The 2012 National Survey of Science and Mathematics Education

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Question

In order to meet the vision laid out in the Common Core State Standards for Mathematics, the K–12 mathematics education system:

a. Needs a complete overhaul.
b. Needs to have a few parts replaced/updated.
c. Needs a minor tune up.

Where Have We Been?

- There is a great deal of talk about the need to improve mathematics education in the nation:
  - Reports about the status of the system
    - A Nation at Risk
    - Adding it Up
  - Large scale assessments
    - NAEP
    - TIMSS
  - Development of standards
    - NCTM Standards (1989, 2000)
    - Common Core State Standards (2010)

Where Do We Want to Go?

- The Common Core documents set a goal for what all students are expected to know and be able to do in mathematics…

- But they don't tell us how to get there.

Where are We Now?

- We can't develop a sensible plan for getting there if we don't know where we are now.

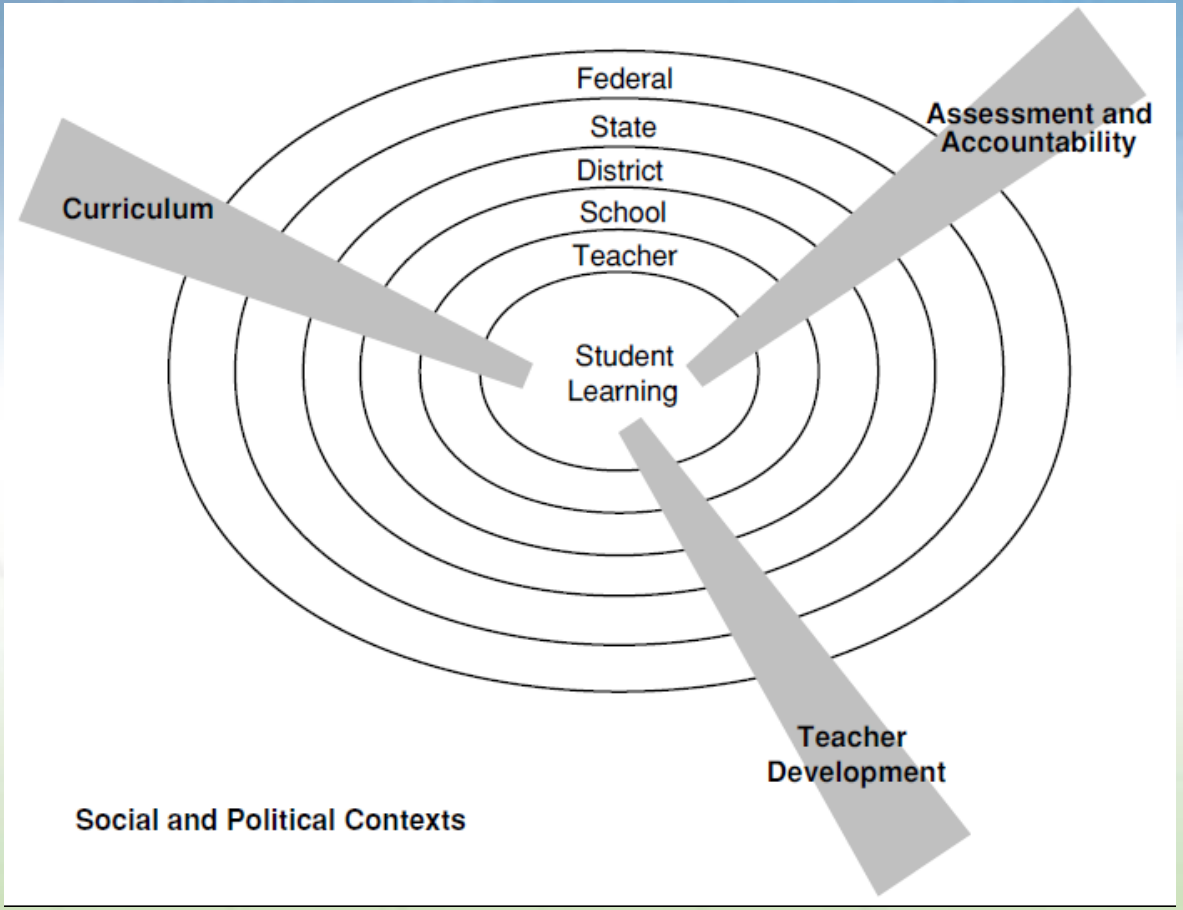
- Data from the 2012 National Survey of Science and Mathematics Education help answer this question.

Question

Which is the most important determinant of student outcomes in mathematics?

a. Teacher preparation programs/professional development
b. Teachers' knowledge, skills, and beliefs
c. Quality of instructional materials
d. High-stakes assessments
e. Parent/community expectations and engagement
f. Classroom practice

Factors Influencing Student Outcomes



National Research Council. (2002). *Investigating the influence of standards: A framework for research in mathematics, science, and technology education*. I.R. Weiss, M.S. Knapp, K.S. Hollweg, and G. Burrill (Eds.), Committee on Understanding the Influence of Standards in K-12 Science, Mathematics, and Technology Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

Session Structure

- Overview of 2012 National Survey of Science and Mathematics Education
- Highlights of mathematics findings
- Implications for your work

About the 2012 National Survey of Science and Mathematics Education

- The 2012 NSSME is the fifth in a series of surveys dating back to 1977.

- It is the only survey specific to science and mathematics education that provides nationally representative results.

Topics Addressed

- Characteristics of the science/mathematics teaching force:
  - demographics
  - content background
  - beliefs about teaching and learning
  - perceptions of preparedness

- Instructional practices
- Factors that shape teachers' decisions about content and pedagogy
- Use of instructional materials
- Opportunities teachers have for professional growth
- How instructional resources are distributed

Who's In the Sample

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

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

Equity Factors

School-Level

- Percentage of students eligible for free/reduced price lunch
- School size
- Community type
- Region

Class-level

- Prior achievement level of students in class
- Percentage of students in class from racial/ethnic groups historically underrepresented in STEM

- As we go through the data, jot down anything that:
  1. Surprises you
  2. Pleases you
  3. Dismays you

