The 2018 NSSME+

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Current reports:
• Technical report
• Highlights report
• Compendium of tables

Upcoming:
• Subject/grade reports
• Trend report
• Equity reports
• Early career teachers
• Briefing book
• Public-release dataset
Session Overview

• About the 2018 NSSME+

• The Mathematics Teaching Force

• Teacher Preparation and Professional Development

• Mathematics Instruction

• Course Offerings, Enrollment, Completion
The 2018 NSSME+, and this presentation, is based upon work supported by the National Science Foundation under Grant No. DGE-1642413. Any opinions, findings, and conclusions or recommendations expressed are those of the authors and do not necessarily reflect the views of the National Science Foundation.
About the 2018 NSSME+

• The 2018 NSSME+ is the sixth in a series of surveys dating back to 1977.

• It is the only survey specific to K-12 STEM education that provides nationally representative results.
Topics Addressed

Six different survey instruments

- Characteristics of the science/mathematics/computer science teaching force
- Opportunities teachers have for professional growth
- Instructional practices
- Factors that shape teachers’ decisions about content and pedagogy
- Resource availability including instructional materials
- Course offerings and enrollment
Who’s In the Sample

Two-stage random sample that targeted:
• 2,000 schools (public and private)
• Over 10,000 K–12 teachers

Very good response rate:
• 1,273 schools participated
• 86 percent of program representatives
• 78 percent of sampled teachers
Endorsing Organizations

• American Association of Chemistry Teachers
• American Association of Physics Teachers
• American Federation of Teachers
• Association of Mathematics Teacher Educators
• American Society for Engineering Education
• Association of State Supervisors of Mathematics
• Association for Science Teacher Education
• Council of State Science Supervisors
• Computer Science Teachers Association
• National Association of Biology Teachers
• National Association of Elementary School Principals
• National Association of Secondary School Principals
• National Council of Supervisors of Mathematics
• National Council of Teachers of Mathematics
• National Earth Science Teachers Association
• National Education Association
• National Science Education Leadership Association
• National Science Teachers Association
Interpreting Results

After data collection, design weights were computed, adjusted for nonresponse, and applied to the data.

The sampling and weighting processes yield results that are national estimates of schools, teachers, and classes—not characteristics of just the respondents.
The Mathematics Teaching Force

The 2018 NSSME+ collected data about:

• Demographics of teachers
• Path to certification
• Perceptions of preparedness
• College-level coursework
Paths to Certification

Percent of Teachers

<table>
<thead>
<tr>
<th></th>
<th>Not credentialed</th>
<th>Masters</th>
<th>Post-baccalaureate program</th>
<th>Undergraduate program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>2</td>
<td>23</td>
<td>65</td>
<td>10</td>
</tr>
<tr>
<td>Middle</td>
<td>4</td>
<td>20</td>
<td>61</td>
<td>14</td>
</tr>
<tr>
<td>High</td>
<td>7</td>
<td>21</td>
<td>57</td>
<td>16</td>
</tr>
</tbody>
</table>

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Perceptions of Preparedness

To teach grade-level content

**Elementary**
- Number and operation
- Early algebra
- Geometry
- Measurement and data representation

**Secondary**
- Number system
- Algebraic thinking
- Functions
- Modeling
- Geometry
- Statistics and probability
- Discrete mathematics

To use student-centered pedagogies

- Use formative assessment
- Develop student abilities to do math
- Encourage student interest in math
- Differentiate instruction
- Incorporate students’ cultural backgrounds into instruction
- …
Perceptions of Preparedness

Teacher Composite Scores

<table>
<thead>
<tr>
<th>Math. Content</th>
<th>Pedagogy</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>69</td>
</tr>
<tr>
<td>78</td>
<td>69</td>
</tr>
<tr>
<td>82</td>
<td>71</td>
</tr>
</tbody>
</table>

- Elementary
- Middle
- High
Elementary Mathematics Teachers’ Coursework Related to Preparation Standards

