# NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION
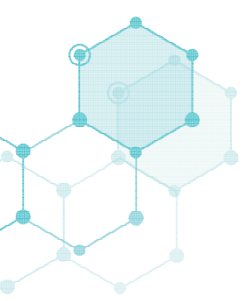
# Are We Providing High-Quality Mathematics Instruction for All? Highlights from the 2018 NSSME+

**ANNUAL AMTE CONFERENCE**
**FEBRUARY 6, 2020**
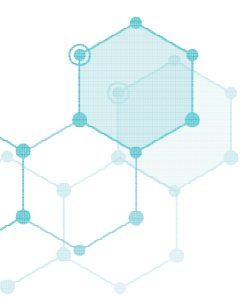
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*horizon* RESEARCH, INC.

# Session Overview

- **Describe the 2018 NSSME+**

- **Share equity findings & trend**
  - Nature of instruction
  - Well-prepared teachers

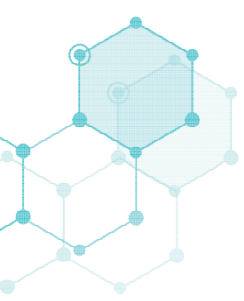- **Discuss implications for teacher preparation & ongoing support**

# 2018 NSSME+

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

- **It is the only survey specific to STEM education that provides nationally representative results.**
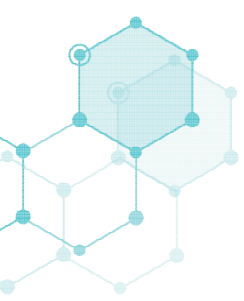
# 2018 NSSME+

**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.**
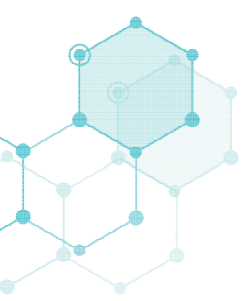
# Topics Addressed

## Program Questionnaire

- School programs & practices

- Course offerings

- Influences on instruction

- PD offerings

## Teacher Questionnaire

- Background & preparation

- Pedagogical beliefs

- PD experiences

- Instruction & materials
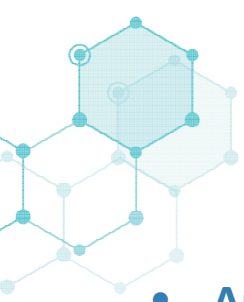
- Influences on instruction

# Sample

**Two-stage random sample that targeted:**

- 2,000 schools (public and private)
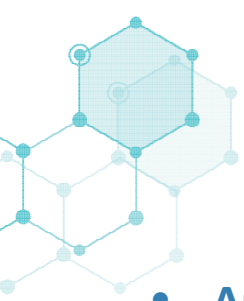- Over 10,000 K–12 teachers

**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**
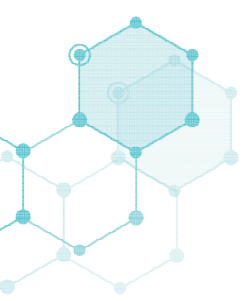- **National Science Teachers Association**

# Endorsing Organizations

- American Association of Chemistry Teachers
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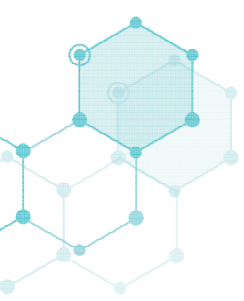- National Science Teachers Association

# Interpreting Results

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

Why is this important?

The sampling and weighting processes mean that the results are national estimates of schools, teachers, and classes—<u>not</u> characteristics of the respondents.

# Situating the Equity Work

- **The 2018 NSSME+ was not designed primarily as an equity study.**

- **The survey offers a rich source of data for examining K–12 mathematics education and the extent to which opportunities are equitably available.**
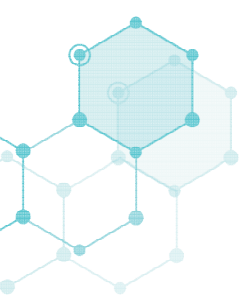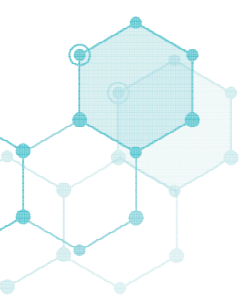
# Factors Associated with Differences in Educational Opportunities

## Class-level Factors

- Percentage of students in the class from race/ethnicity groups historically underrepresented in STEM **(HUS)**
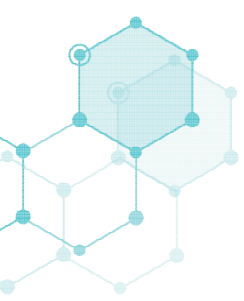- Prior achievement level of students

## School-level Factors

- Percentage of students in the school eligible for free or reduced-price lunch **(FRL)**
- School community type (rural, suburban, urban)

# Correlated Factors

- **HUS and FRL**

- **HUS and prior achievement level**
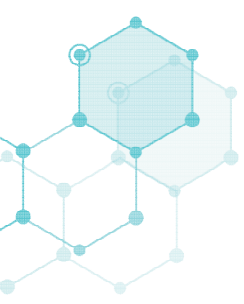
# Equity Comparisons

### HUS & FRL

- Comparisons made between highest and lowest quartiles

### Prior achievement

- Comparisons made between classes of mostly low-prior-achieving students (LPA) and those of mostly high-prior-achieving students (HPA)
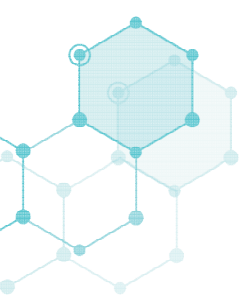
### Community type

- Comparisons were made among all three community types

# General Findings

- **Most disparities existed when comparing classes of mostly LPA and class of mostly HPA.**