- Findings that have implications for your work

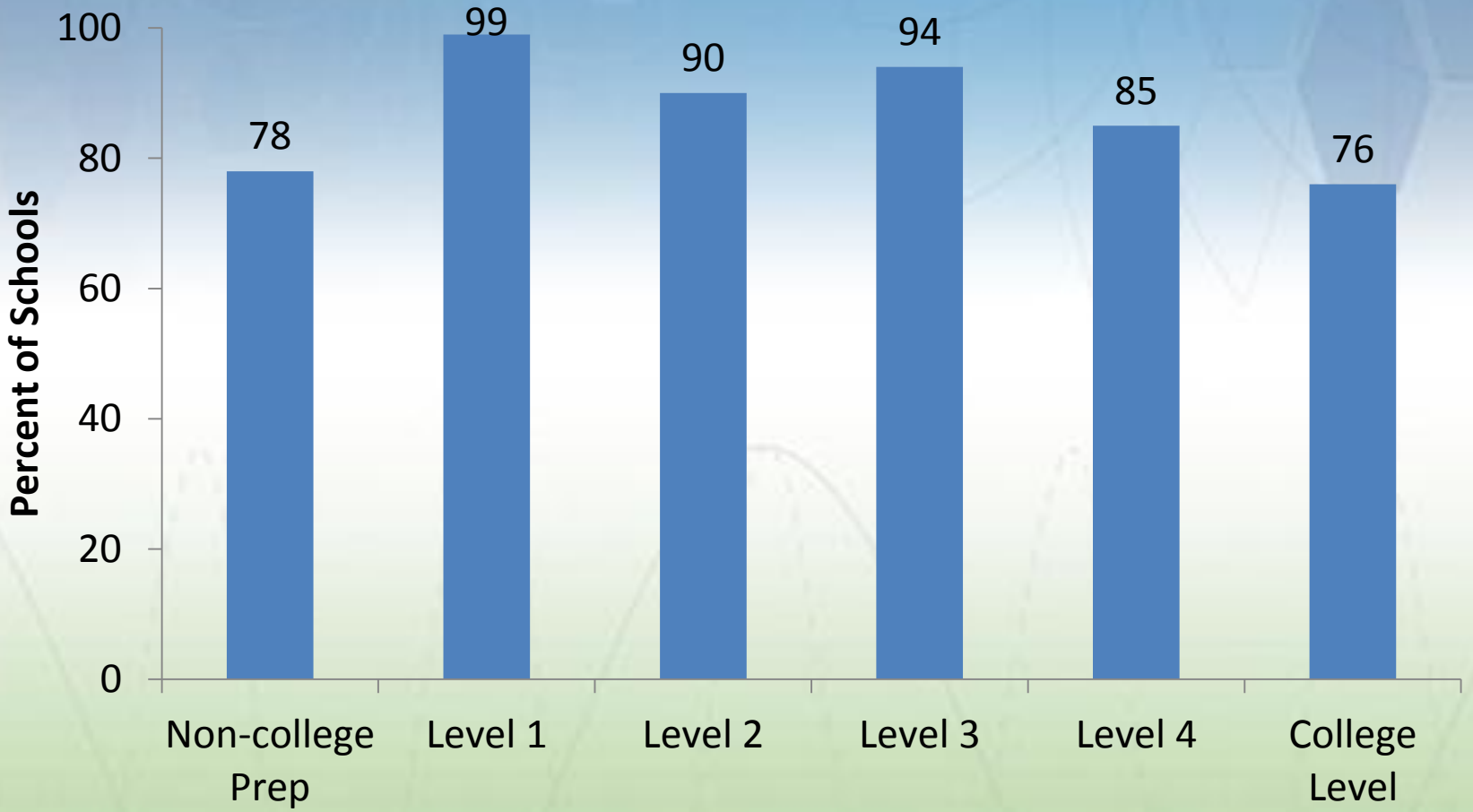
- Questions

Mathematics Instruction

Middle School Mathematics Courses

- 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.

High Schools Offering Various Mathematics Courses

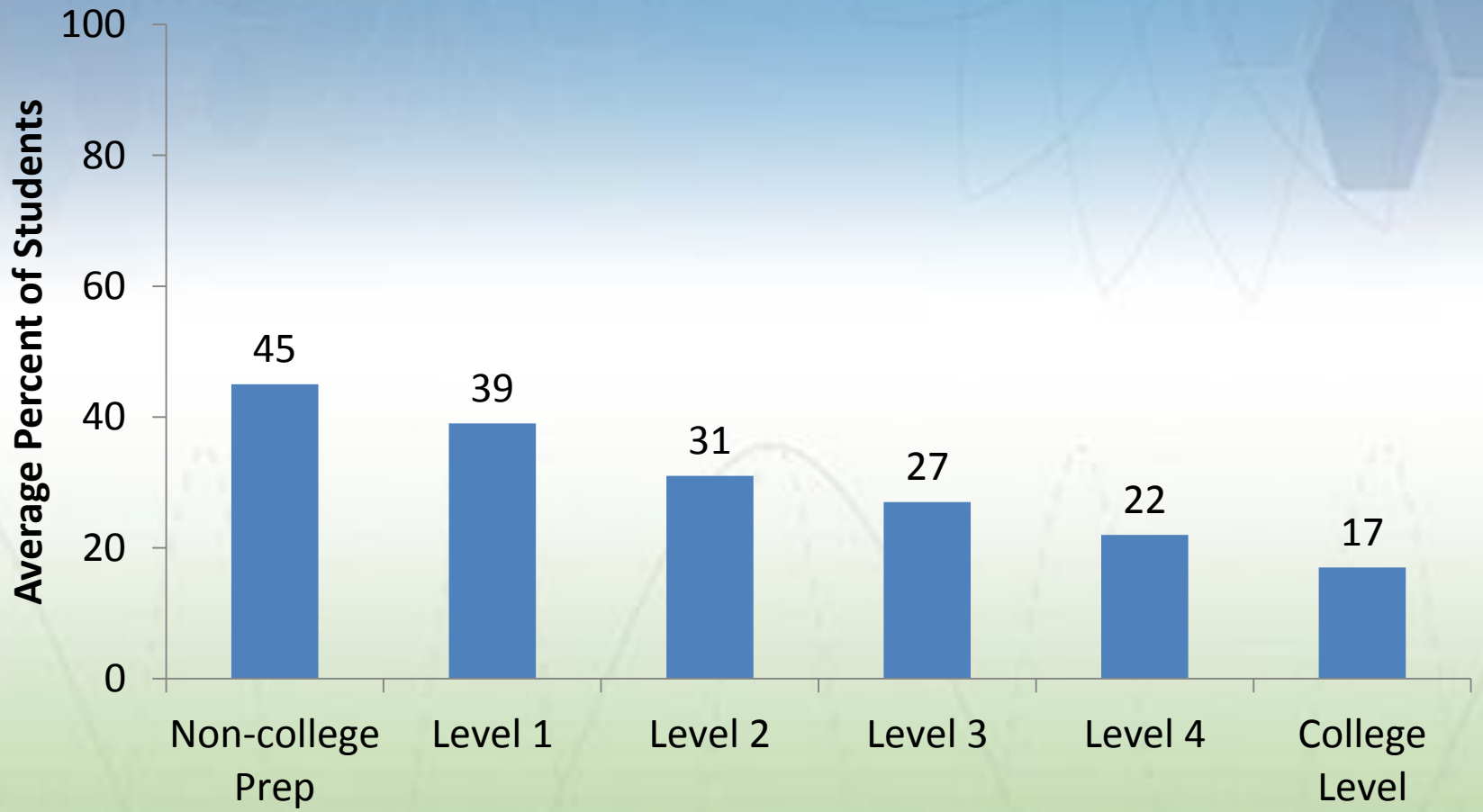


Question

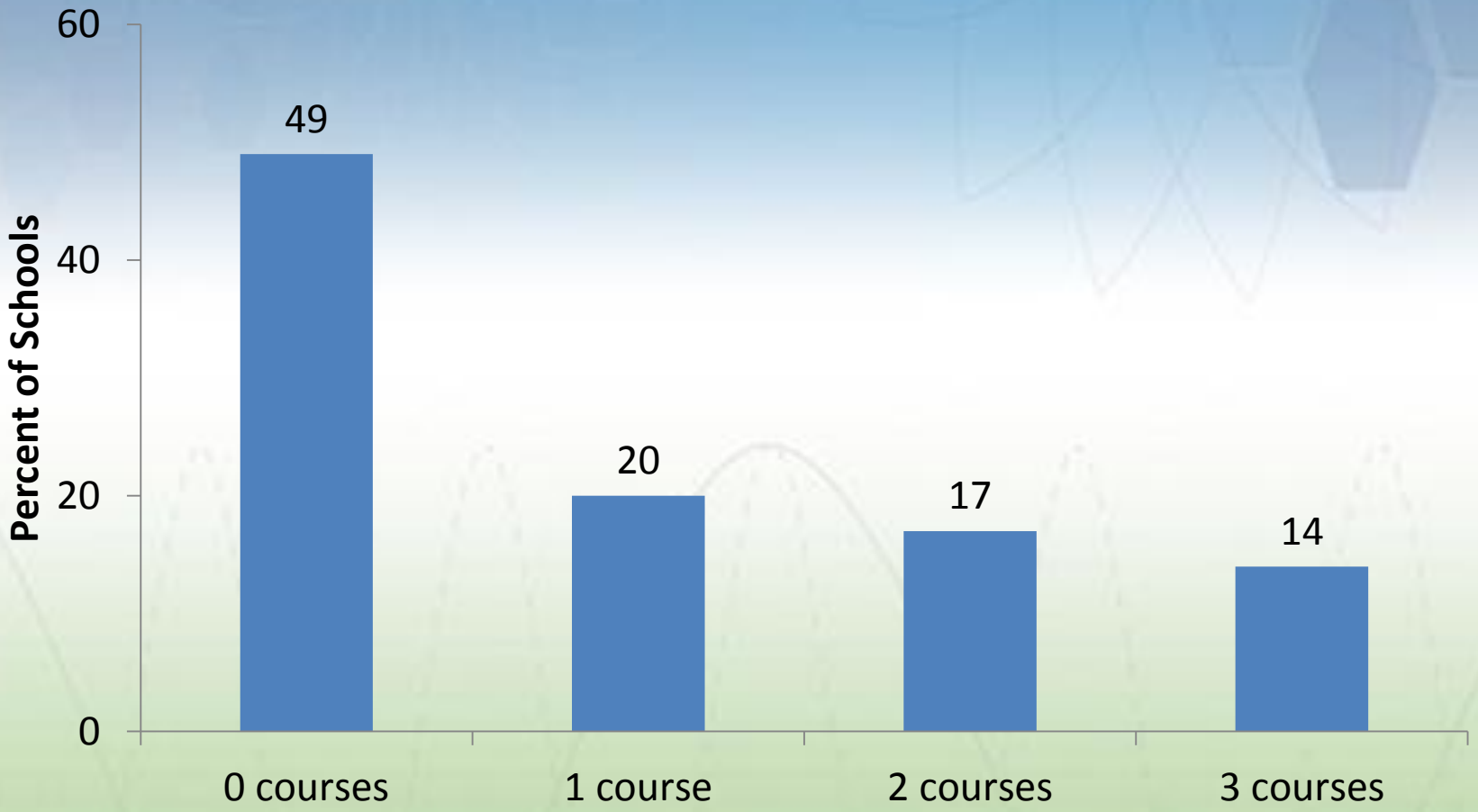
Compared to lower-level high school courses, students in advanced mathematics courses are:

a. Less diverse.
b. Just as diverse.
c. More diverse.

