NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

The 2018 NSSME+

JUNE 11, 2019

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horizon RESEARCH, INC.

Today's Schedule

1:00–1:40 Computer Science

1:45–2:30 Mathematics

2:35–3:20 Science

3:20–3:30 Wrap-up

About the 2018 NSSME+

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

- **The 2018 NSSME+ included a new focus on computer science education.**

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

Six different survey instruments

- Characteristics of the science/mathematics/ computer science teaching force:
  - demographics
  - preparation for teaching
  - 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

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 mean that the results are national estimates of schools, teachers, and classes—not characteristics of the respondents.

Equity

We're also sharing data disaggregated by factors historically associated with differences in students' educational opportunities:

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

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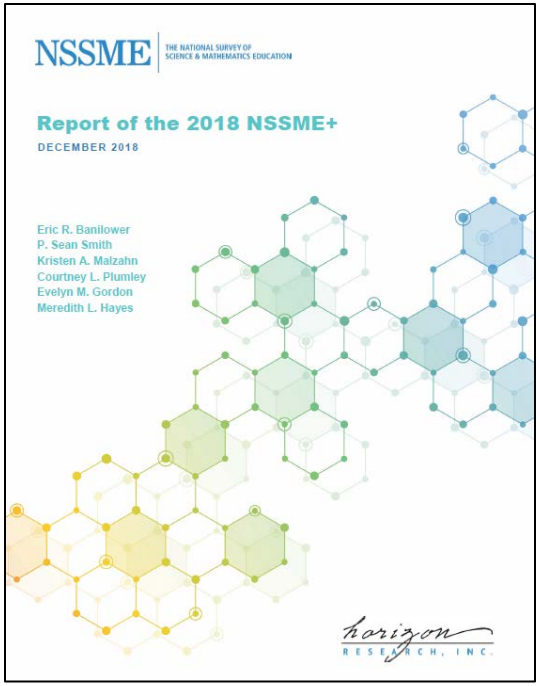
Current reports:

- Technical report
- Highlights report
- Compendium of Tables
- Subject/Grade-level reports and compendia

Coming Soon:

- Equity reports
- Trend reports
- Monitoring Progress report
- NGSS report
- Novice Teacher reports



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#NSSME

Session Overview

For Each Subject:

- Current Status of Instruction
- Resources for Instruction
- The Teaching Force
- Professional Development Experiences

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K–12 Computer Science

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Computer Science Instruction*

Who has access to computer science instruction?

Are students experiencing the kind of computer science instruction we hope for?

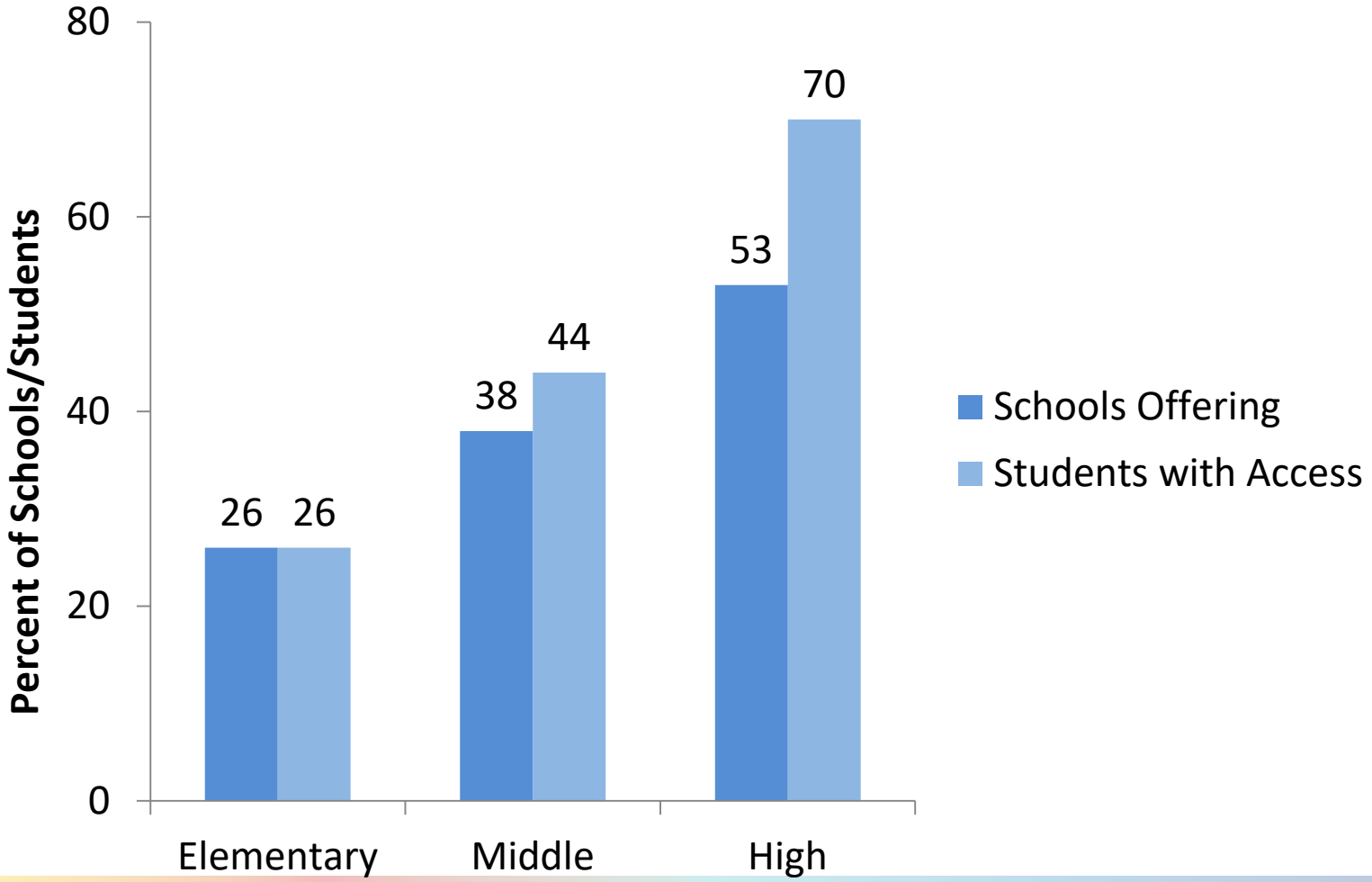
Why might instruction look the way it does?

Computer Science Instruction

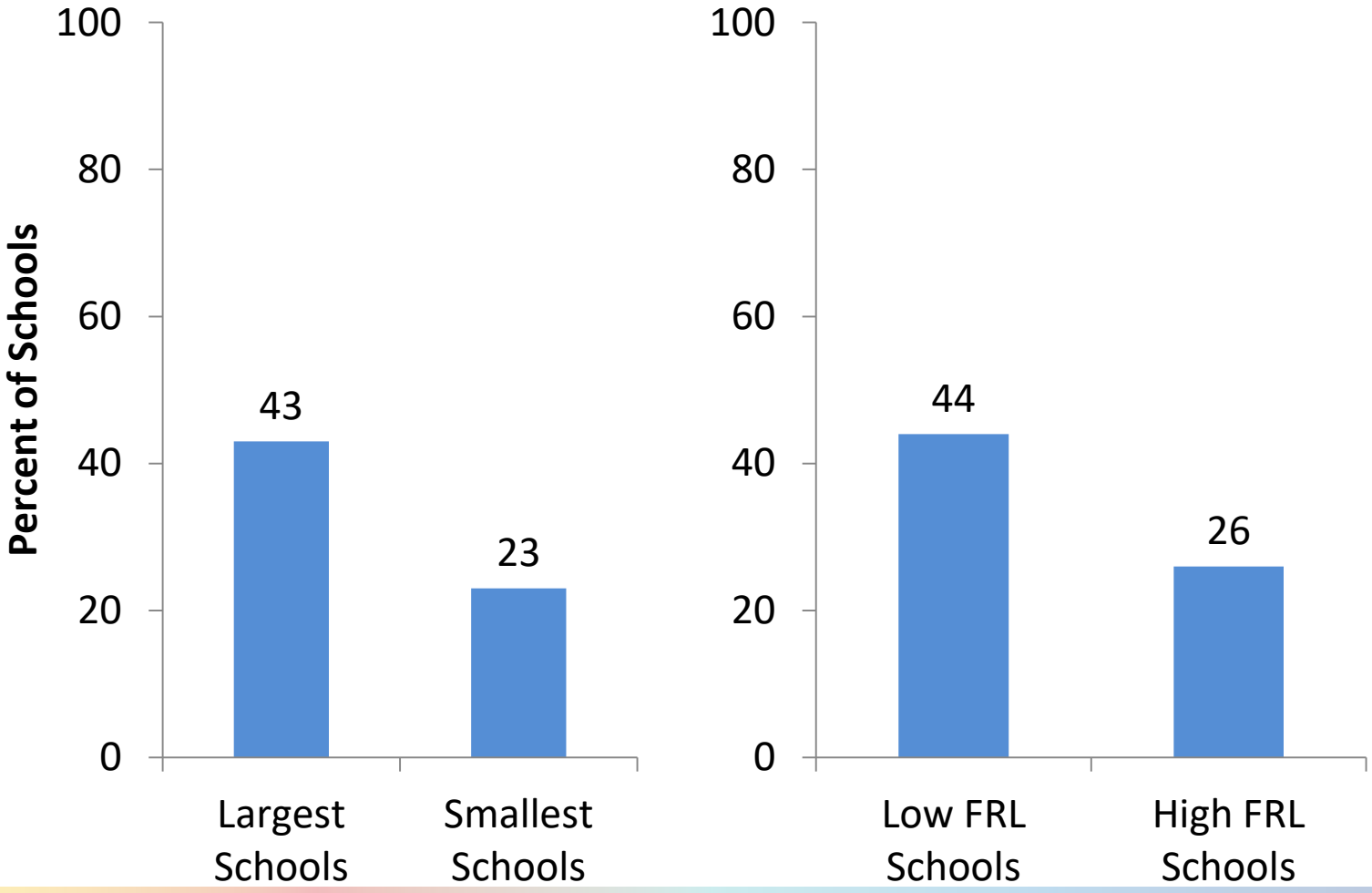
About what percentage of high schools offer computer science courses?