Percent of Elementary Teachers

- 7% in 5 areas
- 53% in 0 areas
- 2% in 4 areas
- 39% in 1-2 areas

Courses in:
- 0 areas
- 1-2 areas
- 3-4 areas
- 5 areas
Middle School Mathematics Teachers’ Coursework Related to Preparation Standards

Percent of Middle School Teachers

- 37% Courses in 6 areas
- 27% Courses in 4-5 areas
- 15% Courses in 2-3 areas
- 21% Courses in 0-1 areas

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High School Mathematics Teachers’ Coursework Related to Preparation Standards

Percent of High School Teachers

- 40% Courses in 7 areas
- 36% Courses in 0-2 areas
- 16% Courses in 3-4 areas
- 7% Courses in 5-6 areas

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Mathematics Teaching Force Take-Aways

A sizeable proportion of the mathematics teaching force is newer. Retention, professional development, and support for these teachers now is essential for the long-term stability of the teaching force.

Teachers’ sense of their content and pedagogical preparedness is encouraging but still an important concern.

Across grade levels, although teachers generally perceive they are well prepared regarding the mathematics content they teach, many lack the breadth and extent of formal preparation that is currently recommended.
Inservice Teacher Support

The 2018 NSSME+ asked about:

• School/district-offered induction programs
• School/district-offered professional development (workshops, study groups/PLCs, coaching)
• Teachers’ PD experiences
Induction Programs

Duration of Formal Induction Program

<table>
<thead>
<tr>
<th>Percent of Schools</th>
<th>Elementary</th>
<th>Middle</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>15</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>20%</td>
<td>26</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>40%</td>
<td>32</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>60%</td>
<td>26</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>80%</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 3+ years
- 2 years
- 1 year or less
- None

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Induction Programs

Common features
• An orientation meeting
• Formal school-based mentor
• Subject-specific PD opportunities
• Release time to observe other teachers
• Common planning time with experienced teachers

Uncommon features
• Classroom aide/teaching assistant
• Reduced number of preparations
• Reduced course load
• Reduced class size
Professional Development

Hours of Mathematics PD in Last 3 Years

Percent of Teachers

- 36+ hours
- 6-35 hours
- <6 hours
- None

Elementary
- 13
- 53
- 17
- 16

Middle
- 37
- 44
- 8
- 11

High
- 41
- 41
- 7
- 11

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## Characteristics of PD

<table>
<thead>
<tr>
<th>Method</th>
<th>Elementary</th>
<th>Middle</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work closely with teachers in school</td>
<td>69</td>
<td>72</td>
<td>67</td>
</tr>
<tr>
<td>Work with those teaching same subject or grade level</td>
<td>56</td>
<td>58</td>
<td>57</td>
</tr>
<tr>
<td>Apply what they learn in classroom and come back to discuss</td>
<td>44</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Examine classroom artifacts</td>
<td>46</td>
<td>49</td>
<td>44</td>
</tr>
<tr>
<td>Engage in mathematics investigations</td>
<td>46</td>
<td>47</td>
<td>43</td>
</tr>
<tr>
<td>Experience lessons as students</td>
<td>48</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Rehearse instructional practices</td>
<td>35</td>
<td>34</td>
<td>32</td>
</tr>
</tbody>
</table>
Schools Offering Teacher Study Groups in Mathematics in Last 3 Years

- Elementary: 55%
- Middle: 57%
- High: 53%
Schools Providing One-on-One Coaching in Mathematics

Percent of Schools

Elementary: 43%
Middle: 33%
High: 29%
Schools Providing One-on-One Coaching in Mathematics

- 18 percent of teachers receive coaching in Elementary schools.
- 16 percent of teachers receive coaching in Middle schools.
- 13 percent of teachers receive coaching in High schools.
Inservice Support Take-Aways

A large majority of schools have new teacher induction programs, though duration and nature vary.

PD programs often have characteristics identified as high quality, but teachers’ extent of opportunity/participation varies widely.

School-based mathematics PD is far from universal.
What mathematics instruction are students experiencing?