Mathematics Course Enrollment: Historically Underrepresented Students



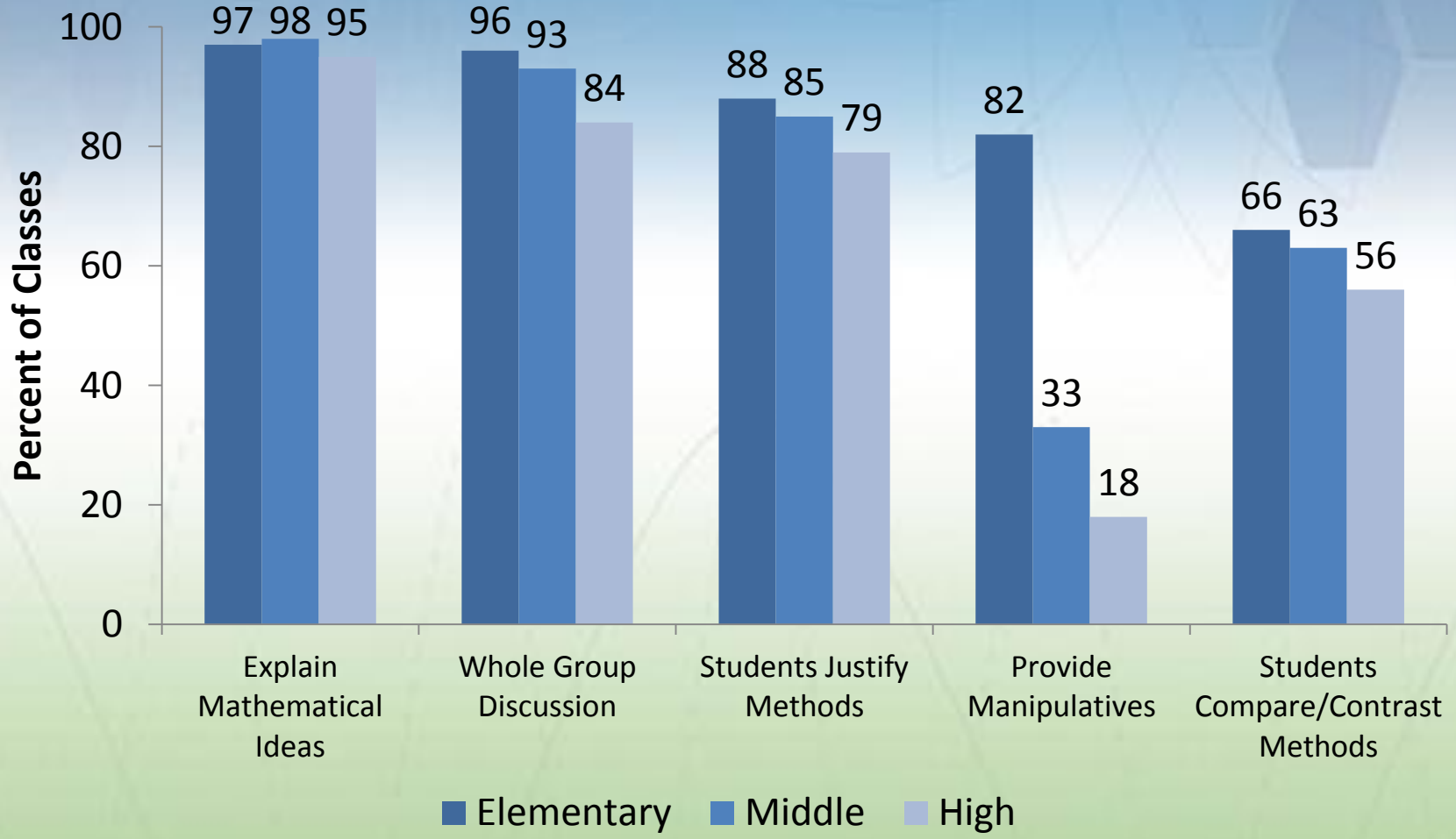
Number of AP Mathematics Courses Offered at High Schools



AP Mathematics Course Offerings

- Fewer AP mathematics courses are offered in
  - small schools than large schools.
  - rural schools than urban schools.
  - high poverty schools than low poverty schools.

Weekly Instructional Practices



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

- The frequency of these practices is *higher* in
  - elementary and middle grades classes than high school classes (class mean score: 74, 73, 67).
  - classes consisting mostly of high achieving students than low achieving students (class mean score: 74, 70).

