Are We Reaching Equity in Mathematics Education?

Highlights from the 2012 National Survey of Science and Mathematics Education

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Pop Quiz

- Take a minute and jot down your answers.
- Turn to a neighbor and discuss your predictions.
- Note: Question 3 should ask about professional development in the last **3 years**

Disclaimers

- We are not equity experts.
- The 2012 NSSME was not designed as an equity study.
- We are here to share a resource.

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Overview of the National Survey of Science and Mathematics Education

Endorsing Organizations

- American Association of Physics Teachers
- American Chemical Society, Education Division
- American Federation of Teachers
- Association of Mathematics Teacher Educators
- Association of State Supervisors of Mathematics
- Center for the Study of Mathematics Curriculum
- Council of State Science Supervisors
- National Association of Biology Teachers
- National Association of Elementary School Principals
- National Association of Secondary School Principals
- National Catholic Education Association
- National Council of Supervisors of Mathematics
- National Council of Teachers of Mathematics
- National Earth Science Teachers Association
- National Education Association
- National School Boards Association
- National Science Education Leadership Association
- National Science Teachers Association

About the Study

- Two-stage sample that targeted:
  - 2,000 schools (public and private)
  - Over 10,000 teachers
  - Purposefully oversampled teachers of advanced mathematics, chemistry, and physics

- Four main instruments:
  - Mathematics program questionnaire
  - Mathematics teacher questionnaire
  - Science program questionnaire
  - Science teacher questionnaire

Nationally Representative Results

- Strong response rates:
  - 1,504 schools agreed to participate
  - Over 80 percent of program representatives
  - Over 75 percent of sampled teachers

- Sampling and analysis techniques used allow for nationally representative estimates about schools, teachers, and classes

Equity Factors

- Prior achievement levels at the classroom level
  (i.e., tracking)

- Racial/ethnic demographics: percent of students from historically underserved racial/ethnic backgrounds at the classroom level

- Socio-economic status: percent of students eligible for free/reduced-priced lunch (FRL) at the school level

Some technical information

Significance tests …

- were conducted using weighted data, K-12
- created quartiles and compared groups at the ends of continuum for the equity factors
- were two-tailed

Composite variables…

- are reported on a 0-100 scale
- created from related sets of items
  - Factor analysis
  - Cronbach's alpha reliability

Session Overview

- Illustrate equity findings in three areas:
  - Student access to well-prepared teachers
  - Student access to mathematics course offerings and instructional practices
  - Resources and policies affecting instruction

- Time for "neighbor" discussions

Student Access to Well-Prepared Teachers

- Mathematics teaching experience
- Perceptions of preparedness
- Amount of mathematics professional development
- Perceptions of quality of mathematics professional development
- Nature of mathematics professional development

Mathematics Teaching Experience

1. Compared to mathematics classes composed of mostly high-achieving students, classes of mostly low-achieving students are:

    a. less likely to be taught by teachers with 0-5 years of experience
    b. equally likely to be taught by teachers with 0-5 years of experience
    c. more likely to be taught by teachers with 0-5 years of experience

Mathematics Teaching Experience

Experience Teaching Mathematics

	Percent of Teachers		
	Elementary	Middle	High
0–2 years	12	14	10
3–5 years	15	17	14
6–10 years	22	25	22
11–20 years	30	29	33
21 years	21	15	21

Mathematics Teaching Experience

- Classes of mostly low-achieving students are more likely to be taught by novice teachers (0-5 years experience).

Classes Taught by Teachers with 0-5 Years of Mathematics Teaching Experience

Prior Achievement Level of Class	Percent of Classes
Mostly High Achievers	20
Mostly Low Achievers	29*

Mathematics Teaching Experience

1. Compared to mathematics classes composed of mostly high-achieving students, classes of mostly low-achieving students are:

   a. less likely to be taught by teachers with 0-5 years of experience
   b. just as likely to be taught by teachers with 0-5 years of experience
   ✓ c. more likely to be taught by teachers with 0-5 years of experience

Perceptions of Preparedness

2. Mathematics teachers of classes composed of mostly low-achieving students feel _____ to teach mathematics than teachers of classes of mostly high-achieving students.