A. 25%
B. 50%
C. 75%
D. 100%

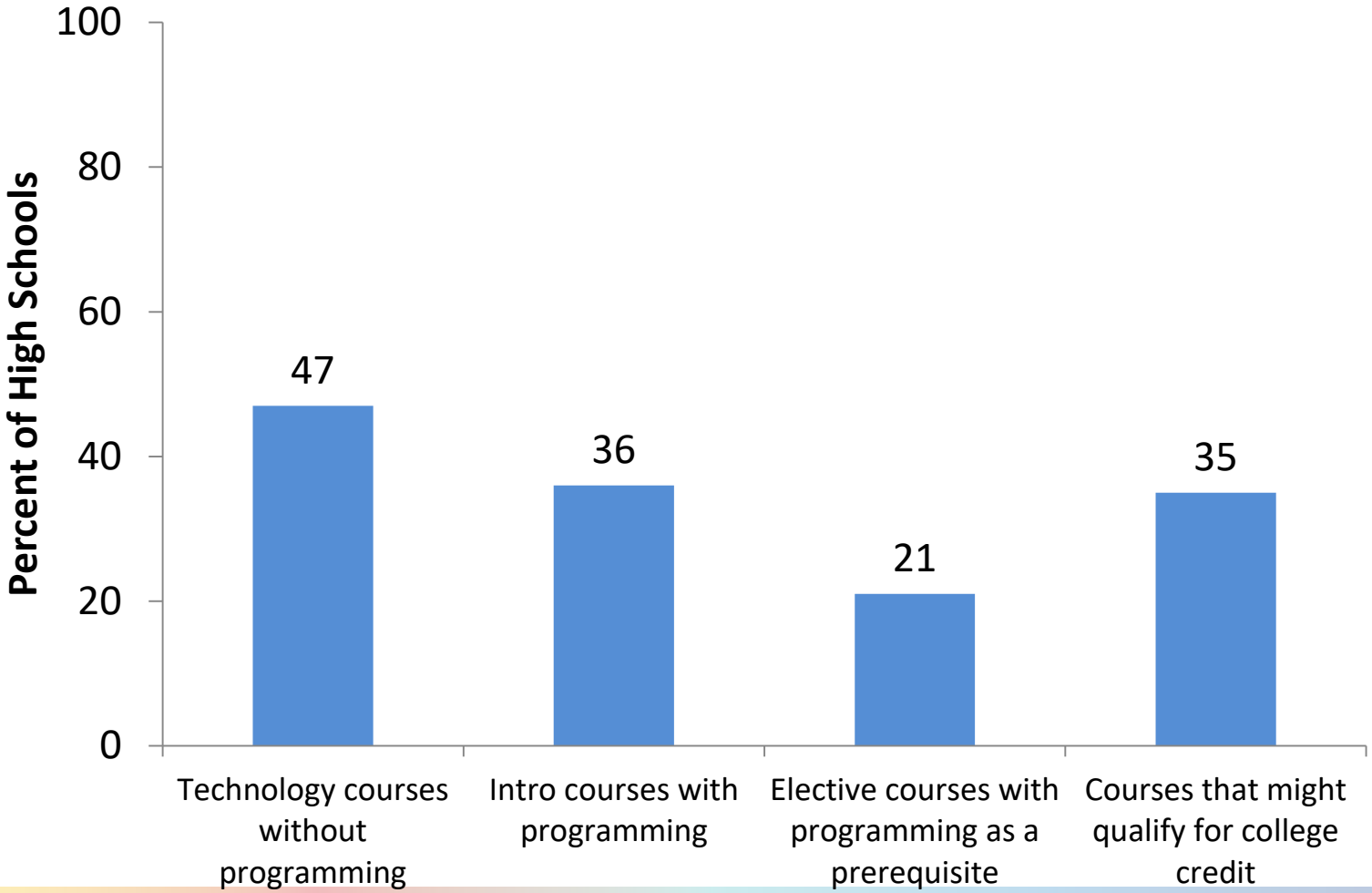
Schools Offering Computer Science Instruction



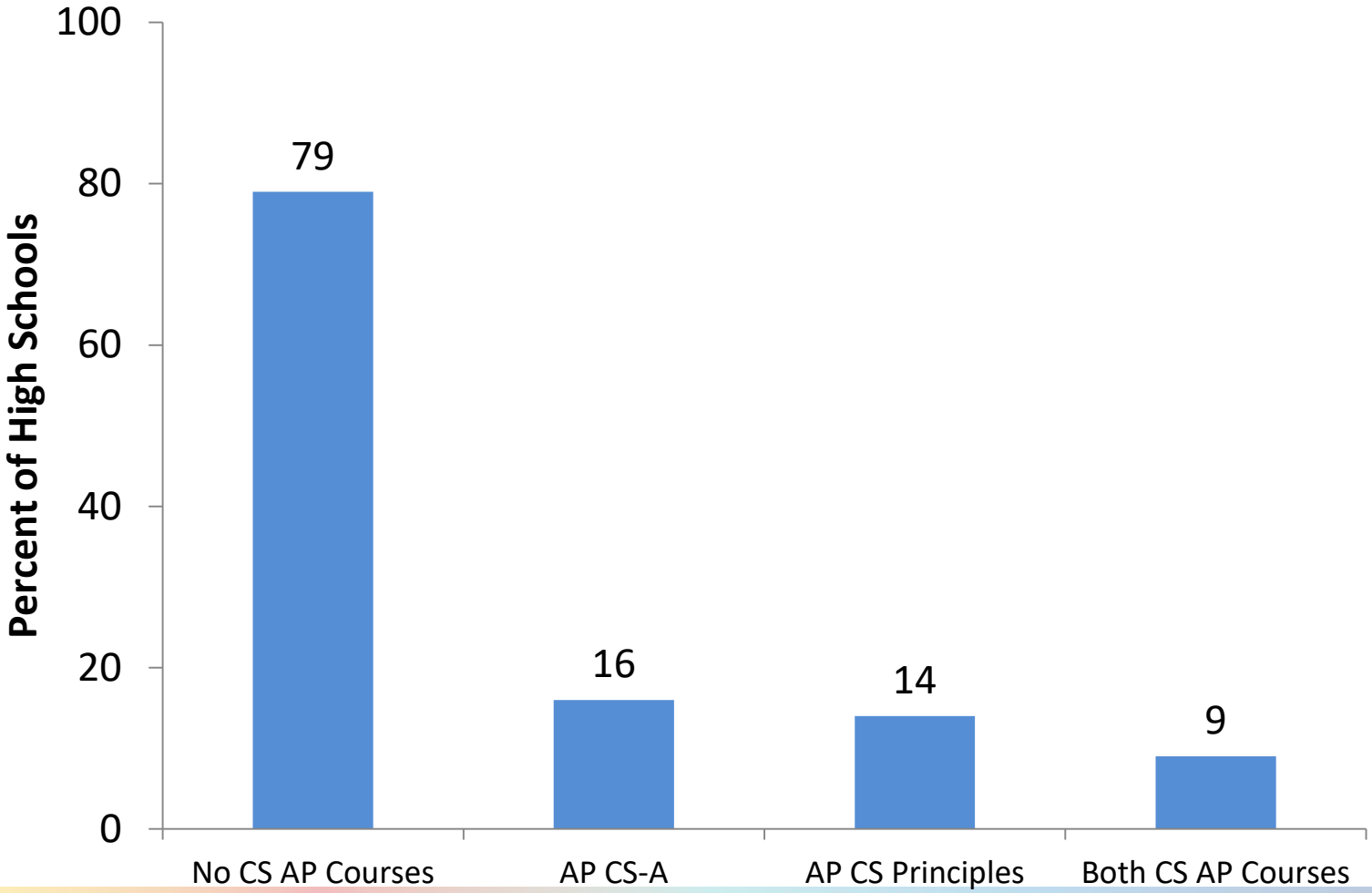
Equity Analysis: Schools Offering Computer Science Instruction