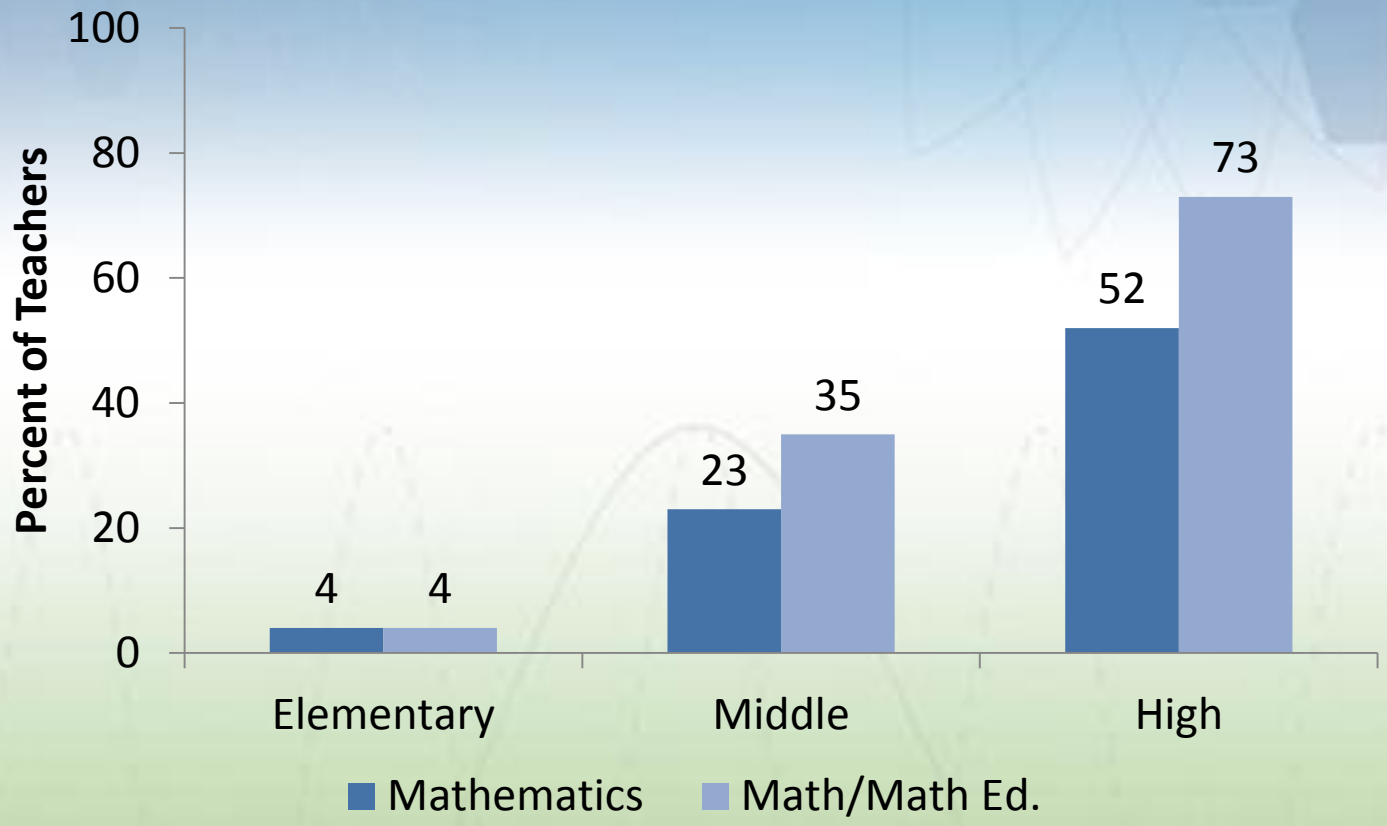
The Mathematics Teaching Force

Question

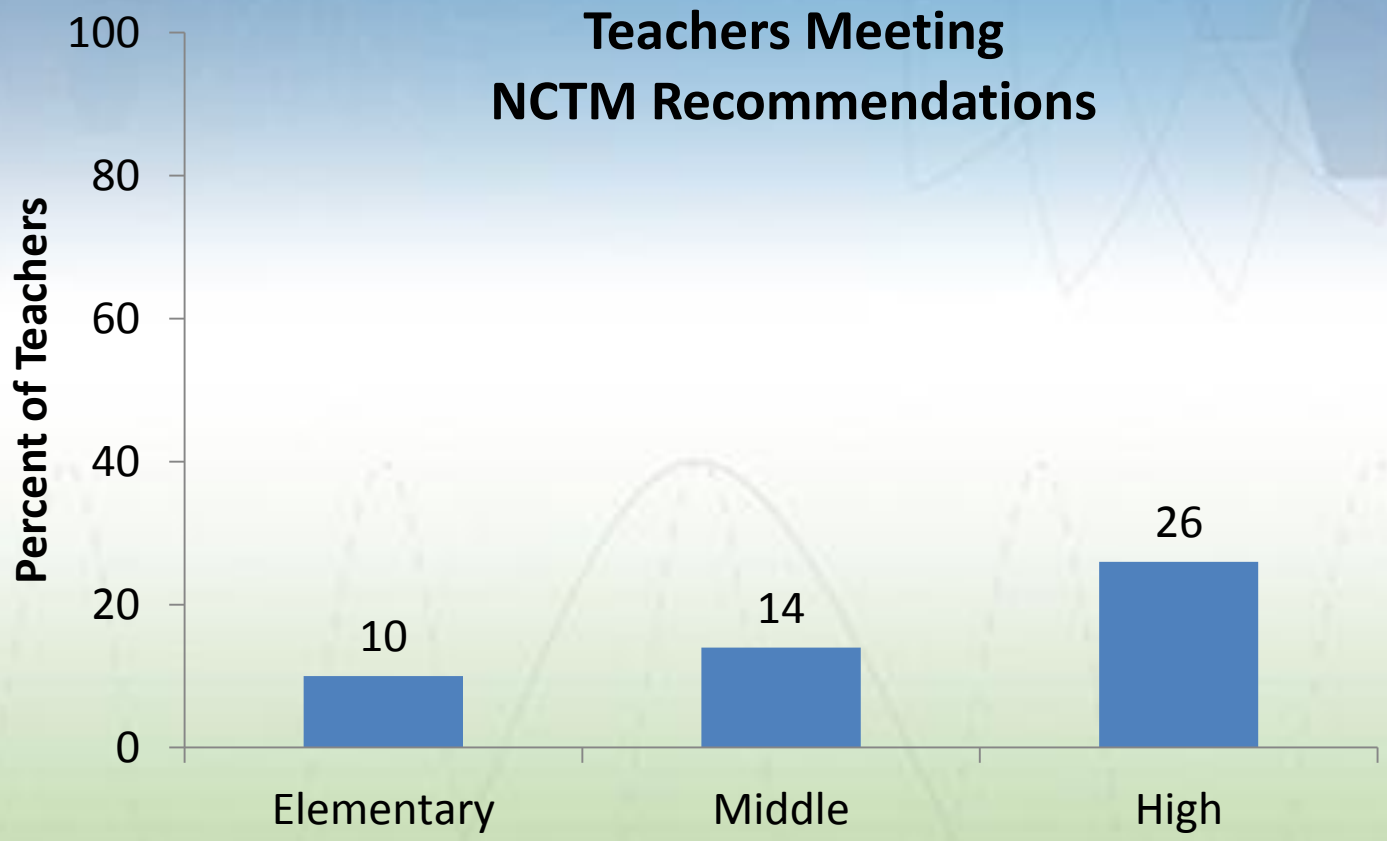
About what percentage of high school mathematics teachers have a college degree in mathematics?

a. 50 percent
b. 60 percent
c. 70 percent
d. 80 percent

Mathematics Teacher Degrees



Mathematics Coursework



Question

The percentage of elementary teachers who feel very well prepared to teach mathematics falls within which of the following ranges?