- **Far fewer disparities exist by community type.**

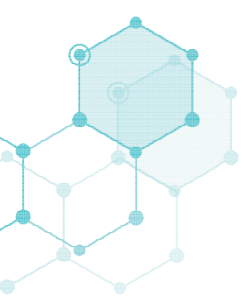- **Not much has changed since 2012.**
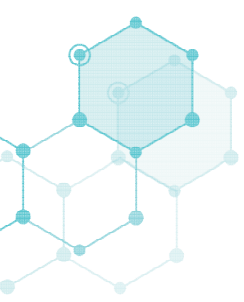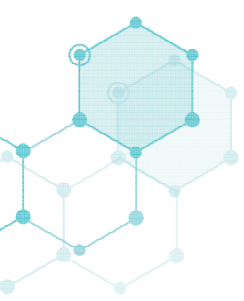
# Nature of Mathematics Instruction

# Nature of Mathematics Instruction

- **Instructional time**

- **Course taking opportunities & enrollment**

- **Instructional objectives**
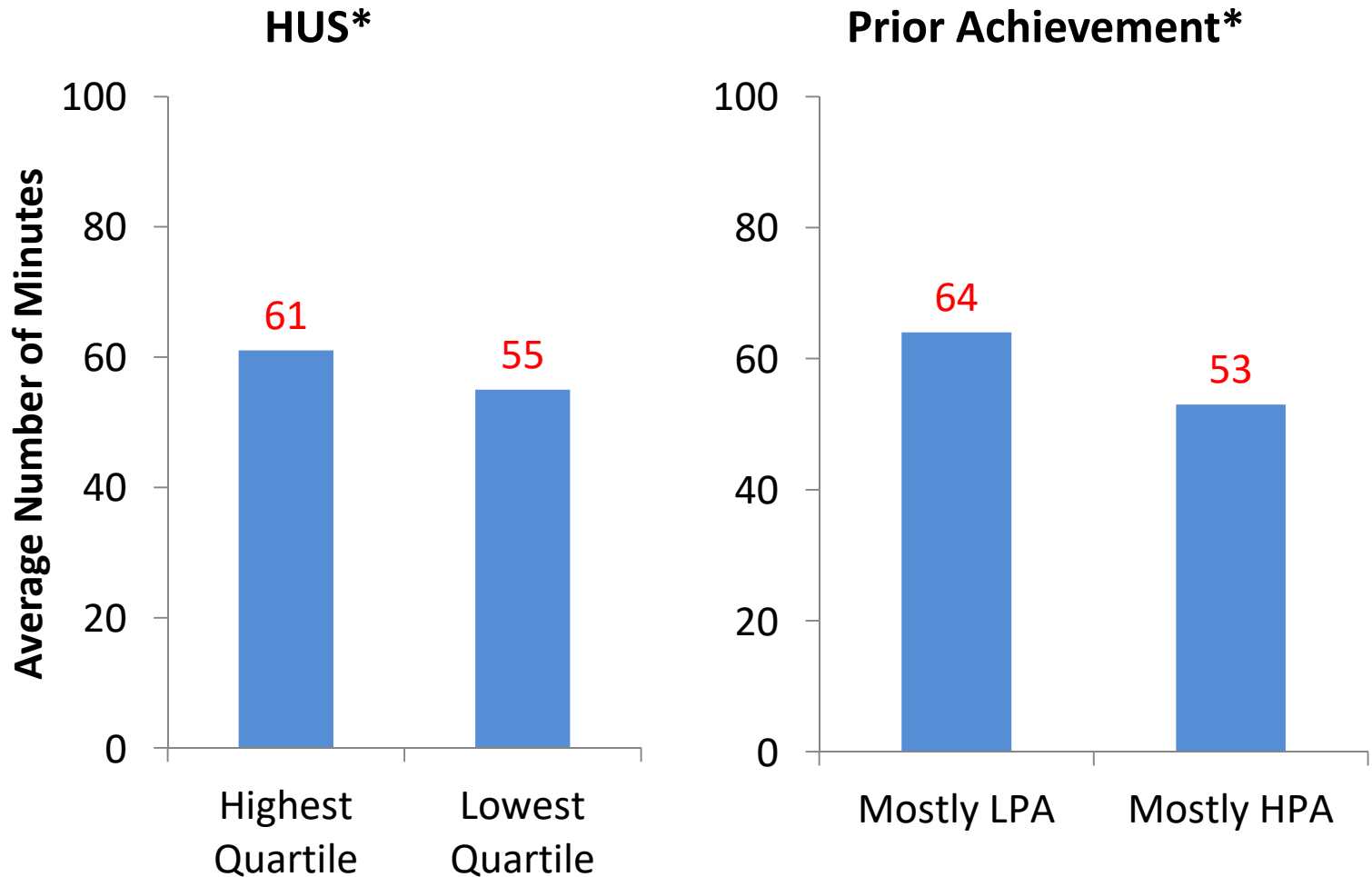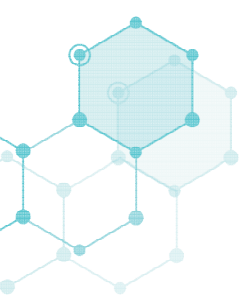
- **Class activities**

# Average Number of Minutes Per Day on Elementary Mathematics

- **No differences in amount of time spent on elementary mathematics by FRL or community type**
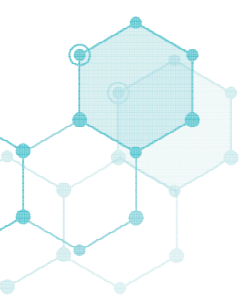
- **Differences by both class level factors**