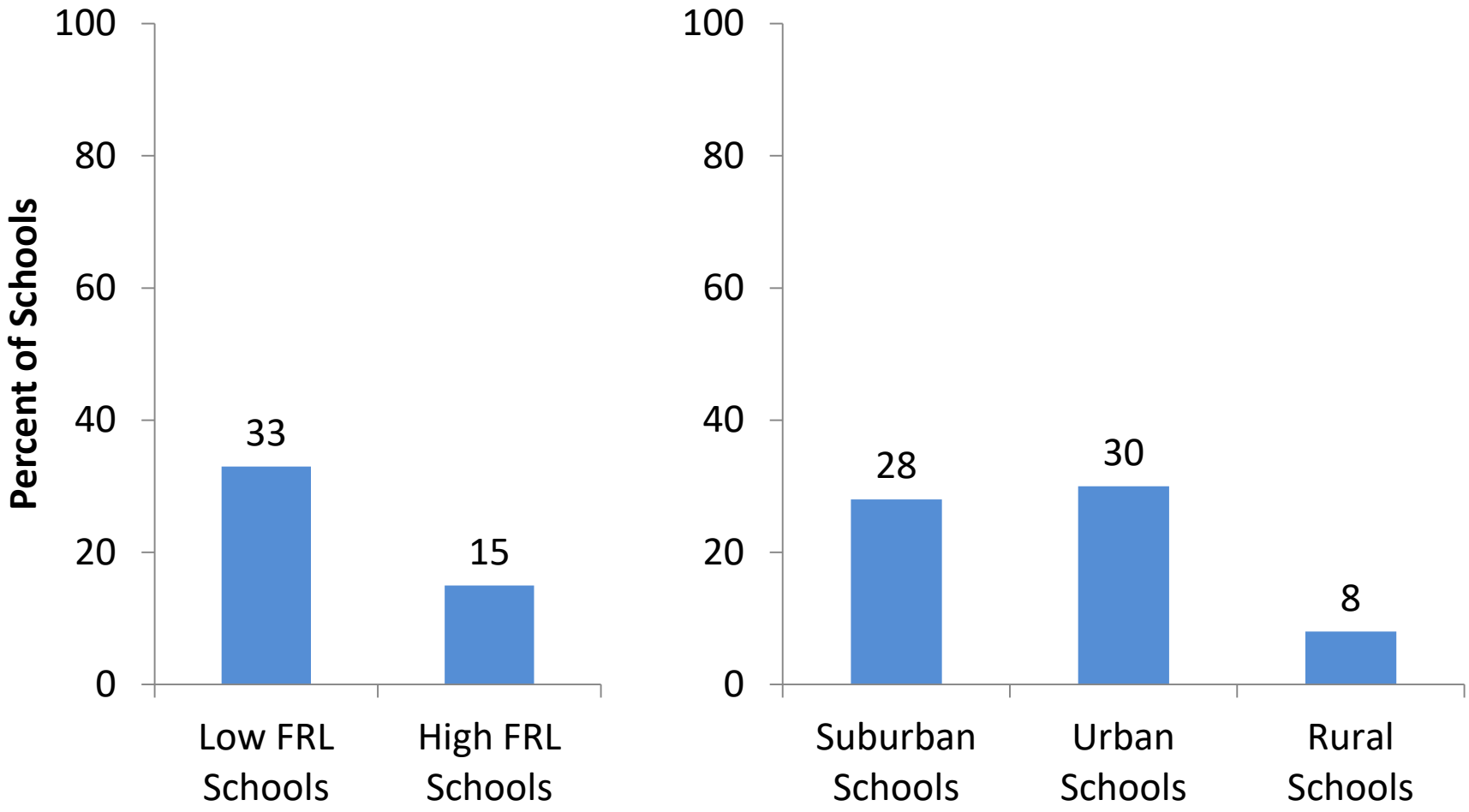
High Schools Offering Computer Science and Technology Courses



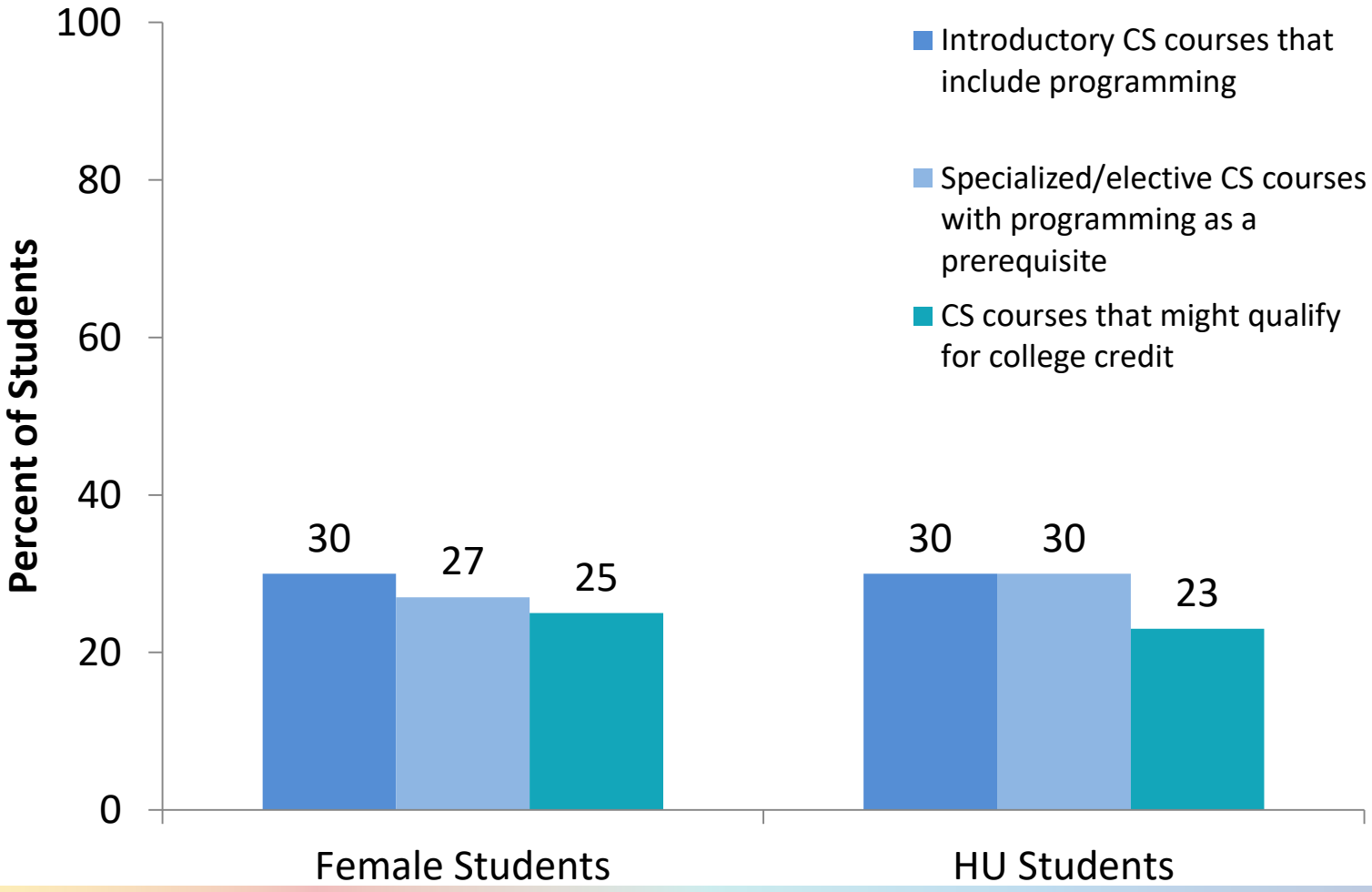
High Schools Offering AP Computer Science Courses