a. 0-25 percent
b. 26-50 percent
c. 51-75 percent
d. 76-100 percent

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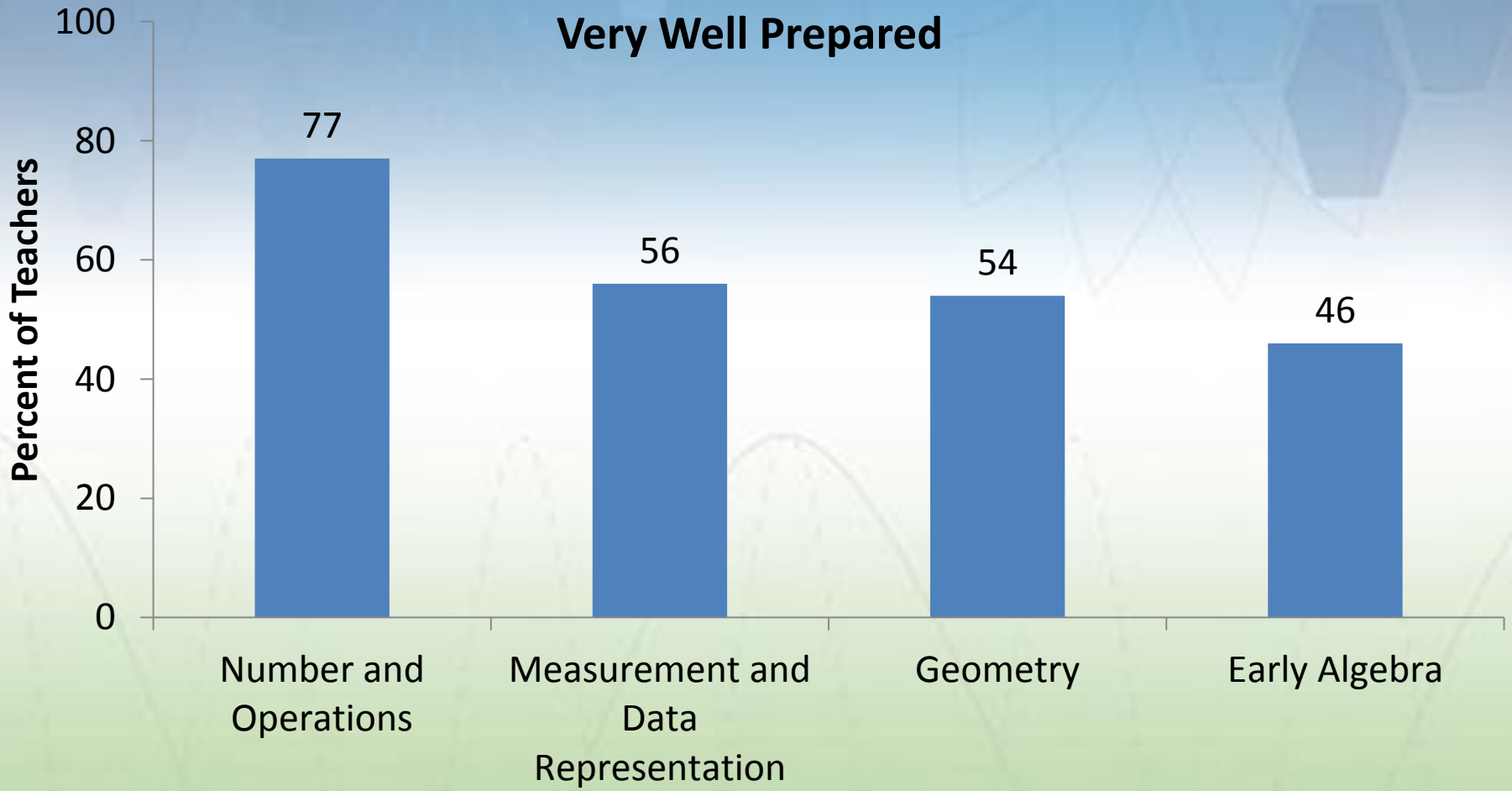
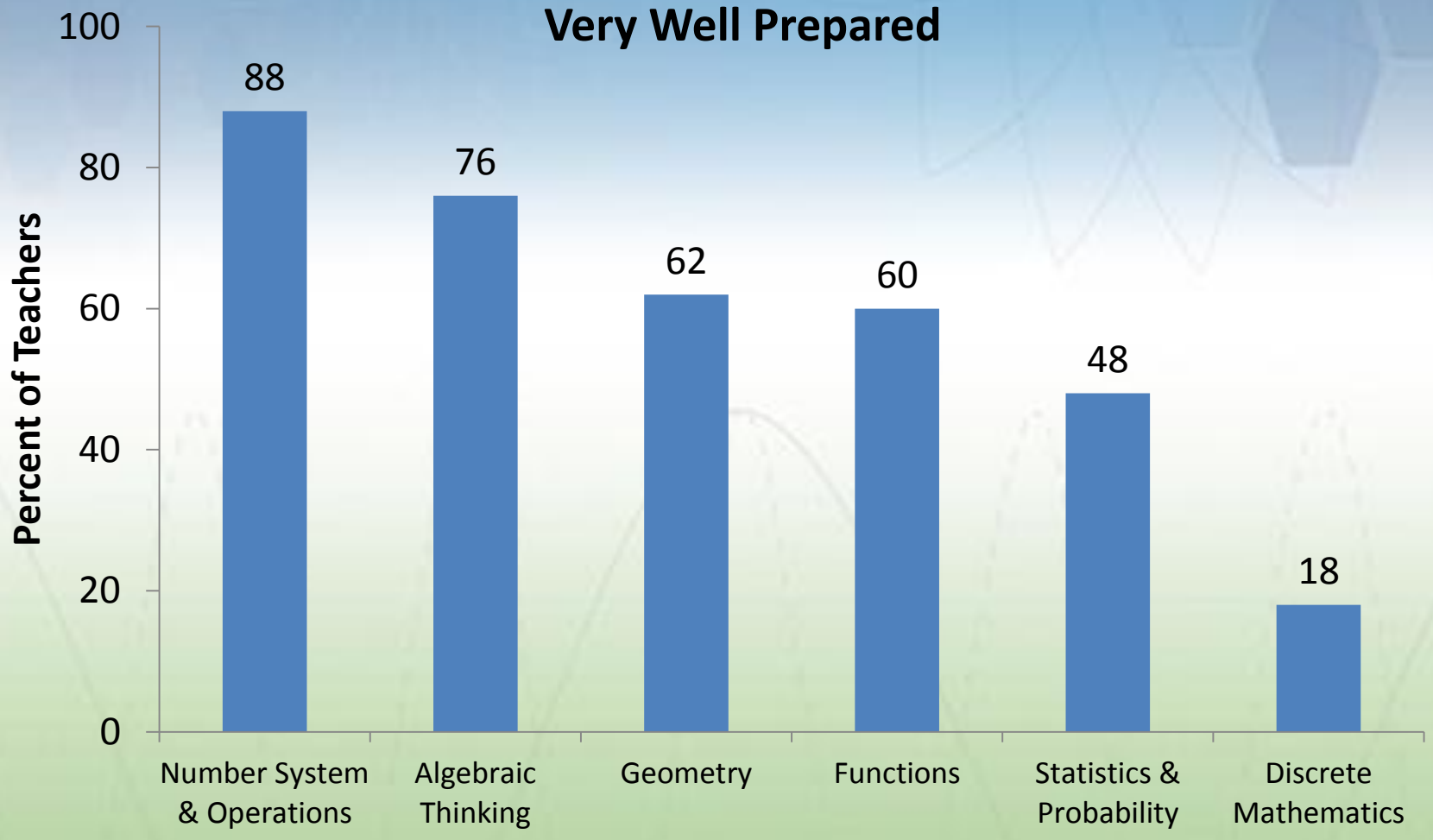
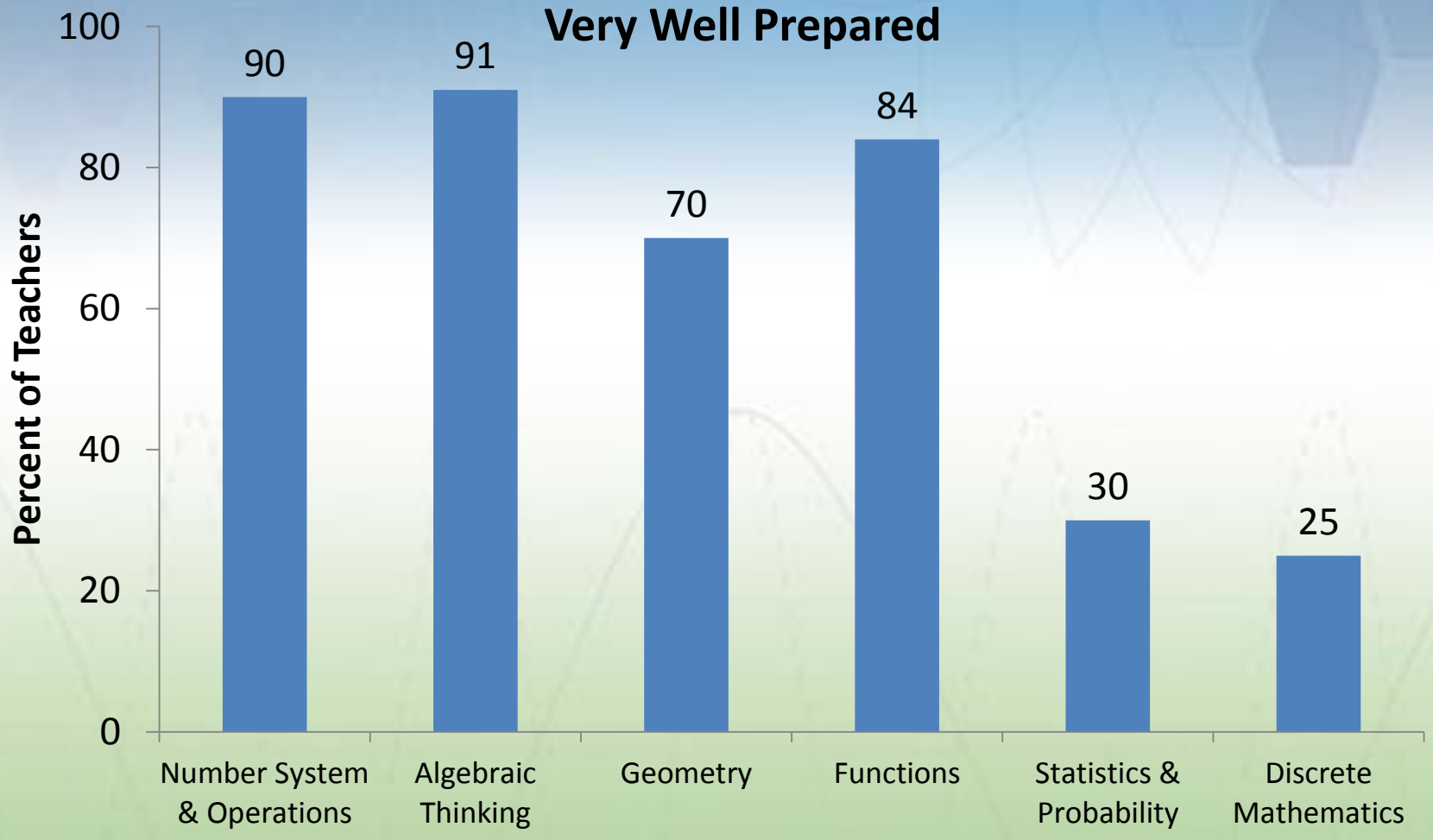
Elementary Teachers' Perceptions of Preparedness



Middle Grade Teachers' Perceptions of Preparedness



High School Teachers' Perceptions of Preparedness



Questions: True or False

- A majority of K–12 mathematics teachers believe it is better to focus on ideas in depth, even if it means covering fewer topics.

- A majority of K–12 mathematics teachers believe students should be given definitions of new vocabulary at the beginning of instruction.

Views about Effective Instruction Vary

- It is better to focus on ideas in depth, even if it means covering fewer topics.
- Classes should provide students opportunities to share thinking/reasoning.
- Classes should end with a summary of key ideas.

Views about Effective Instruction Vary

- 81-90 percent think students should be given definitions of new vocabulary at the beginning of instruction.
- 51-77 percent agree that students learn best with those of similar abilities.
- 37-48 percent think teachers should explain ideas to students before having them investigate the idea.