The 2018 NSSME+ asked about:

- Instructional formats
- Instructional objectives
- Mathematical practices
- Instructional materials
Instructional Formats: Weekly

- Teacher explains ideas: 95% (Elementary), 95% (Middle), 95% (High)
- Whole-class discussion: 84% (Elementary), 91% (Middle), 95% (High)
- Small-group work: 71% (Elementary), 77% (Middle), 88% (High)
- Provide manipulatives: 20% (Elementary), 29% (Middle), 78% (High)
- Write reflections: 19% (Elementary), 30% (Middle), 41% (High)
- Use flipped instruction: 10% (Elementary), 11% (Middle), 13% (High)
Objectives Receiving a Heavy Emphasis

- Understand mathematical concepts
- Learn how to do math
- Develop student confidence
- Increase student interest
- Learn math vocabulary
- Learn how to perform computations

Percent of Classes

<table>
<thead>
<tr>
<th>Objective</th>
<th>Elementary</th>
<th>Middle</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand mathematical concepts</td>
<td>67</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Learn how to do math</td>
<td>62</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Develop student confidence</td>
<td>37</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Increase student interest</td>
<td>34</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Learn math vocabulary</td>
<td>27</td>
<td>29</td>
<td>36</td>
</tr>
<tr>
<td>Learn how to perform computations</td>
<td>20</td>
<td>21</td>
<td>33</td>
</tr>
</tbody>
</table>
Engagement in Standards for Mathematical Practice

The 2018 NSSME+ included a series of items asking how often students were engaged in aspects of the mathematical practices:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments/critique reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning
Standards for Mathematical Practice: Weekly

- Determine if answer makes sense: Elementary 85, Middle 85, High 84
- Provide math reasoning: Elementary 85, Middle 83, High 76
- Work on challenging problems: Elementary 71, Middle 75, High 74
- Develop math models: Elementary 70, Middle 64, High 75
- Work on generating a rule or formula: Elementary 61, Middle 59, High 70
- Analyze math reasoning of others: Elementary 65, Middle 53, High 61
Standards for Mathematical Practice: Daily

- Determine if answer makes sense: Elementary 46, Middle 39, High 44
- Provide math reasoning: Elementary 44, Middle 39, High 36
- Work on challenging problems: Elementary 25, Middle 24, High 22
- Develop math models: Elementary 26, Middle 23, High 36
- Work on generating a rule or formula: Elementary 20, Middle 22, High 20
- Analyze math reasoning of others: Elementary 23, Middle 21, High 15

Percent of Classes

Elementary | Middle | High
Instructional Materials

For most classes, districts/diocese designate instructional materials to be used:

- **Elementary:** 91%
- **Middle:** 80%
- **High:** 66%
## What Is Designated?

<table>
<thead>
<tr>
<th></th>
<th>Percent of Classes</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elementary</td>
<td>Middle</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Commercially published textbooks</td>
<td>89</td>
<td>88</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>State, county, or district-developed units or lessons</td>
<td>44</td>
<td>37</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Lessons or resources from websites that are free</td>
<td>28</td>
<td>30</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Lessons or resources from websites that have a subscription fee or cost</td>
<td>31</td>
<td>22</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Self-paced online courses or units</td>
<td>33</td>
<td>33</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>
### What Are Teachers Using? (weekly)

<table>
<thead>
<tr>
<th>Source of Material</th>
<th>Percent of Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elementary</td>
</tr>
<tr>
<td>Commercially published textbooks</td>
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<td>54</td>
</tr>
<tr>
<td>Self-paced online courses or units</td>
<td>36</td>
</tr>
<tr>
<td>Teacher-developed units or lessons</td>
<td>44</td>
</tr>
<tr>
<td>Units or lessons from other sources (e.g., conferences, colleagues)</td>
<td>30</td>
</tr>
</tbody>
</table>
Instruction Take-Aways

Lecture/exposition, whole class discussion, and small group work are all common activities in most mathematics classes.

Developing conceptual understanding and learning how to do mathematics receive heavy emphases in most classes across grade bands.

Most mathematics classes engage with the Standards for Mathematical Practice on a weekly basis, but most do not engage with them daily.