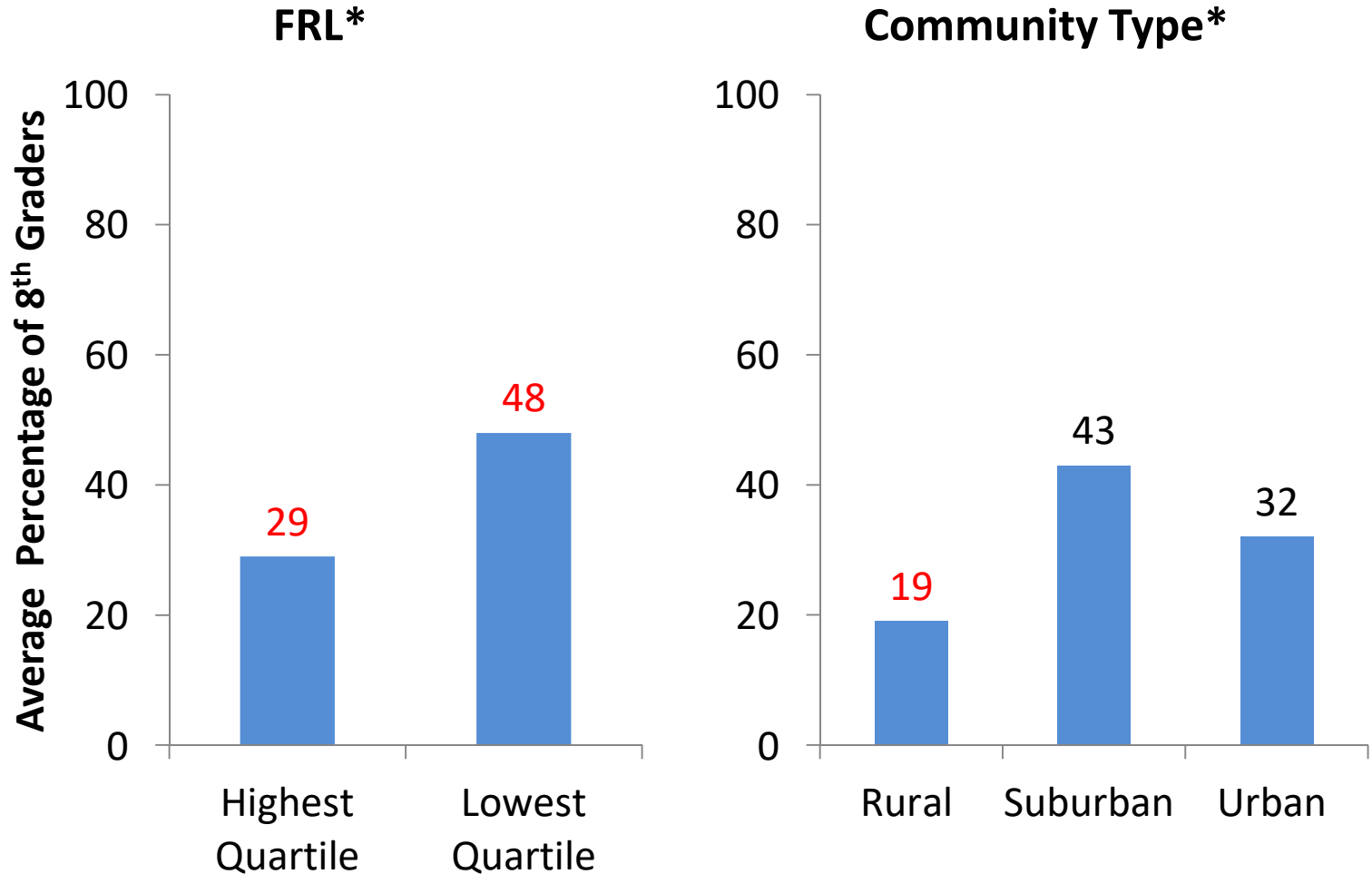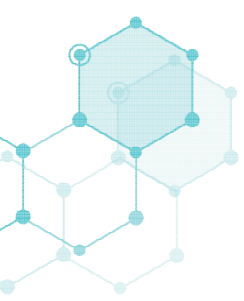# Average Number of Minutes Per Day on Elementary Mathematics

# Course Offerings

- **8th grade students completing Algebra 1, Geometry**

- **High school mathematics course offerings**
  - Non-college prep
  - Formal/College prep level 1-4
  - AP courses

# Average Percentage of 8th Graders Completing Algebra



FRL*

Community Type*

# Average Percent of HU Students in High School Math Courses

| | Percent of HU Students |
|---|---|
| Non-college prep (e.g., Remedial Math, General Math, Consumer Math) | 53 |
| Formal/College prep level 1 (e.g., Algebra 1, Integrated Math 1) | 38 |
| Formal/College prep level 2 (e.g., Geometry, Integrated Math 2) | 39 |
| Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry) | 37 |
| Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3) | 33 |
| Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics) | 22 |
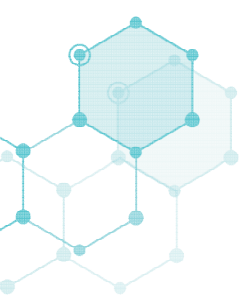
# Reform-Oriented Instructional Objectives Composite

- **Understanding mathematical ideas**
- **Learning how to do mathematics**
- **Learning about real-life applications of mathematics**
- **Increasing students' interest in mathematics**
- **Developing students' confidence that they can successfully pursue careers in mathematics**
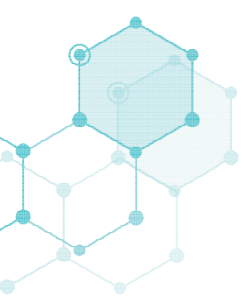
**No differences by HUS, FRL, or Community type**