Professional Development

Features of High Quality Professional Development

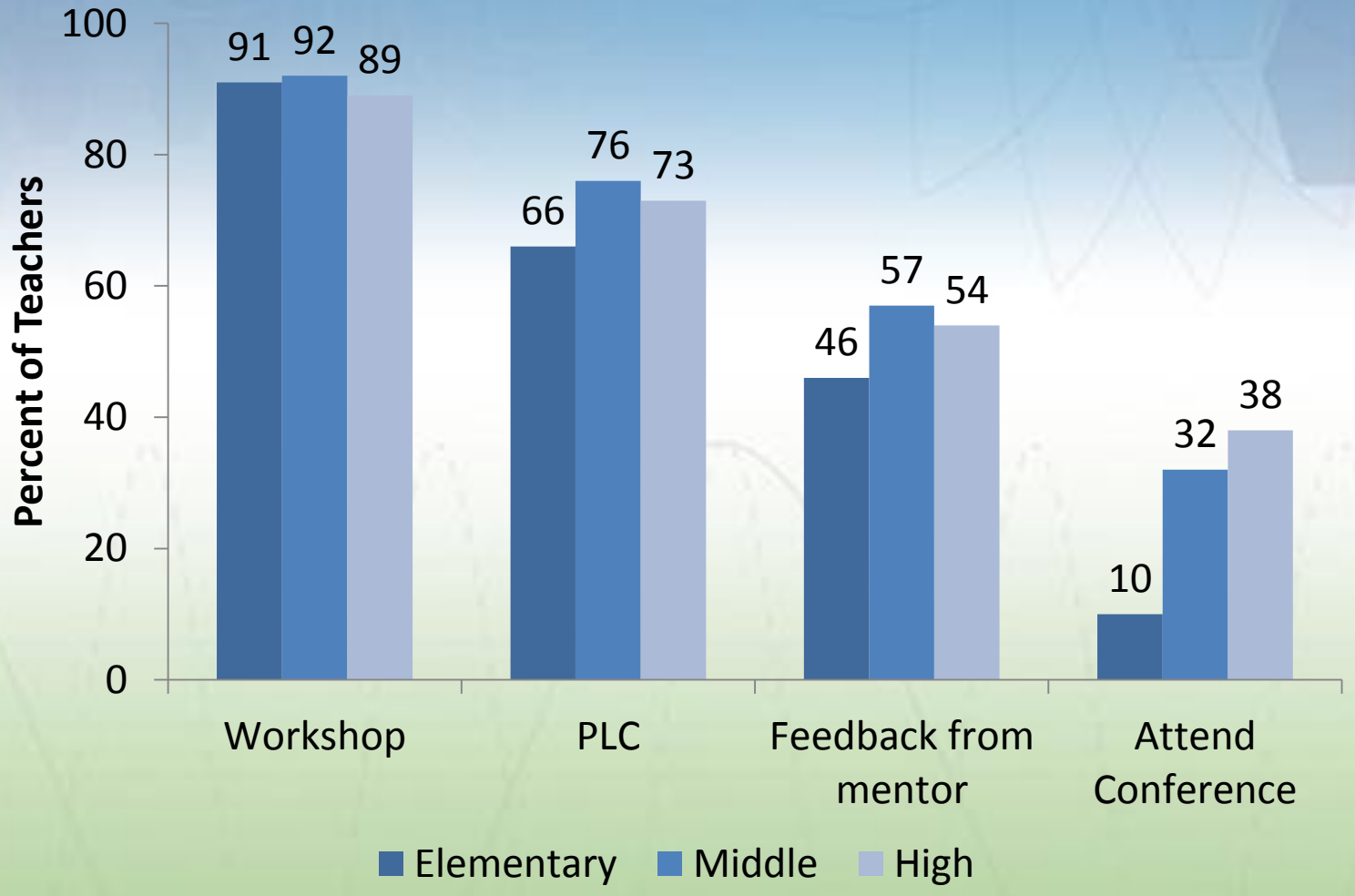
- Focuses on content knowledge;
- Emphasizes active learning;
- Promotes coherence;
- Provides a large amount of training sustained over time; and
- Encourages collaboration among teachers.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. American educational research journal, 38(4), 915–945.

Participation in Mathematics Professional Development in Last 3 Years

- More than 80 percent of K–12 teachers have participated.
- 22-35 percent of teachers have had less than 6 hours of mathematics professional development.
- Only about 30 percent of secondary teachers and 10 percent of elementary teachers have had more than 35 hours.

Mathematics Professional Development Activities in Last 3 Years

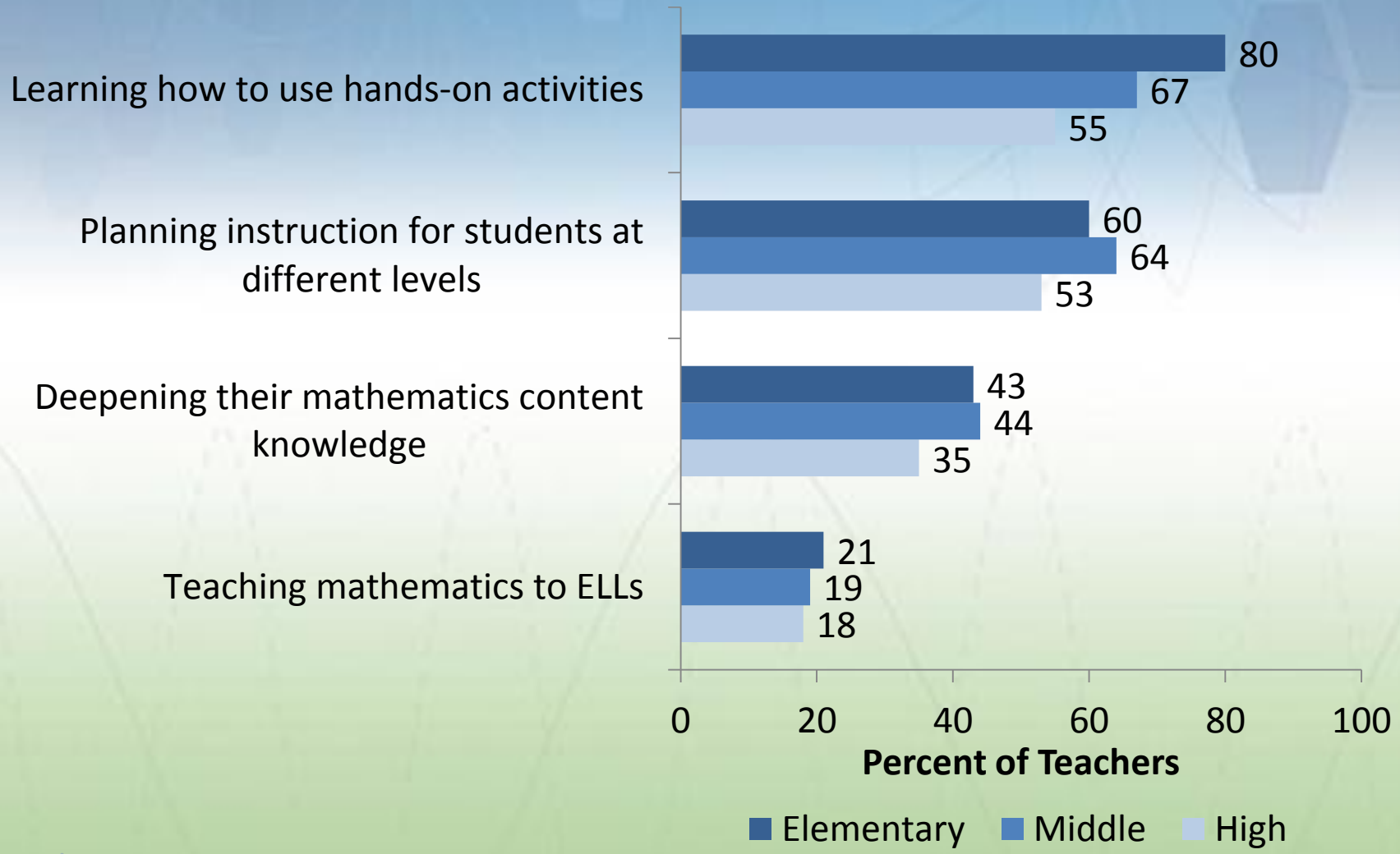


Question

Which of the following areas was *most* heavily emphasized in elementary teachers' mathematics professional development/coursework in the last 3 years?

a. Deepening their mathematics content knowledge
b. Learning how to use hands-on activities
c. Teaching mathematics to ELLs
d. Planning instruction for students at different levels

Heavy Emphasis of Mathematics Professional Development/Coursework in Last 3 Years



The Typical PLC…

- Requires participation
- Meets for the entire year; frequency varies
- Has a designated leader from within the school
- Limits participation to teachers from within school
- Includes teachers from multiple grade levels

Emphasis of Mathematics PLCs

	Percent of Schools with PLCs
Analyze student assessment results	83
Analyze instructional materials	65
Plan mathematics lessons together	62
Analyze classroom artifacts	34
Engage in mathematics investigations	30

- PLCs are more likely to be offered in high poverty schools than low poverty schools (61 percent and 39 percent, respectively).

Instructional Materials

Question

About what percentage of mathematics classes at each grade level uses a published textbook as the primary instructional material?