    a. less prepared
    b. equally as prepared
    c. more prepared

Perceptions of Preparedness to Encourage Students Composite

- Encourage
  - students' interest in mathematics
  - participation of females in mathematics
  - participation of students from historically underrepresented racial/ethnic backgrounds in mathematics
  - participation of students from low socioeconomic backgrounds in mathematics

Perceptions of Content Preparedness Composite

- The number system and operations*
- Early algebra/algebraic thinking*
- Functions
- Modeling
- Measurement*
- Geometry*
- Statistics and probability
- Discrete mathematics

Perceptions of Preparedness to Implement Instruction in Most Recent Unit Composite

- Anticipate difficulties students will have with particular mathematics ideas and procedures in this unit
- Find out what students thought or already knew about the key mathematical ideas
- Implement the mathematics textbook/program to be used during this unit
- Monitor student understanding during this unit
- Assess student understanding at the conclusion of this unit

Perceptions of Preparedness

Class Mean Scores for Mathematics Teacher Perceptions of Preparedness Composites

Composite	Mean Score
Encourage Students in Mathematics	78.1
Teach Mathematics Content	81.6
Implement Instruction in Most Recent Unit	84.1

Perceptions of Preparedness

- Teachers of classes composed of mostly low-achieving students feel less prepared to teach mathematics than teachers of classes composed mostly of high-achieving students.

Class Mean Scores for Mathematics Teacher Perceptions of Preparedness Composite

Prior Achievement Level of Class	Mean Score		
	Encourage Students in Mathematics	Teach Mathematics Content	Implement Instruction in Most Recent Unit
Mostly High Achievers	79	86	88
Mostly Low Achievers	75*	80*	83*

Perceptions of Preparedness

2. Mathematics teachers of classes composed of mostly low-achieving students feel _____ to teach mathematics than teachers of classes of mostly high-achieving students.

✓a. less prepared
b. equally as prepared
c. more prepared

Amount of Mathematics Professional Development

3. Compared to teachers of mathematics classes with the smallest proportion of historically underserved students, teachers of classes with the largest proportion of historically underserved students are _____ to have had more than 35 hours of mathematics professional development in the past 3 years.

    a. less likely
    b. equally likely
    c. more likely

Amount of Mathematics Professional Development

Time Spent on Mathematics Professional Development in the Last Three Years

	Percent of Teachers		
	Elementary	Middle	High
Less than 6 hours	35	22	23
6–15 hours	35	24	24
16–35 hours	20	23	22
More than 35 hours	11	31	32

Amount of Mathematics Professional Development

- Teachers in classes with the largest proportion of historically underserved students are more likely to have had 35+ hours of mathematics PD in the past 3 years.

Classes Taught by Teachers with More than 35 Hours of Mathematics Professional Development in the Last Three Years

Percent of Historically Underserved Students in Class	Percent of Classes
Lowest Quartile	19
Highest Quartile	29*

Amount of Mathematics Professional Development

3. Compared to teachers of mathematics classes with the smallest proportion of historically underserved students, teachers of classes with the largest proportion of historically underserved students are _____ to have had more than 35 hours of mathematics professional development in the past 3 years.

   a. less likely
   b. equally likely
   ✓c. more likely

Perceptions of Quality of Mathematics Professional Development

4. Which of the following equity variables is correlated with how mathematics teachers perceive the quality of their mathematics professional development?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Perceptions of Quality of Mathematics Professional Development Composite

- You had opportunities to
  - engage in mathematics investigations
  - examine classroom artifacts (e.g., student work samples)
  - try out what you learned in your classroom and then talk about it as part of the professional development

- You worked closely with other
  - mathematics teachers from your school
  - mathematics teachers who taught the same grade and/or subject whether or not they were from your school

- The professional development was a waste of your time

Perceptions of Quality of Mathematics Professional Development

Class Mean Scores for the Quality of Mathematics Professional Development Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	65
Mostly Low Achievers	64
Percent of Historically Underserved Students in Class	
Lowest Quartile	58
Highest Quartile	66*
Percent of Students in School Eligible for FRL	
Lowest Quartile	65
Highest Quartile	65

Perceptions of Quality of Professional Development

4. Which of the following equity variables is correlated with how mathematics teachers perceive the quality of their mathematics professional development?