# Reform-Oriented Objectives Composite
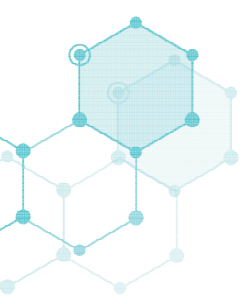
**Prior Achievement***
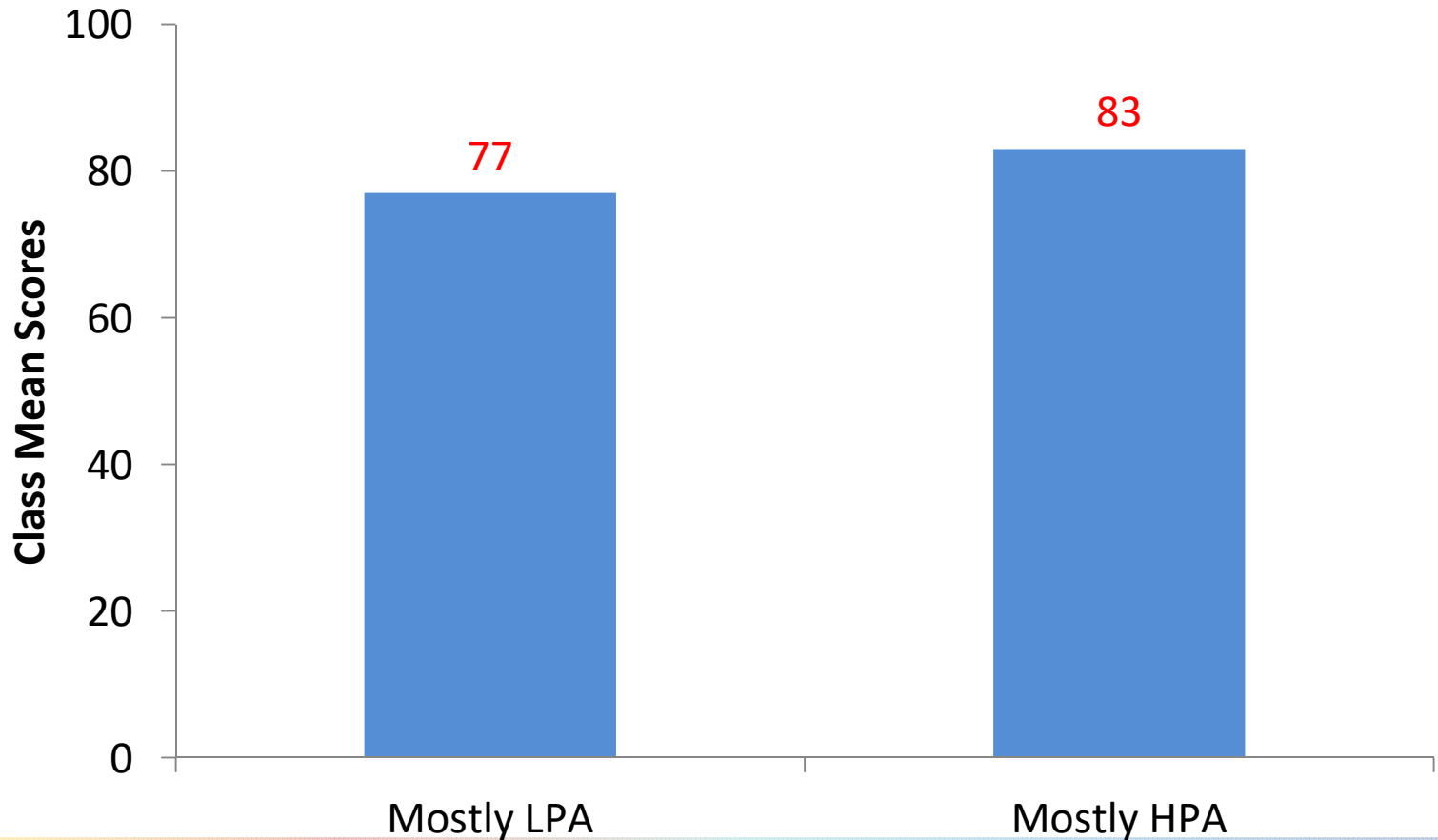
# Class Activities

**Common weekly activities:**

- **Teacher explaining ideas**
- **Leading whole class discussions**
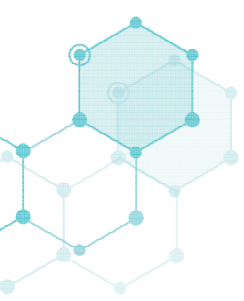- **Having students work in small groups***

**Notable differences (HUS, prior ach., FRL)**

- **Providing manipulatives for problem-solving**
- **Having students write reflections**
- **Practice for standardized tests**
- **Focus on literacy skills**
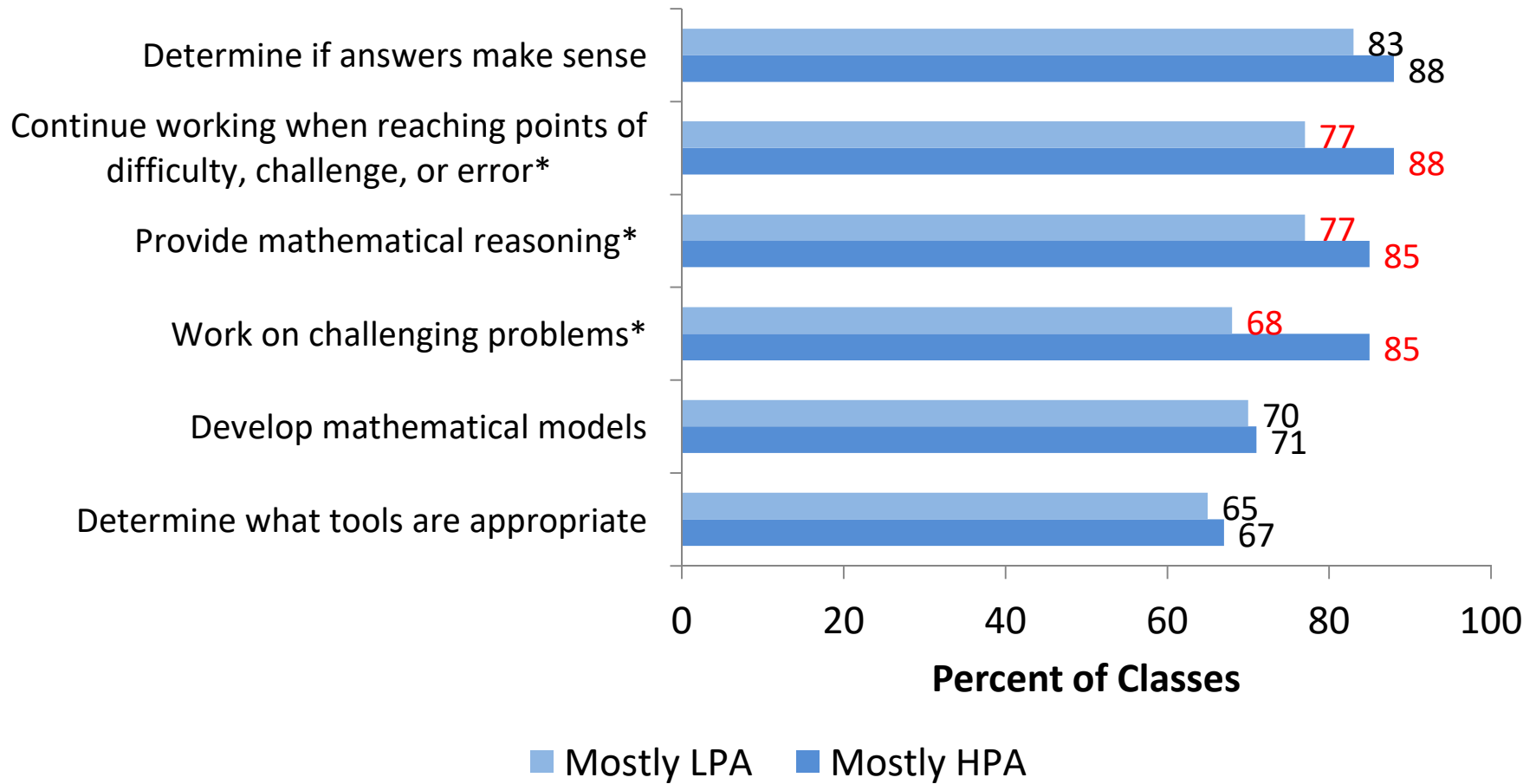
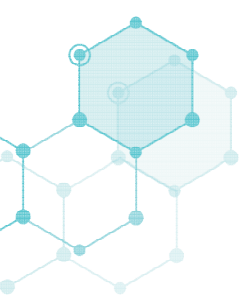# Engagement in Standards for Mathematical Practice