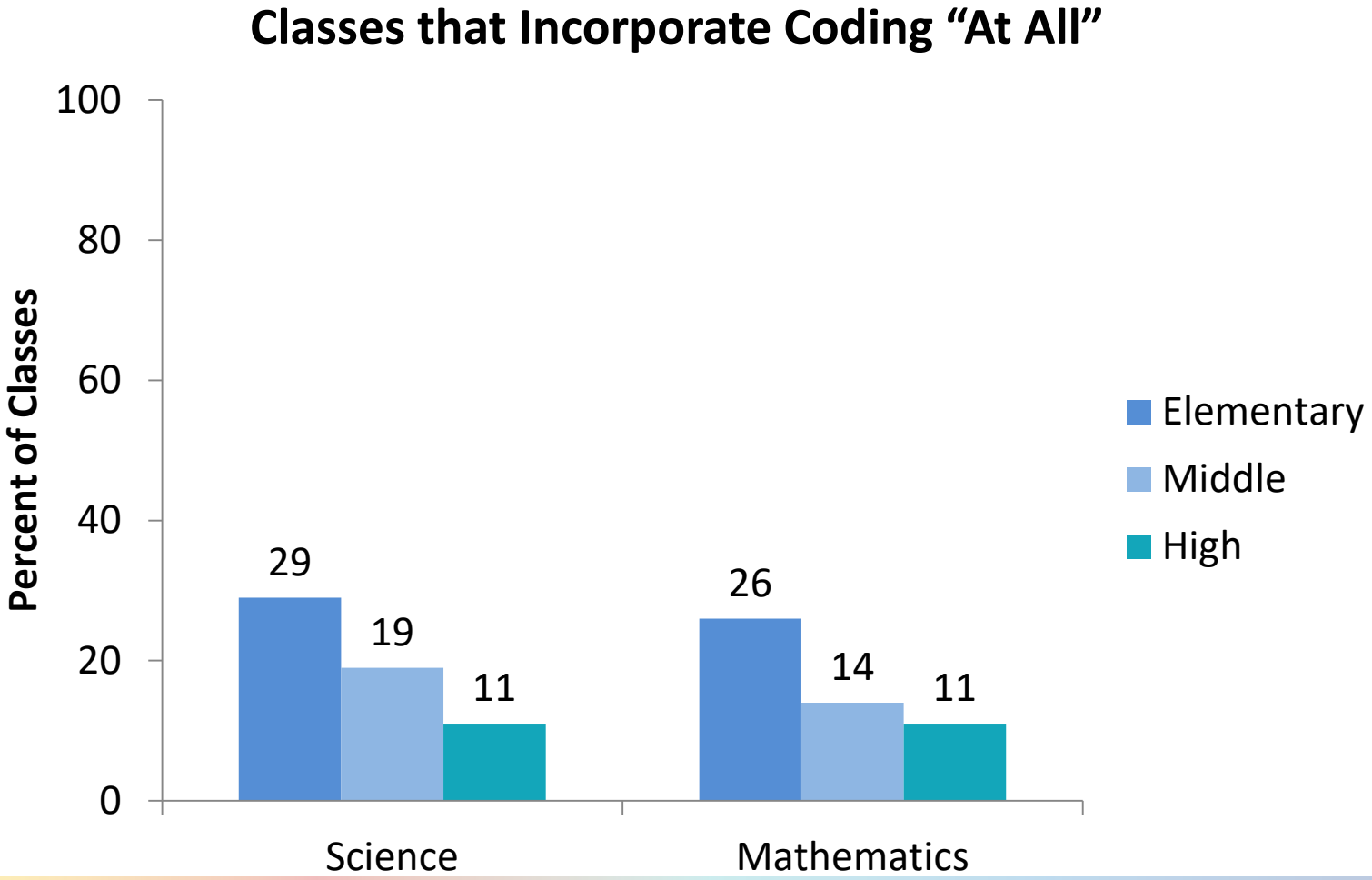
Equity Analysis: High Schools Offering AP CS



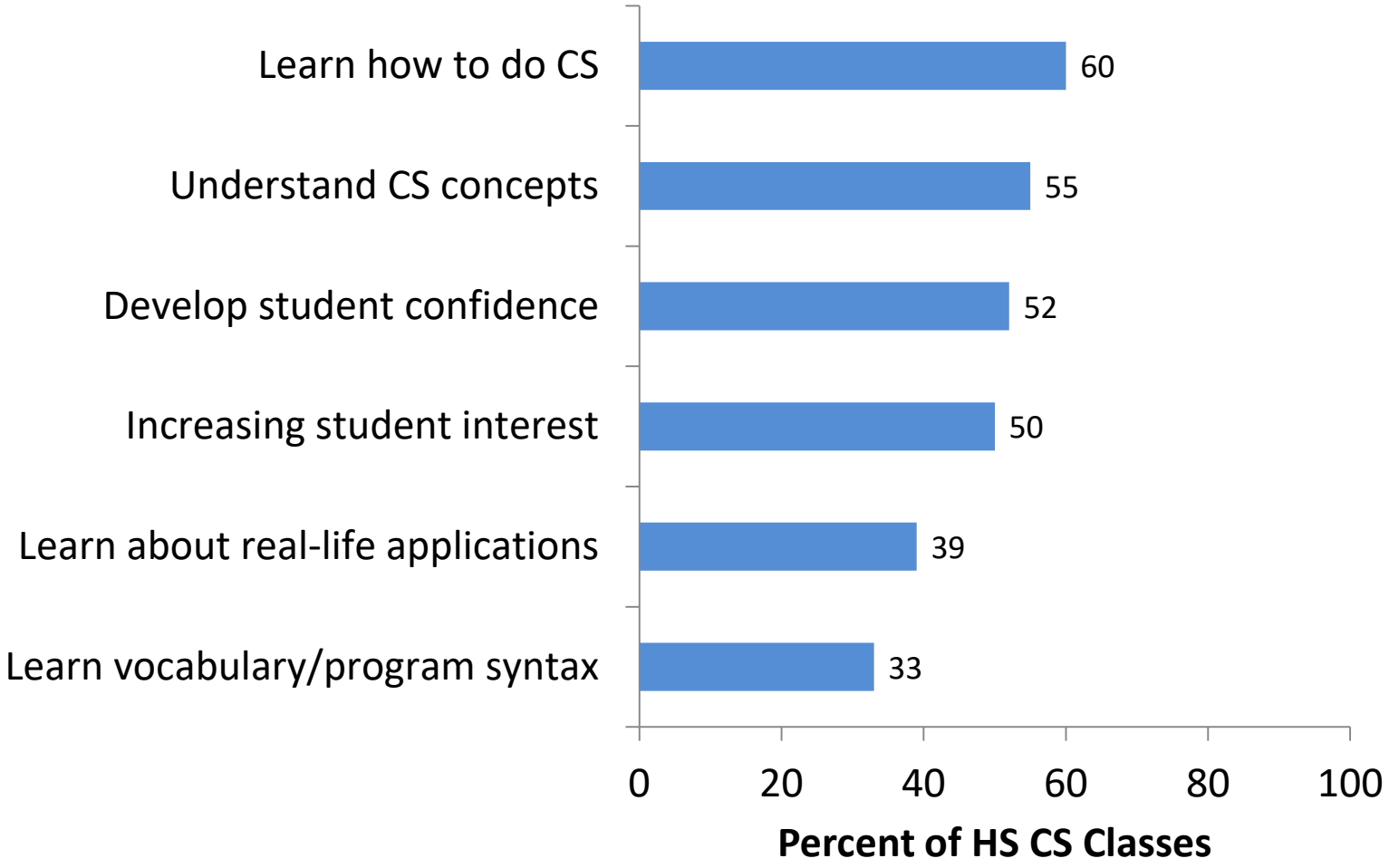
Equity Analysis: High School Students Taking CS Courses