Teachers use an array of instructional materials, raising questions about quality and coherence.
Approach to examining equity

Equitable distribution with respect to:

• Mathematics teaching contexts

• Well-prepared teachers

• Nature of instruction

• Course offerings and enrollment
Factors Associated with Differences in Educational Opportunities

Class-level Factors

• Prior achievement level of students in the class
• Percentage of students in the class from race/ethnicity groups historically underrepresented in STEM (HU)

School-level Factors

• Percentage of students in the school eligible for free or reduced-price lunch (FRL)
• School size
• School community type (rural, urban, suburban)
Course Offerings and Enrollment

- 8th grade students completing Algebra 1, Geometry

- High schools offering formal advanced mathematics courses (e.g., Algebra 2, pre-calculus, AP Calculus)

- Availability of AP courses

- Enrollment in high school mathematics courses
Middle School Students Completing Algebra 1 and Geometry

• About $\frac{3}{4}$ of middle schools have at least some students completing Algebra 1 prior to 9th grade

• About $\frac{1}{4}$ of middle schools have at least some students completing Geometry prior to 9th grade
Average Percentage of 8th Graders Completing Algebra 1 & Geometry

<table>
<thead>
<tr>
<th></th>
<th>Low FRL Schools</th>
<th>High FRL Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1*</td>
<td>48</td>
<td>29</td>
</tr>
<tr>
<td>Geometry</td>
<td>17</td>
<td>7</td>
</tr>
</tbody>
</table>
Average Percentage of 8th Graders Completing Algebra 1 & Geometry

<table>
<thead>
<tr>
<th>Suburban Schools</th>
<th>Urban Schools</th>
<th>Rural Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1*</td>
<td>43</td>
<td>32</td>
</tr>
<tr>
<td>Geometry*</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

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## High Schools Offering Various Mathematics Courses

<table>
<thead>
<tr>
<th>Level/Description</th>
<th>Percent of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-college prep (e.g., Remedial Math, General Math, Consumer Math)</td>
<td>79</td>
</tr>
<tr>
<td>Formal/College prep level 1 (e.g., Algebra 1, Integrated Math 1)</td>
<td>98</td>
</tr>
<tr>
<td>Formal/College prep level 2 (e.g., Geometry, Integrated Math 2)</td>
<td>93</td>
</tr>
<tr>
<td>Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry)</td>
<td>91</td>
</tr>
<tr>
<td>Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3)</td>
<td>90</td>
</tr>
<tr>
<td>Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)</td>
<td>72</td>
</tr>
</tbody>
</table>
Average Number of AP Mathematics Courses Offered

Percent FRL in School*

<table>
<thead>
<tr>
<th>School Size*</th>
<th>Average Number of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest Schools</td>
<td>2</td>
</tr>
<tr>
<td>Smallest Schools</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Low FRL Schools 1.3

High FRL Schools 0.8
Average Number of AP Mathematics Courses Offered

Community Type*

<table>
<thead>
<tr>
<th></th>
<th>Average Number of Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suburban Schools</td>
<td>1.5</td>
</tr>
<tr>
<td>Urban Schools</td>
<td>1.5</td>
</tr>
<tr>
<td>Rural Schools</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Average Percentages of Historically Under-represented Students in High School Courses

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Percent HU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-college prep (e.g., Remedial Math, General Math, Consumer Math)</td>
<td>53</td>
</tr>
<tr>
<td>Formal/College prep level 1 (e.g., Algebra 1, Integrated Math 1)</td>
<td>38</td>
</tr>
<tr>
<td>Formal/College prep level 2 (e.g., Geometry, Integrated Math 2)</td>
<td>39</td>
</tr>
<tr>
<td>Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry)</td>
<td>37</td>
</tr>
<tr>
<td>Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3)</td>
<td>33</td>
</tr>
<tr>
<td>Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)</td>
<td>22</td>
</tr>
</tbody>
</table>
Closing Thoughts

• Important limitations

• NSSME+ provides an opportunity to examine some questions of access at national scale

• Some hopeful findings

• Also evidence that historic inequities persist

• What implications do you see for your work?

• What implications do you see for improving mathematics education more broadly?