   a. Prior achievement level of the class
   ✓ b. Percent of historically underserved students in the class
   c. Percent of students in school eligible for FRL
   d. None of the above
   e. All of the above

Nature of Mathematics Professional Development

5. Mathematics teachers of classes composed of mostly low-achieving students reported that their mathematics professional development/ coursework was _____ focused on student-centered instruction than teachers of classes of mostly high-achieving students.

    a. less
    b. equally
    c. more

Mathematics Professional Development/Coursework Focused on Student-Centered Instruction Composite

- Finding out what students think or already know about the key mathematical ideas prior to instruction on those ideas
- Planning instruction so students at different levels of achievement can increase their understanding of the ideas targeted in each activity
- Monitoring student understanding during mathematics instruction
- Assessing student understanding at the conclusion of instruction on a topic

Mathematics Professional Development/Coursework Focused on Student-Centered Instruction

Teacher Mean Score on the Extent to which Mathematics Professional Development/Coursework Focused on Student-Centered Instruction Composite

	Mean Score
Elementary	57
Middle	55
High	50

Mathematics Professional Development/Coursework Focused on Student-Centered Instruction

- Professional development/coursework for teachers of classes composed of mostly low-achieving students was more focused on student-centered instruction

Teacher Mean Score on the Extent to which Mathematics Professional Development/Coursework Focused on Student-Centered Instruction Composite

Prior Achievement Level of Class	Mean Score
Mostly High Achievers	45
Mostly Low Achievers	51*

Nature of Mathematics Professional Development

5. Mathematics teachers of classes composed of mostly low-achieving students reported that their mathematics professional development/ coursework was _____ focused on student-centered instruction than teachers of classes of mostly high-achieving students.

   a. less
   b. equally
   ✓ c. more

Neighbor Discussion

- How could further investigations of the National Survey data about ***student access to well-prepared teachers*** help answer the question: Are we reaching equity in mathematics education?

Student Access to Mathematics Courses and Instructional Practices

- Access to mathematics courses
- Reform-oriented objectives for mathematics instruction
- Use of reform-oriented instructional practices in mathematics
- Use of external mathematics assessments

Access to Mathematics Courses

6. In schools with the smallest proportion of students eligible for FRL, students are _____ to complete Algebra 1 prior to 9th grade compared to their peers in schools with the largest proportion of students eligible for FRL.

    a. less likely
    b. equally likely
    c. more likely

Middle School Mathematics Courses

- Overall results
  - About ¾ of middle schools offer Algebra 1
  - Only about ¼ offer Geometry
  - Majority of middle school students do not complete either one in middle school

Access to Mathematics Courses

- Students in schools with the smallest proportion of students eligible for FRL are more likely to complete Algebra 1 prior to 9th grade.

Average Percent of 8th Graders Completing Algebra I Prior to 9th Grade

Percent of Students in School Eligible for FRL	Percent of 8th Grade Students
Lowest Quartile	46
Highest Quartile	28*

Access to Mathematics Courses

6. In schools with the smallest proportion of students eligible for FRL, students are _____ to complete Algebra 1 prior to 9th grade compared to their peers in schools with the largest proportion of students eligible for FRL.

   a. less likely
   b. equally likely
   ✓ c. more likely

Reform-oriented Instructional Objectives

7. Compared to mathematics classes composed of mostly high-achieving students, classes of mostly low-achieving students are:

   a. Less likely to emphasize reform-oriented objectives.
   b. Equally likely to emphasize reform-oriented objectives.
   c. More likely to emphasize reform-oriented objectives.

8. Compared to mathematics classes composed of the largest proportion of historically underserved students, classes with the smallest proportion of historically underserved students are:

   a. Less likely to emphasize reform-oriented objectives.
   b. Equally likely to emphasize reform-oriented objectives.
   c. More likely to emphasize reform-oriented objectives.