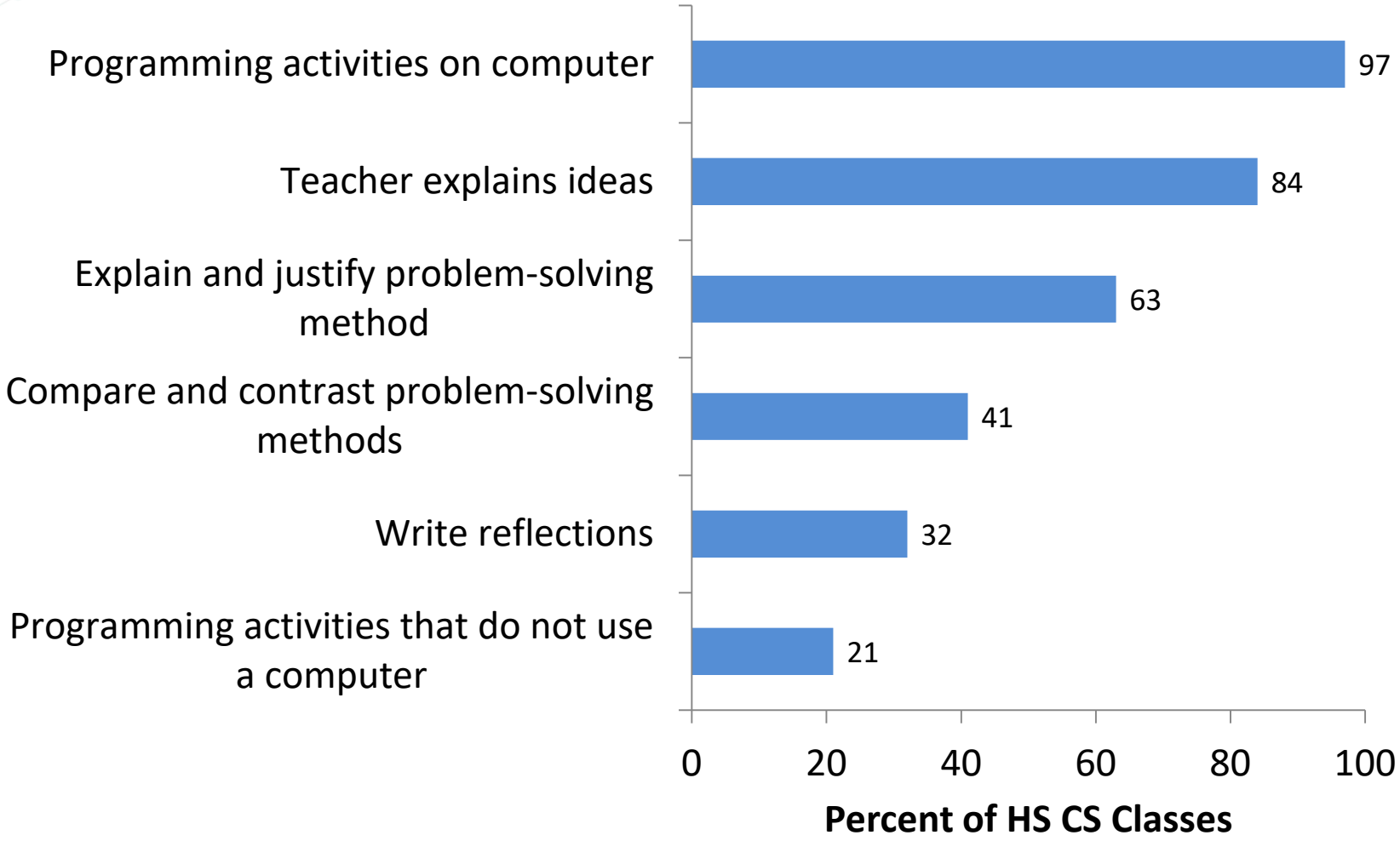
CS in Science and Mathematics Instruction



Objectives Receiving a Heavy Emphasis



Instructional Activities: Weekly



Engagement in Computer Science Practices

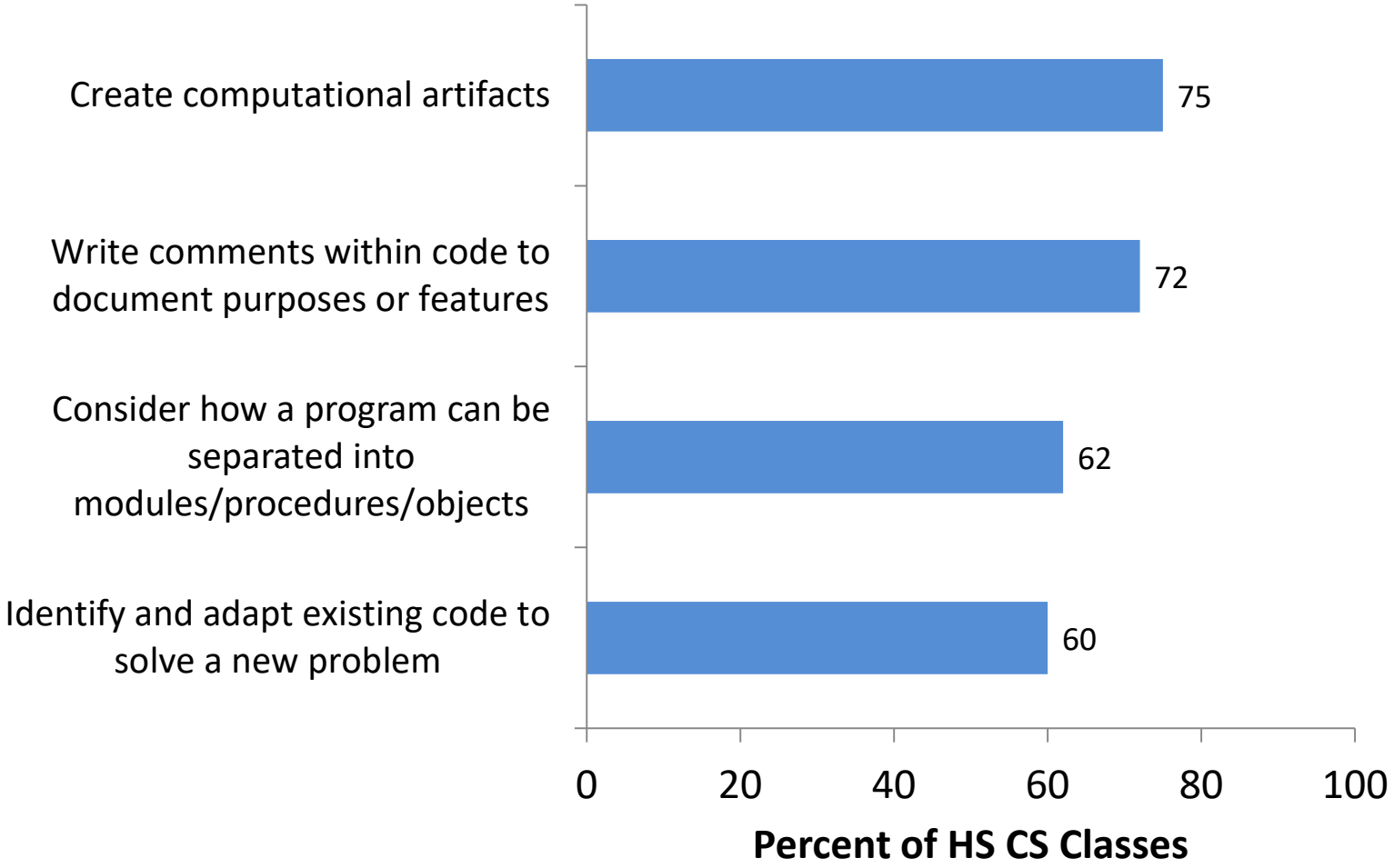
The 2018 NSSME+ included a series of items asking how often students were engaged in aspects of the computer science practices:

1. Fostering an inclusive computing culture
2. Collaborating around computing
3. Recognizing and defining computational problems
4. Developing and using abstractions
5. Creating computational artifacts
6. Testing and refining computational artifacts
7. Communicating about computing

Engagement in Computer Science Practices

Students are often engaged in aspects of computer science related to developing computational artifacts