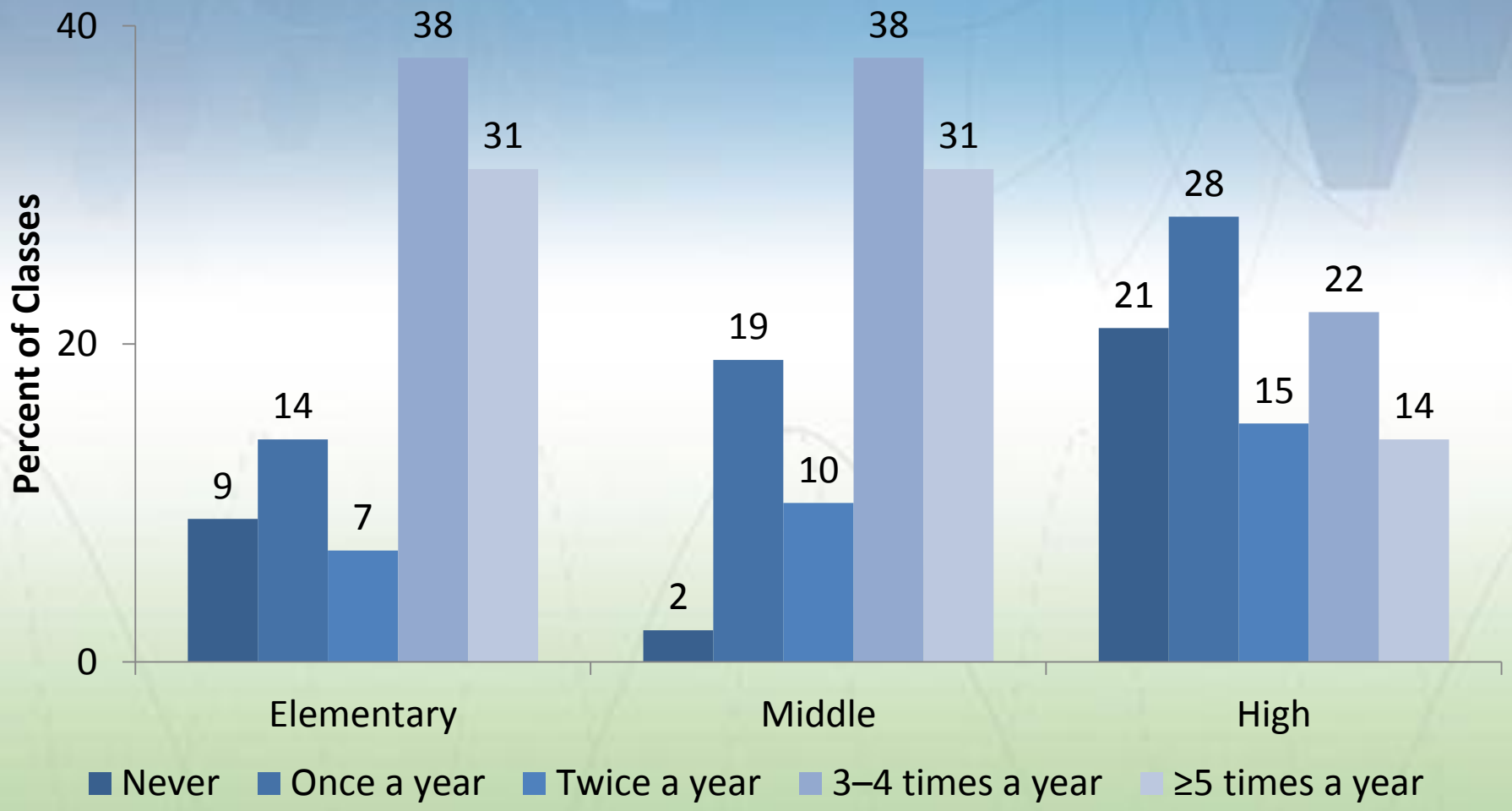
a. 40 percent
b. 60 percent
c. 80 percent
d. 100 percent

How Teachers Use their Materials

- Over 80 percent of mathematics classes at each grade range are using published textbooks.
- 67-81 percent of classes cover a substantial portion of the textbook (75 percent or more).
- Primarily being used to guide both the overall and detailed structure of the unit.
- More than half of mathematics classes also supplement their textbook.

External Testing

Frequency of Required External Testing in Mathematics Classes

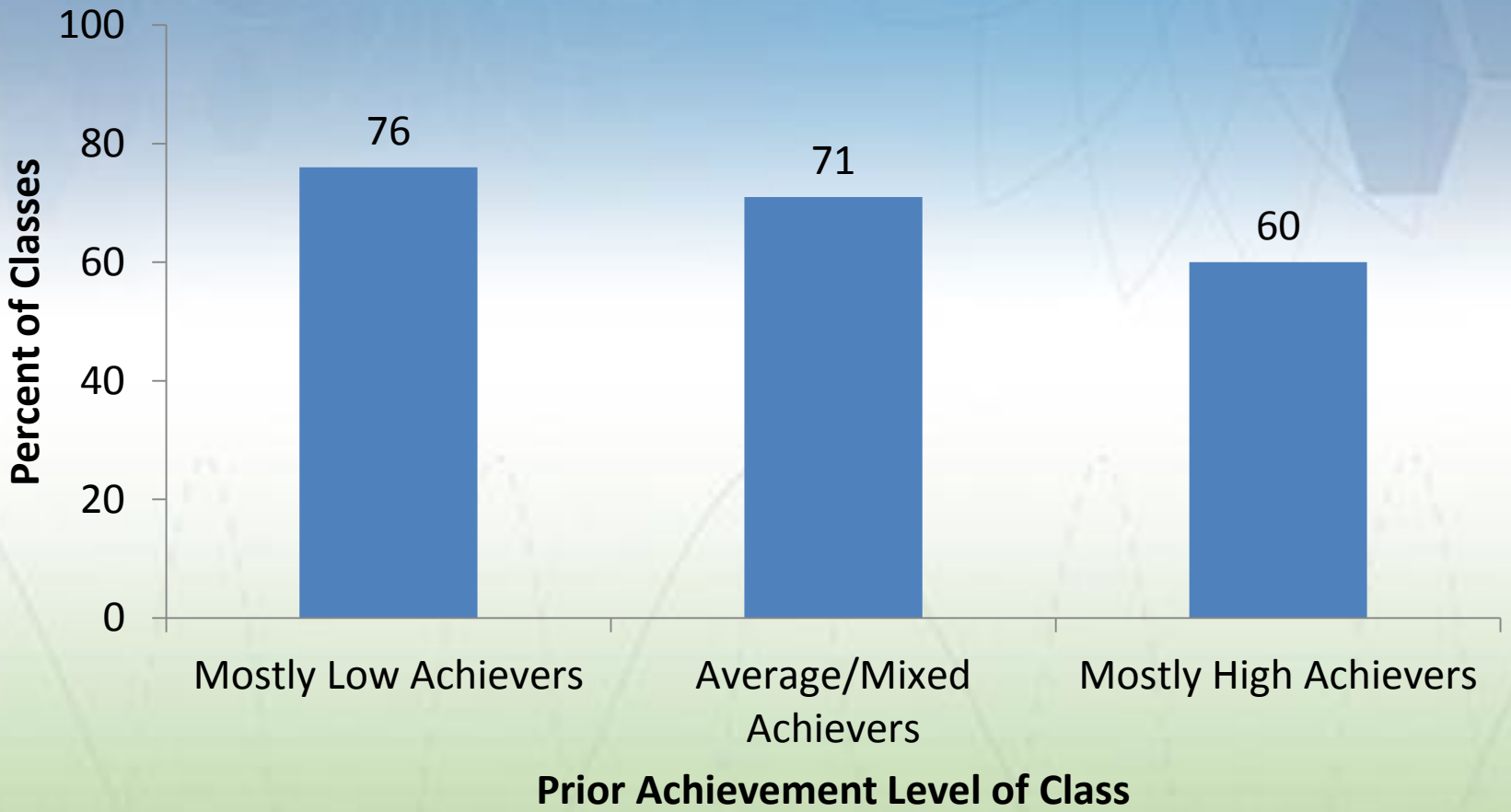


Question

Which of the following equity variables is associated with the frequency of required external assessments?