Reform-oriented Instructional Objectives

- Understanding mathematical ideas
- Learning mathematical practices (e.g., considering how to approach a problem, justifying solutions)
- Learning about real-life applications of mathematics
- Increasing students' interest in mathematics
- Preparing for further study in mathematics

Reform-oriented Instructional Objectives

Mathematics Class Mean Scores on the Reform-Oriented Instructional Objectives Composite

	Mean Score
Elementary	81
Middle	81
High	78

Reform-oriented Instructional Objectives

Mathematics Class Mean Scores on the Reform-Oriented Instructional Objectives Composite, by Equity Factor

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	85
Mostly Low Achievers	77*
Percent of Historically Underserved Students in Class	
Lowest Quartile	80
Highest Quartile	81

Reform-oriented Instructional Objectives

7. Compared to mathematics classes composed of mostly high-achieving students, classes of mostly low-achieving students are:

✓ a. Less likely to emphasize reform-oriented objectives.
b. Equally likely to emphasize reform-oriented objectives.
c. More likely to emphasize reform-oriented objectives.

8. Compared to mathematics classes composed of the largest proportion of historically underserved students, classes with the smallest proportion of historically underserved students are:

a. Less likely to emphasize reform-oriented objectives.
✓ b. Equally likely to emphasize reform-oriented objectives.
c. More likely to emphasize reform-oriented objectives.

Reform-oriented Teaching Practices

9. Which of the following equity variables is *not* related to the frequency with which mathematics classes use reform-oriented teaching practices?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Reform-oriented Teaching Practices

- Have students consider multiple representations in solving a problem (e.g., numbers, tables, graphs, pictures)
- Have students explain and justify their method for solving a problem
- Have students compare and contrast different methods for solving a problem
- Have students present their solution strategies to the rest of the class

Reform-oriented Teaching Practices

Mathematics Class Mean Scores on the Reform-Oriented Teaching Practices Composite

	Mean Score
Elementary	74
Middle	73
High	67

Reform-oriented Teaching Practices

Mathematics Class Mean Scores on Reform-oriented Teaching Practices Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	74
Mostly Low Achievers	70*
Percent of Historically Underserved Students in Class	
Lowest Quartile	71
Highest Quartile	73*
Percent of Students in School Eligible for FRL	
Lowest Quartile	74
Highest Quartile	72

Reform-oriented Teaching Practices

9. Of the following equity variables, which one is *not* related to the frequency with which mathematics classes use reform-oriented <u>teaching</u> practices?

   a. Prior achievement level of the class
   b. Percent of historically underserved students in the class
   ✓ c. Percent of students in school eligible for FRL
   d. None of the above
   e. All of the above

Frequency of External Mathematics Assessment Practices

10. Which of the following equity variables is correlated with the frequency of required external assessments?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Frequency of External Mathematics Assessment Practices

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Frequency of Required External Testing in Mathematics Classes

	Percent of Classes		
	Elementary	Middle	High
Never	9	2	21
Once a year	14	19	28
Twice a year	7	10	15
Three or four times a year	38	38	22
Five or more times a year	31	31	14

Frequency of External Mathematics Assessment Practices

Mathematics Classes Required to Take External Assessments Two or More Times per Year, by Equity Factors

	Percent of Classes
Prior Achievement Level of Class	
Mostly High Achievers	60
Mostly Low Achievers	76*
Percent of Historically Underserved Students in Class	
Lowest Quartile	56
Highest Quartile	83*
Percent of Students in School Eligible for FRL	
Lowest Quartile	66
Highest Quartile	81*

Frequency of External Mathematics Assessment Practices

10. Which of the following equity variables is correlated with the frequency of required external assessments?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    ✓ e. All of the above

Neighbor Discussion

- How could further investigations of the National Survey data about ***student access to mathematics courses and instructional practices*** help answer the question: Are we reaching equity in mathematics education?

Resources and Policies Affecting Instruction

- Resources for mathematics instruction
- Availability of instructional technologies
- Frequency of use of instructional technologies
- Policy support for effective mathematics instruction

Adequacy of Resources for Mathematics Instruction

11. Which of the following equity variables is correlated with teachers' ratings of the adequacy of instructional resources?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Adequacy of Resources for Mathematics Instruction Composite

- Instructional technology (e.g., calculators, computers, probes/sensors)
- Measurements tools (e.g., protractors, rulers)
- Manipulatives (e.g., pattern blocks, algebra tiles)
- Consumable supplies (e.g., graphing paper, batteries)

Adequacy of Resources for Mathematics Instruction

Mathematics Class Mean Scores on the Adequacy of Resources for Instruction Composite