Developing Computational Artifacts: Weekly

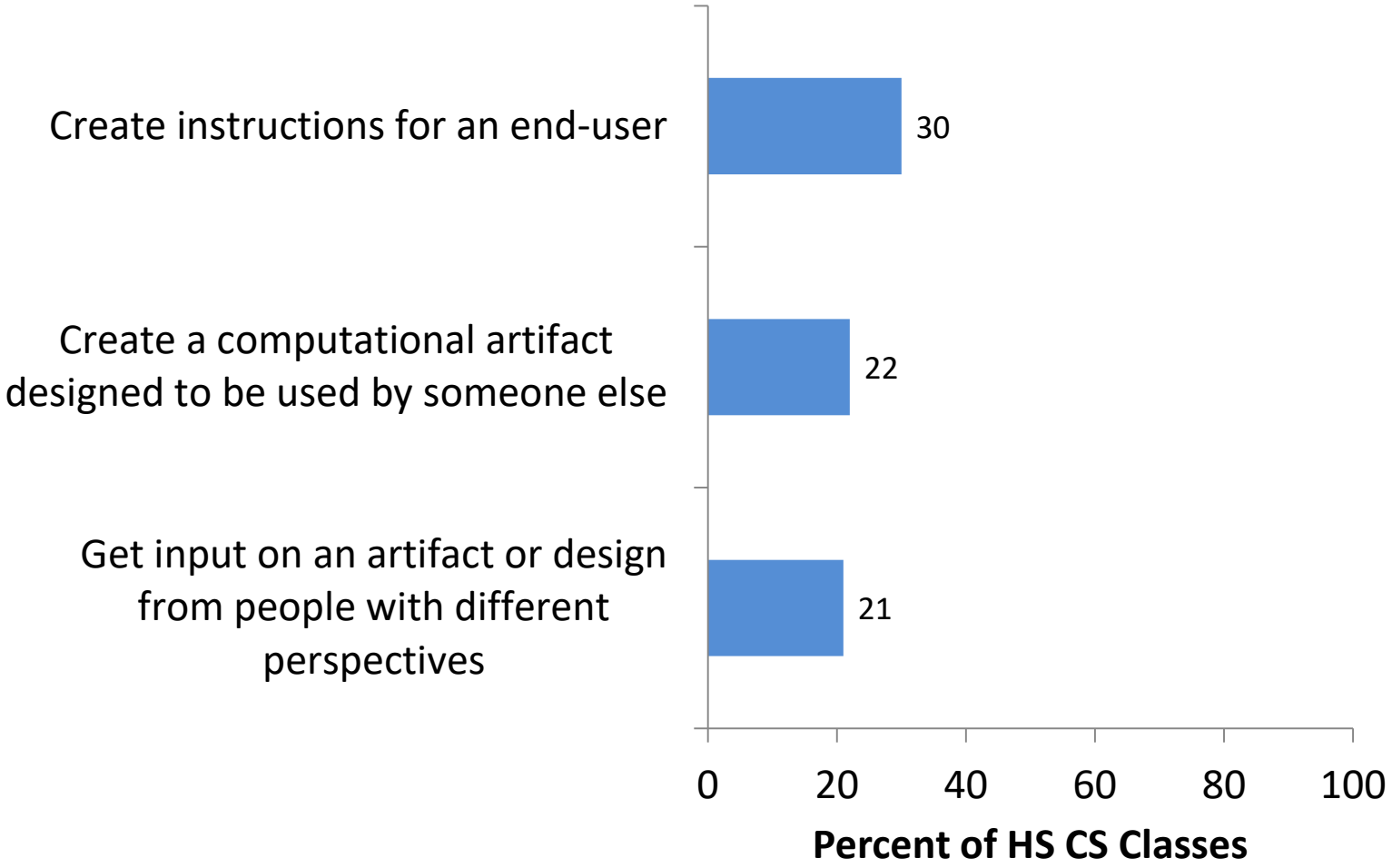


Engagement in Computer Science Practices

Students are often engaged in aspects of computer science related to developing computational artifacts

Students tend not to be engaged very often in aspects of computer science related to communicating with end-users or considering diverse needs

Considering End Users: Weekly



Instructional Materials

About what percentage of high school computer science classes base instruction on commercially published textbooks at least once a week?

A. 25%

B. 50%

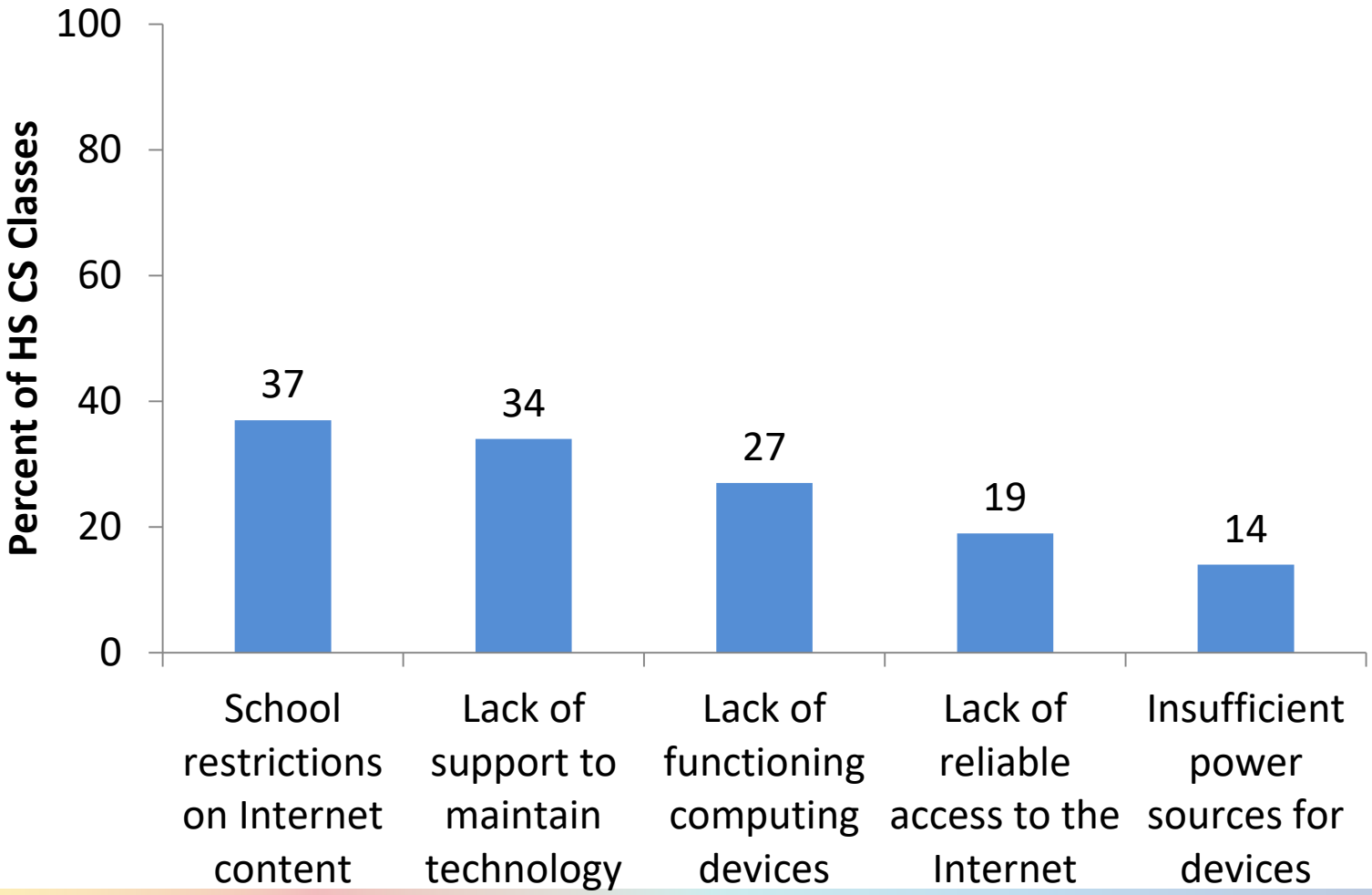
C. 75%

D. 100%

Instructional Materials Used (Weekly)

	Percent of Classes
Teacher-developed units or lessons	64
Units or lessons from websites that are free	43
Self-paced online courses or units	32
Units or lessons from other sources (e.g., conferences or colleagues)	28
Commercially published textbooks (printed or online)	26
Lessons or resources from websites that have a subscription fee or cost	9
State, county, district, or diocese-developed unit or lessons	7

Factors Perceived as Problems



Computer Science Instruction Takeaways

Only about half of high schools offer computer science; it is less common in smaller schools, high-poverty schools, and rural schools

Computer science instruction is relatively rare at elementary and middle schools

On average, female students and students from race/ethnicity groups historically underrepresented in STEM make up less than a third of students in high school computer science classes

Students work on creating computational artifacts often, but are not asked to attend to end-users' needs nearly as often

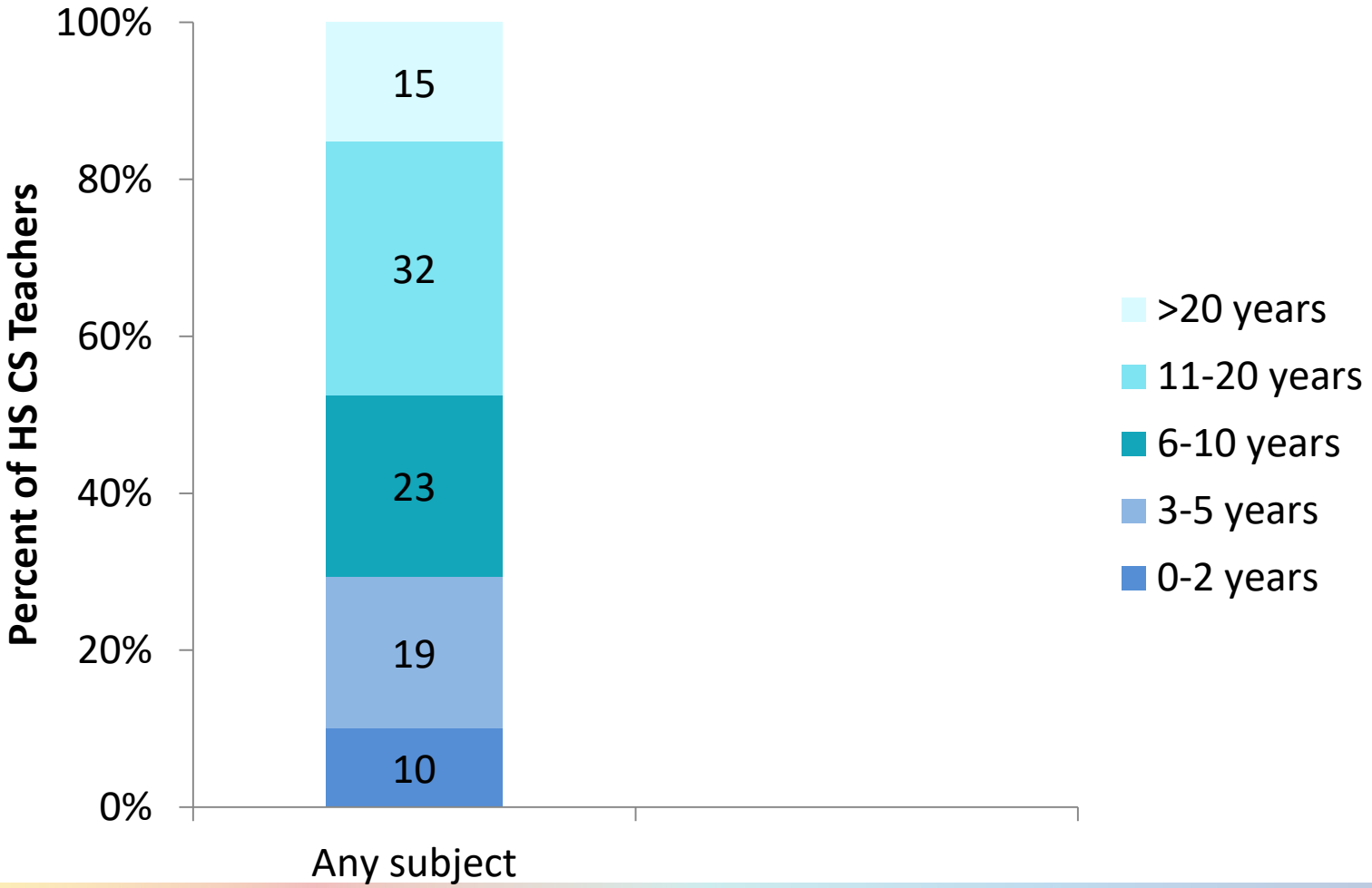
Teachers are often using self-developed units and lessons, and picking and choosing from other sources, raising questions about quality and coherence