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

Mathematics Classes Required to Take External Assessments Two or More Times per Year



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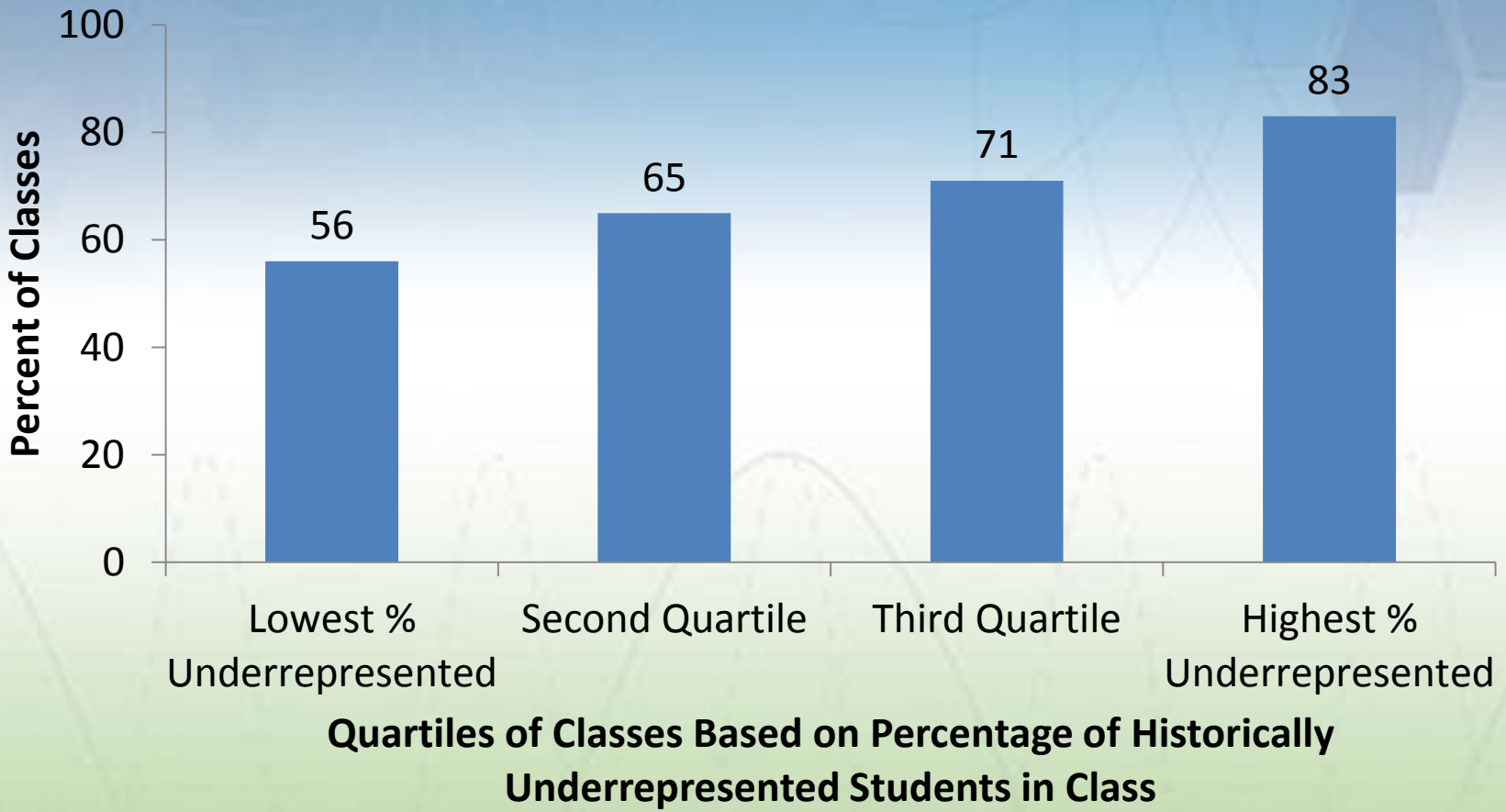

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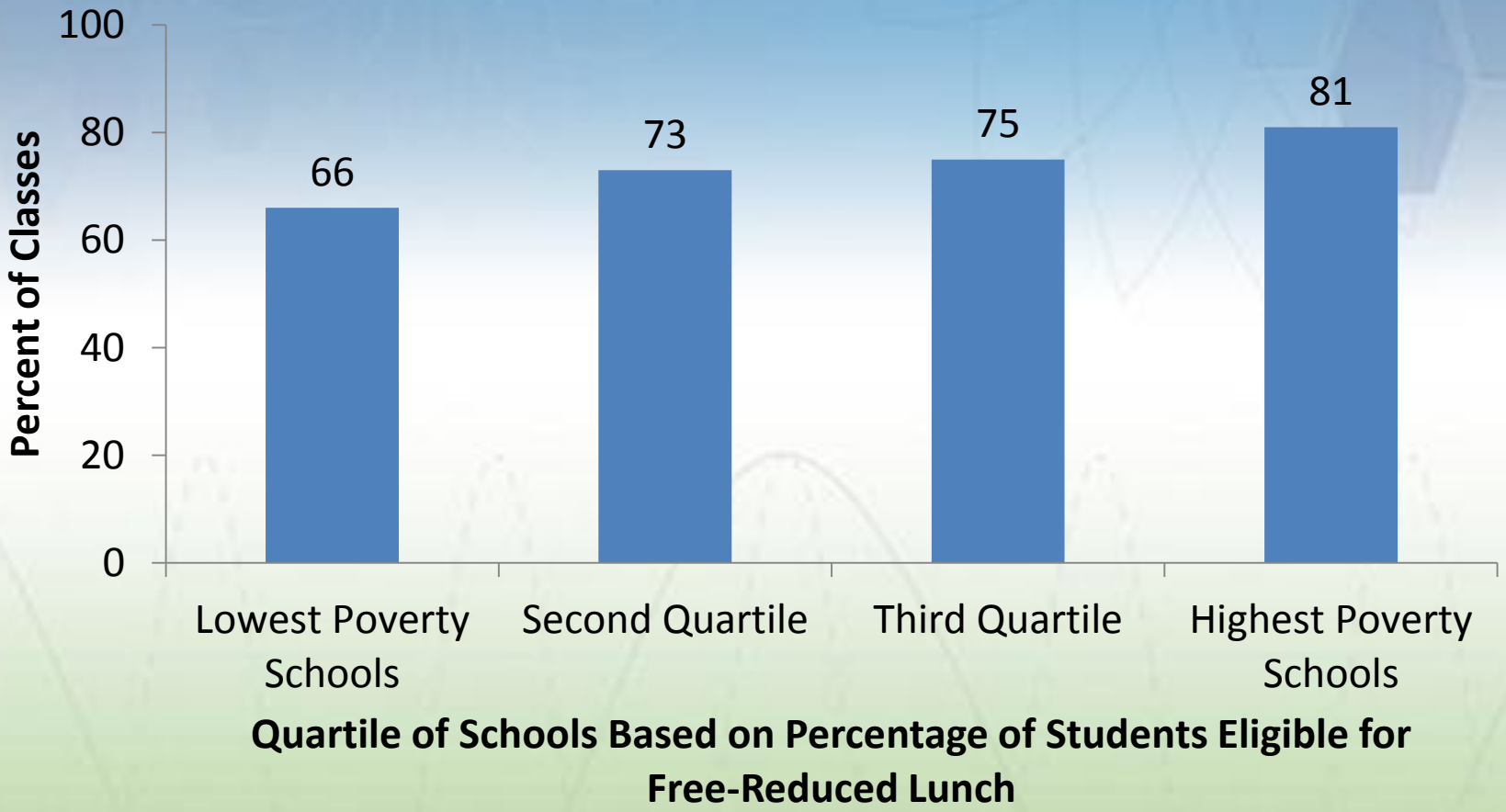

Recap

- The 2012 National Survey highlights both strengths and areas in need of improvement across the K–12 mathematics education system:
  - Instruction
  - Teacher preparation and support
  - Instructional materials
  - Assessment

Implications for the Future

- The K–12 mathematics education system will have to change if it is going to meet the goals of new mathematics standards
- The better the system components are aligned, the more likely we will be successful at meeting these goals
- There's a lot of work to do

Have to Consider the System

- "Every system is perfectly designed to get the results it gets." -- *Michael Patton*

- To change the results, you need to change the system, i.e., the guidance and/or incentives for teachers, administrators, students

Areas to Address

- Pre-service teacher preparation and induction
- Professional development
- Instructional materials
- Assessments
- District and state policies
  - Curriculum
  - Accountability

Dilemma of System Reform

- You can't do everything at once
- But anything you don't attend to may come back to haunt you later
- You need to be strategic in deciding what to take on, when, and in what depth

Areas to Address

- Pre-service teacher preparation and induction
- Professional development
- Instructional materials
- Assessments
- District and state policies
  - Curriculum
  - Accountability

Small Group Discussion: Implications for Your Work

- Which areas are of particular interest or focus in your state?
  - What are the likely causes of certain findings related to these areas?
  - What barriers exist to improving the situation?
  - What can you do in your work to improve these areas?

For More Information on the 2012 NSSME

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