	Mean Score
Elementary	70
Middle	71
High	70

Adequacy of Resources for Mathematics Instruction

Mathematics Class Mean Scores on the Adequacy of Resources for Instruction Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	74
Mostly Low Achievers	68*
Percent of Historically Underserved Students in Class	
Lowest Quartile	73
Highest Quartile	69*
Percent of Students in School Eligible for FRL	
Lowest Quartile	73
Highest Quartile	68*

Adequacy of Resources for Instruction

11. Which of the following equity variables is correlated with teachers' ratings of the adequacy of instructional resources?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    ✓ e. All of the above

Availability of Instructional Technologies

12. Which of the following equity variables is correlated with the availability of instructional technologies in mathematics?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. a and b only
    e. a and c only

Availability of Instructional Technologies

Availability of Instructional Technologies in Mathematics Classes

	Percent of Classes		
	Elementary	**Middle**	**High**
Graphing calculators	11	50	83
Scientific calculators	16	69	74

Availability of Instructional Technologies

Availability of Instructional Technologies in Mathematics Classes, by Equity Factor

	Percent of Classes	
	Scientific Calculators	Graphing Calculators
Prior Achievement Level of Class		
Mostly High Achievers	60	61
Mostly Low Achievers	55	50*
Percent of Historically Underserved Students in Class		
Lowest Quartile	58	53
Highest Quartile	37*	34*
Percent of Students in School Eligible for FRL		
Lowest Quartile	52	47
Highest Quartile	41*	38

Availability of Instructional Technologies

12. Which of the following equity variables is correlated with the availability of instructional technologies in mathematics?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
✓ d. a and b only
✓ e. a and c only

Frequency of Use of Instructional Technology

13. Which of the following equity variables is correlated with the frequency with which mathematics classes use instructional technology?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Frequency of Use of Instructional Technology Composite

- Personal computers, including laptops
- Hand-held computers
- Internet
- Calculators/Graphing Calculators
- Probes for collecting data

Frequency of Use of Instructional Technology

Mathematics Class Mean Scores on Use of Instructional Technology Composite

	Mean Score
Elementary	33
Middle	28
High	21

Frequency of Use of Instructional Technology

Mathematics Class Mean Scores on Use of Instructional Technology Composite, by Equity Factors

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	27
Mostly Low Achievers	30
Percent of Historically Underserved Students in Class	
Lowest Quartile	27
Highest Quartile	29
Percent of Students in School Eligible for FRL	
Lowest Quartile	27
Highest Quartile	31

Frequency of Use of Instructional Technology

13. Which of the following equity variables is related to the frequency with which mathematics classes use instructional technology?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    ✓ d. None of the above
    e. All of the above

Policy Support for Effective Mathematics Instruction

14. Which of the following equity variables is correlated with teachers' perception of policy support for effective mathematics instruction?

    a. Prior achievement level of the class
    b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Policy Environment Promotes Effective Mathematics Instruction Composite

- Current state standards
- District/Diocese curriculum frameworks
- School/District/Diocese pacing guides
- State testing/accountability policies
- District/Diocese testing/accountability policies
- Textbook/program selection policies
- Teacher evaluation policies

Policy Environment Promotes Effective Mathematics Instruction Composite

Mathematics Class Mean Scores for Extent to Which the Policy Environment Promotes Effective Instruction Composite

	Mean Score
Elementary	72
Middle	65
High	66

Factors Affecting Mathematics Instruction

Mathematics Class Mean Scores for Extent to Which the Policy Environment Promotes Effective Instruction Composite, by Equity Factor

	Mean Score
Prior Achievement Level of Class	
Mostly High Achievers	68
Mostly Low Achievers	65
Percent of Historically Underserved Students in Class	
Lowest Quartile	71
Highest Quartile	66*
Percent of Students in School Eligible for FRL	
Lowest Quartile	70
Highest Quartile	66

Factors Affecting Mathematics Instruction

14. Which of the following equity variables is correlated with teachers' perception of policy support for effective mathematics instruction?

    a. Prior achievement level of the class
    ✓ b. Percent of historically underserved students in the class
    c. Percent of students in the school eligible for FRL
    d. None of the above
    e. All of the above

Neighbor Discussion

- How could further investigations of the National Survey data about ***resources and policies affecting instruction*** help answer the question: Are we reaching equity in mathematics education?

For More Information

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