The Computer Science Teaching Force

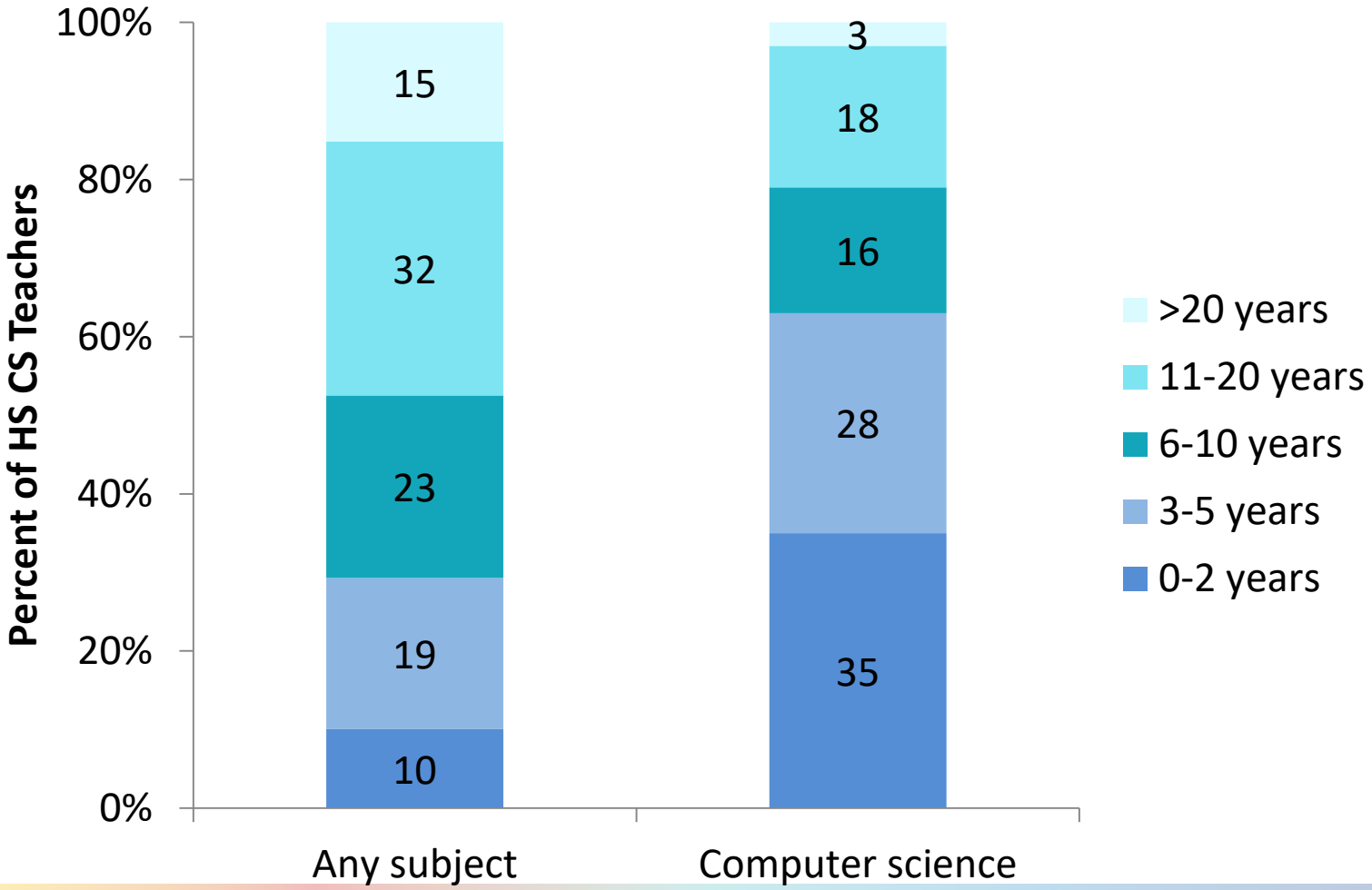
The 2018 NSSME+ collected data about:

- Demographics of teachers
- College degrees and coursework
- Path to certification
- Feelings of preparedness
- Beliefs about teaching and learning

