider themselves very well prepared to teach a number of mathematics topics.

In terms of pedagogical preparedness, both novice and veteran teachers felt only moderately well prepared to carry out a number of tasks. Notably, fewer than 30 percent of teachers at each grade band felt very well prepared to provide mathematics instruction based on students' ideas, incorporate students' cultural backgrounds into mathematics instruction, or develop students' awareness of STEM careers. However, these percentages tended to increase with increasing grade band.

When asked specifically about their preparedness to implement instruction in a particular unit, most novice teachers did not feel very well prepared to monitor student understanding during the unit or anticipate difficulties that students may have with particular mathematical ideas and procedures. Further, novices as each grade band felt less well prepared in these areas than veterans.

Both novices and veterans felt much more in control of pedagogical decisions, such as determining the amount of homework to be assigned, than curriculum decisions, such as determining course goals and objectives. Data on instructional objectives indicate that classes heavily emphasized learning how to do mathematics and understanding mathematical ideas. Across grade bands and teacher experience level, classes were generally likely to emphasize these reform-oriented instructional objectives.

Mathematics instruction in classes taught by novices and veterans relied heavily on whole group discussions and teacher explanation of ideas. Further, survey data indicate that engagement with the mathematical practices was relatively high and was similar across grade levels and between novice and veteran teachers.

Many classes were taught by teachers who relied on teacher-created units or lessons on a weekly basis. Lessons or resources that have a subscription fee; commercially published textbooks; and materials developed by the state, county, or district were also frequently used. Teachers using commercially published textbooks or materials published by their state or district often deviated from these materials by supplementing, modifying, or skipping parts of activities. However, novices deviated less often than their veteran counterparts, likely due to their perceived lack of preparedness to teach mathematics concepts and use various pedagogical strategies. Common reasons for modifications included lack of instructional time and the level of difficulty of the materials.

When asked about the adequacy of resources for mathematics instruction, teachers at all levels rated the availability of resources as adequate. However, novice teachers of elementary and high school classes were less likely than their veteran counterparts to report adequate access to manipulatives, measurement tools, instructional technology, and consumable supplies.