- **A new series of items in 2018**

- **Composite: Engaging Students in the Practices of Mathematics**

- **There were no differences on composites class mean scores between groups for any of the equity factors.**

- **Classes were generally likely to engage students in these practices.**

- **Some differences on individual items**

# Mathematics Practices Profile (weekly basis)

## Prior Achievement



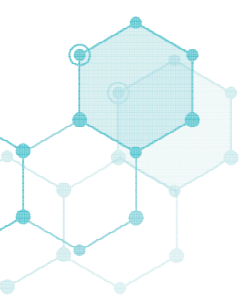| Practice | Mostly LPA | Mostly HPA |
|---|---|---|
| Determine if answers make sense | 83 | 88 |
| Continue working when reaching points of difficulty, challenge, or error* | 77 | 88 |
| Provide mathematical reasoning* | 77 | 85 |
| Work on challenging problems* | 68 | 85 |
| Develop mathematical models | 70 | 71 |
| Determine what tools are appropriate | 65 | 67 |

Percent of Classes

■ Mostly LPA ■ Mostly HPA

# Two or More External Mathematics Assessments Per Year

- **Tests teachers did not choose to administer (e.g., state assessments, district benchmarks)**

- **No differences among community types (about three-quarters of classes)**

- **Differences by HUS, Prior achievement, FRL, disadvantaging those already disadvantaged**

# Since 2012…

- **Nature of mathematics instruction has remained largely consistent**

- **Emphasis on learning procedures and/or algorithms:**
  - Gap between classes in high-FRL and low-FRL schools has become more pronounced; increase in high-FRL schools

- **External testing:**
  - Gap between classes in urban and suburban schools has reversed; increase in suburban schools
  - Gap between high-HUS and low-HUS classes has narrowed; increase in low-HUS classes
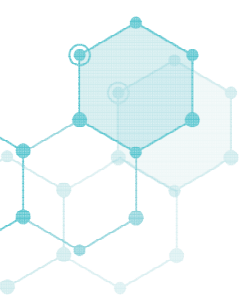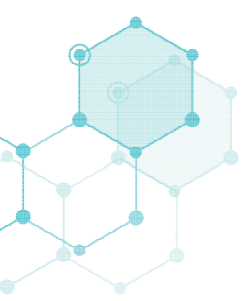
# Main Takeaways about Equity in Mathematics Instruction

Overall, classes had relatively equal emphasis on reform-oriented instructional objectives.

Overall, students had similar opportunities to engage in mathematical practices; however, prior achievement played more of a role in the inequities.

Historically disadvantaged students were less likely to be enrolled in advanced mathematics courses.

More frequent external testing occurred in classes of historically disadvantaged students.

# Turn & Talk Moment

1. How are these findings about equity in mathematics instruction similar or different from what you see in your local context?

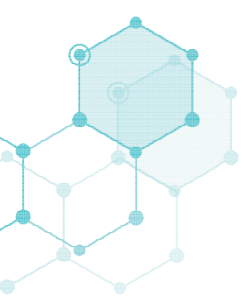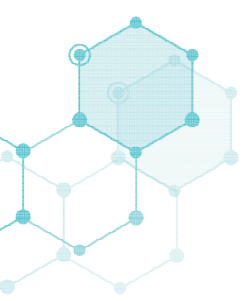2. How have you addressed some of the inequities?
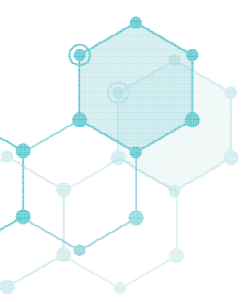
# Well-Prepared Teachers

# Well-Prepared Teachers

**NSSME+ collected data on teachers including:**

- Teacher characteristics

- Pedagogical beliefs

- Perceptions of preparedness

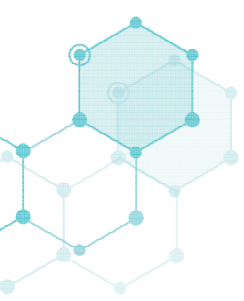- Professional development opportunities

# Teacher Characteristics

- **Years of experience teaching mathematics**

- **Race/ethnicity group**

- **Degree in mathematics or mathematics education**

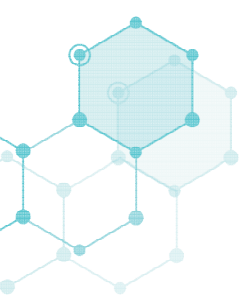- **Coursework related to NCTM preparation standards**

**Differences existed in at least one characteristic for each equity factor**

**Most disparities by prior achievement**

# Teacher Characteristics, by Prior Achievement

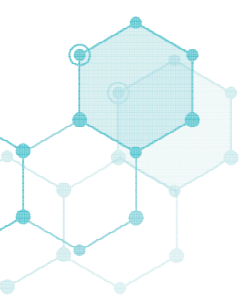| | Percent of Classes | |
|---|---|---|
| | Mostly LPA | Mostly HPA |
| 0-5 years of experience teaching mathematics* | 36 | 25 |
| Historically underrepresented race/ethnicity group* | 18 | 12 |
| Degree in mathematics or mathematics education* | 59 | 74 |
| Substantial coursework related to NCTM preparation standards* | 62 | 73 |

# Pedagogical Beliefs Composites

**Traditional:**

- Defining new vocabulary at the beginning of a unit
- Grouping students by ability
- Using hands-on/manipulatives to reinforce ideas
- Explaining ideas before students investigate them

**Reform-oriented:**

- Asking students to justify their thinking
- Having students share their thinking and reasoning
- Focusing on ideas more in-depth
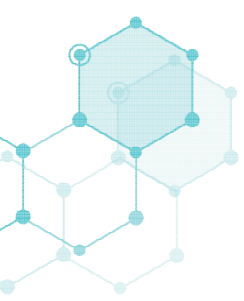- Connecting instruction to students' everyday lives

# Pedagogical Beliefs

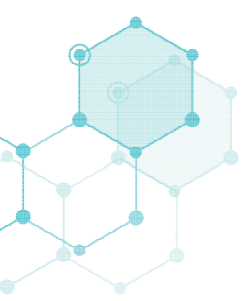No differences on composites by prior achievement or community type

Teachers of high-HUS classes and classes in high-FRL schools were more likely to hold reform-oriented beliefs than their counterparts.

They were also more likely to hold traditional beliefs.

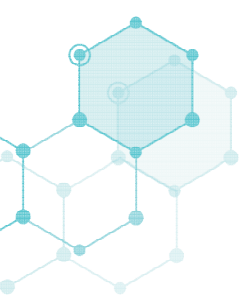# Teacher's Perceptions of Preparedness

- **Perceptions of preparedness to teach mathematics content**

- **Perceptions of pedagogical preparedness**

- **Perceptions of preparedness to carry out tasks related to monitoring and addressing student thinking**
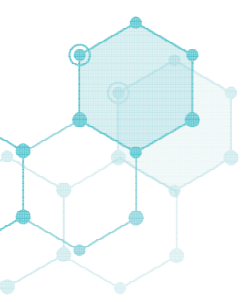
# Perceptions of Preparedness to Teach Math Content Composite

|  | Class Mean Scores |
|---|---|
| **HUS*** | |
| Highest Quartile | 79 |
| Lowest Quartile | 81 |
| **Prior Achievement*** | |
| Mostly LPA | 78 |
| Mostly HPA | 84 |
| **FRL*** | |
| Highest Quartile | 79 |
| Lowest Quartile | 82 |

# Perceptions of Pedagogical Preparedness Composite

|  | Class Mean Scores |
|---|---|
| **HUS*** |  |
| Highest Quartile | 71 |
| Lowest Quartile | 68 |
| **Prior Achievement** |  |
| Mostly LPA | 69 |
| Mostly HPA | 71 |
| **FRL** |  |
| Highest Quartile | 71 |
| Lowest Quartile | 71 |

# Perceptions of Preparedness to Implement Instruction in the Most Recent Unit Composite

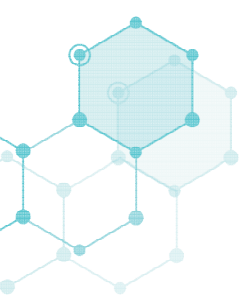|  | Class Mean Scores |
|---|---|
| **HUS*** |  |
| Highest Quartile | 80 |
| Lowest Quartile | 83 |
| **Prior Achievement*** |  |
| Mostly LPA | 79 |
| Mostly HPA | 85 |
| **FRL*** |  |
| Highest Quartile | 80 |
| Lowest Quartile | 84 |

# Professional Development Experiences

- **Amount of mathematics-focused professional development**

- **Nature of professional development**

- **Emphasis of professional development**

# Classes Taught by Teachers with More Than 35 hours of Math PD in Last Three Years
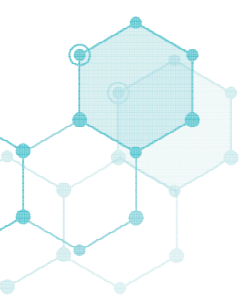
**HUS***
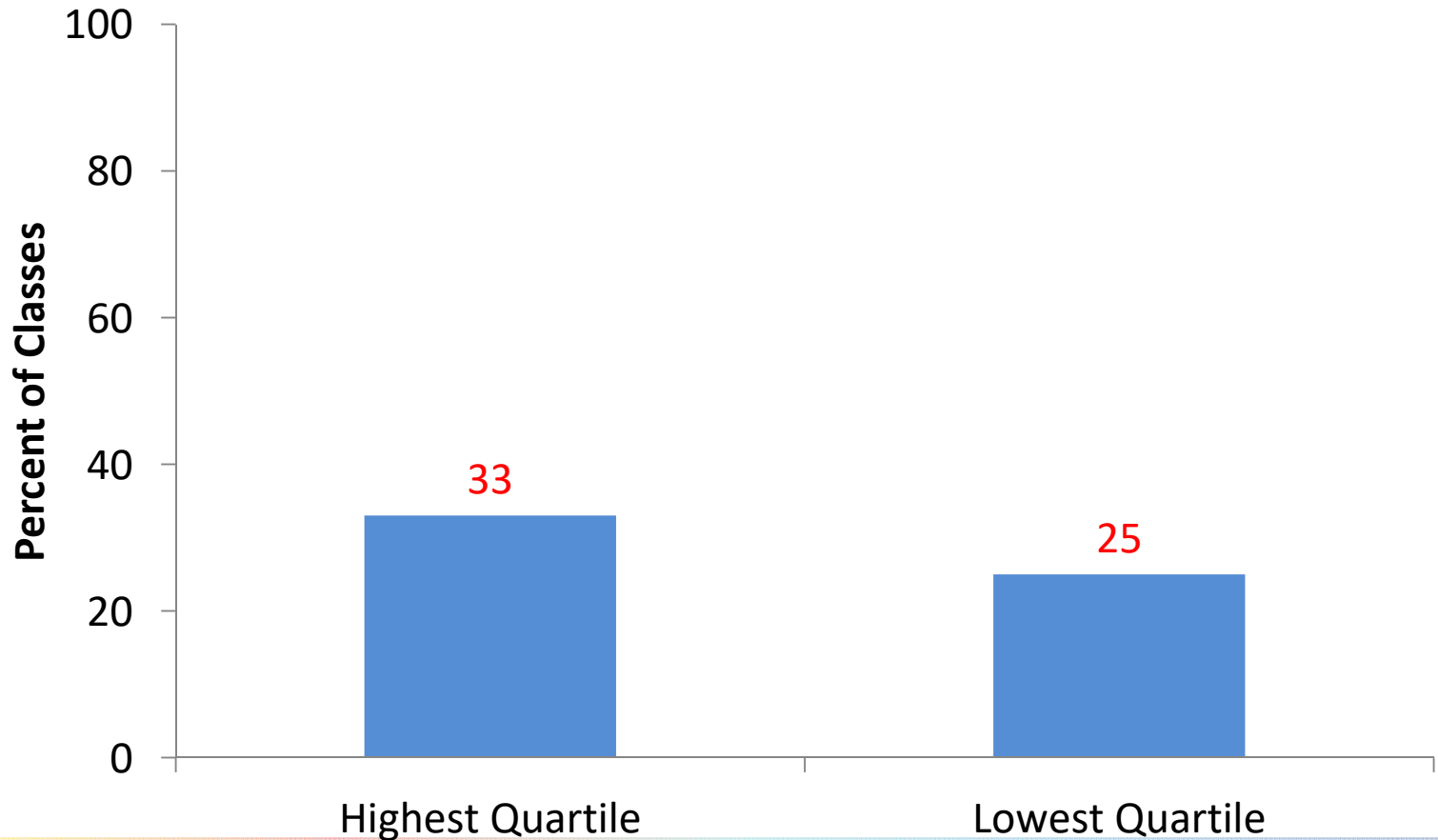
# Extent PD Aligns with Elements of Effective PD Composite
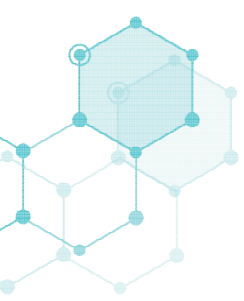
**Examples:**

- Worked closely with other teachers from their school

- Engaged in math investigations

- Applied what they learned to their classroom

- Examined classroom artifacts

- Rehearsed instructional practices during the professional development

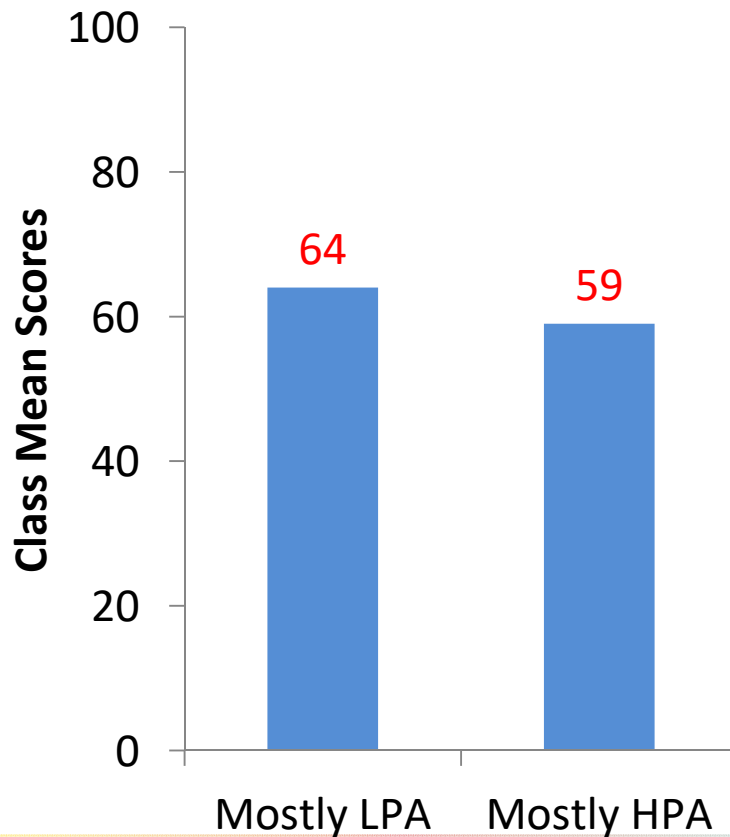# Extent PD Supports Student-Centered Instruction Composite

**Examples:**

- Deepening understanding of how mathematics is done

- Learning how to use hands-on/manipulatives

- Learning about difficulties students may have with mathematical ideas

- Monitoring student understanding

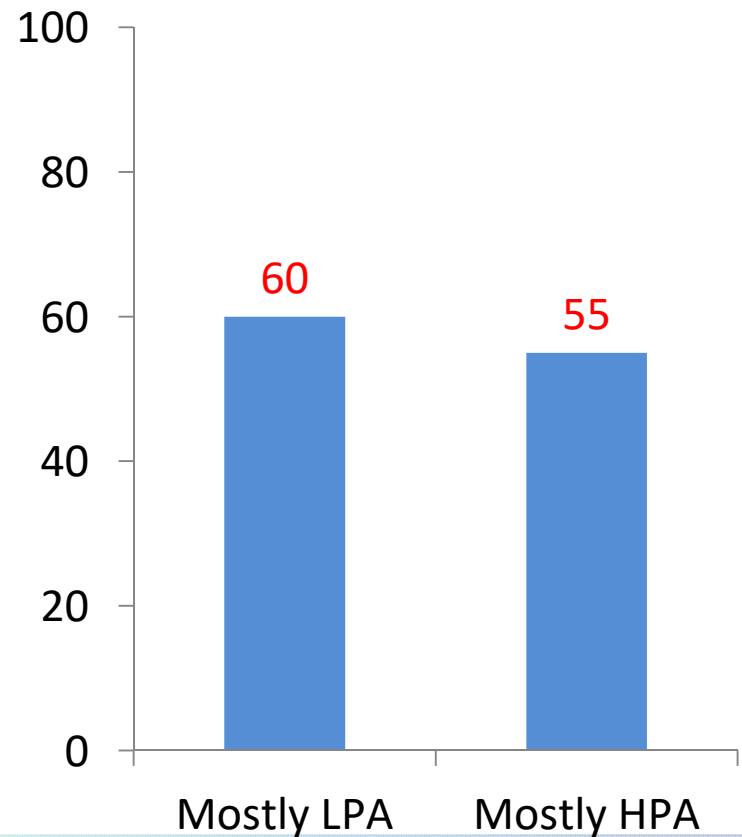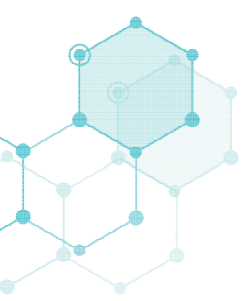- Differentiating to meet diverse learners' needs

# Professional Development Composites, by Prior Achievement



Extent PD Aligns with Elements of Effective PD

Extent PD Supports Student-Centered Instruction

# Since 2012...

- **Distribution of well-prepared teachers has remained largely consistent**

- **Preparedness to teach topics**
  - <u>Geometry (elem.)</u>: Gap between top and bottom groups for HUS and FRL have become more pronounced
  - <u>Functions</u>: Gap between classes of LPA students and HPA students has become more pronounced
  - <u>Modeling, measurement, discrete math</u>: Gap between classes of high- and low-FRL schools has narrowed

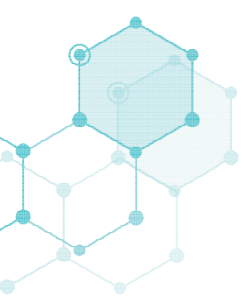# Main Takeaways about Distribution of Well-Prepared Teachers

Classes of mostly LPA students were more likely to be taught by teachers with less experience and background preparation.

Teachers of high-HUS classes were more likely to have had more PD in the last three years.

Overall, teachers had similar PD experiences; however, teachers of mostly LPA students were more likely to have had PD that was aligned with effective PD and student-centered activities.
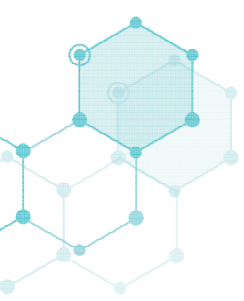
# Discussion

1.  What findings surprised you most? Least?

2.  How can these national results inform the work that you do as part of teacher preparation programs?

# Closing Thoughts

- **Study limitations (as with all research studies)**

- **NSSME+ provides an opportunity to examine some questions of access & opportunity to learn at national scale**

- **Some hopeful findings**

- **Also evidence that historic inequities persist**

- **Disseminate and use findings to catalyze change and further improvements**

# www.horizon-research.com/NSSME
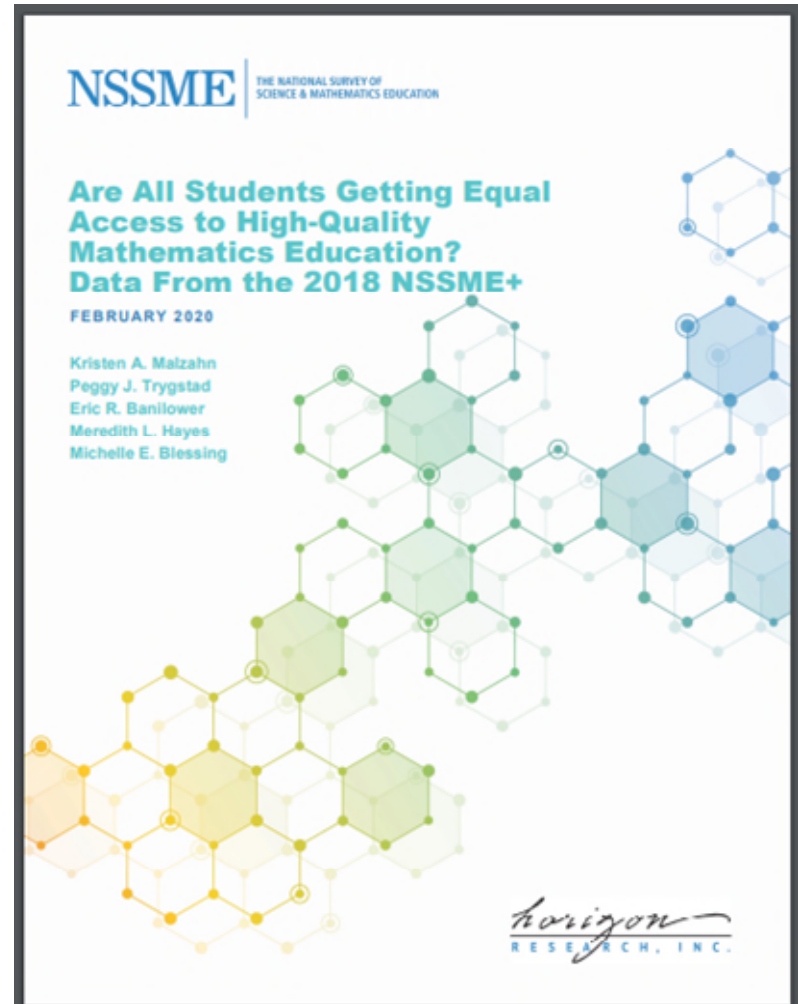
Current reports:
- Technical
- Highlights
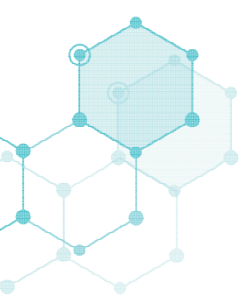- Subject specific
- Compendium of Tables
- **Math Equity**

Upcoming reports:
- Trend
- Novice Teacher

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**Are All Students Getting Equal Access to High-Quality Mathematics Education? Data From the 2018 NSSME+**

FEBRUARY 2020

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Michelle E. Blessing

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# Upcoming AMTE Webinar

**The Current Status of Novice Mathematics Teachers: Findings from the 2018 NSSME+**

*Wednesday, February 26, 2020, 12-1:00 pm Eastern Time*

**https://amte.net/content/webinar-current-status-novice-mathematics-teachers-findings-2018-nssme**

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