Teaching Experience



Teaching Experience

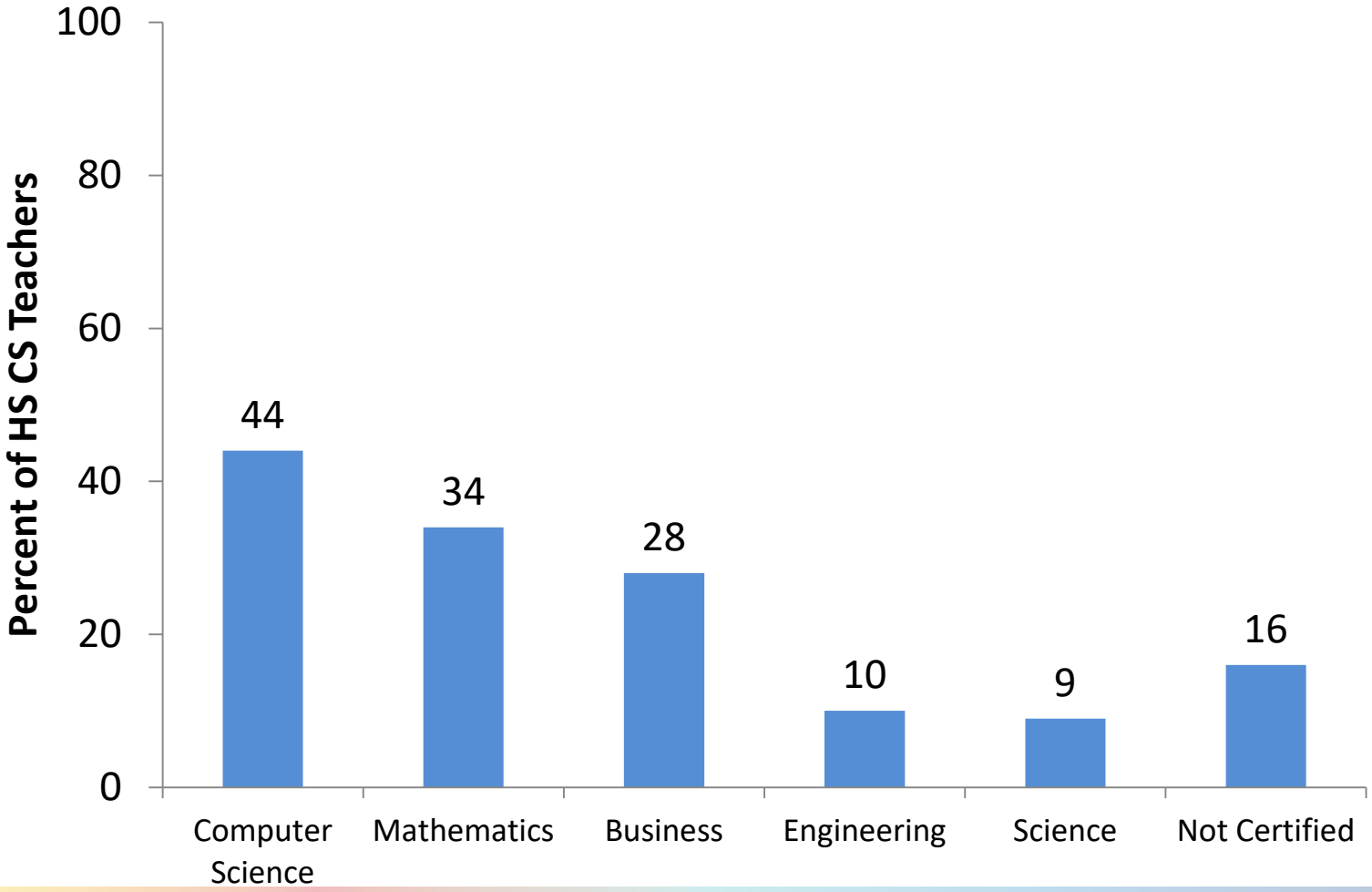


Certification

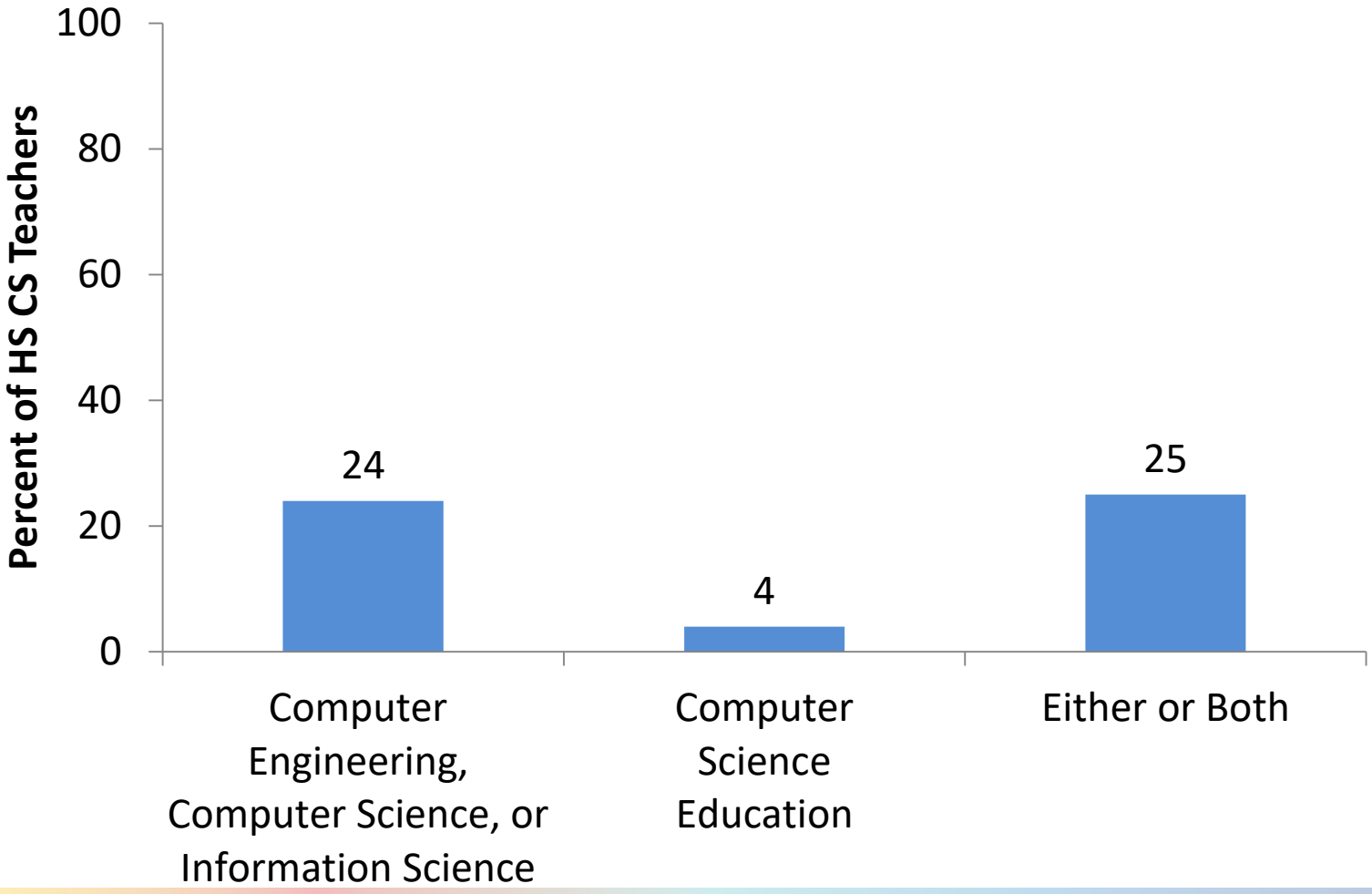
About what percentage of high school computer science teachers are certified to teach computer science?

A. 25%
B. 50%
C. 75%
D. 100%

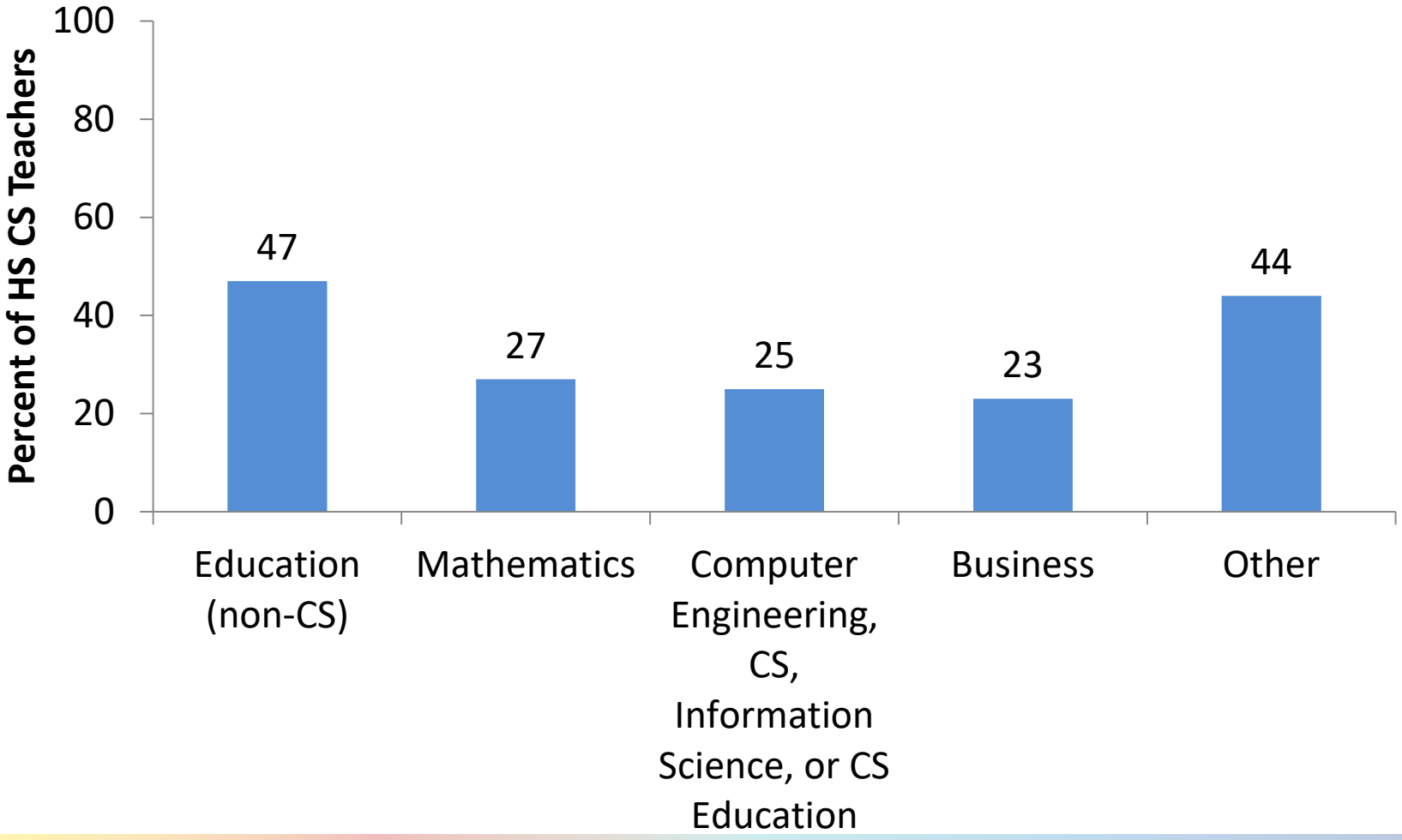
Areas of Certification



Degree in Computer Science/ Related Field/CS Education



Computer Science Teacher Degrees



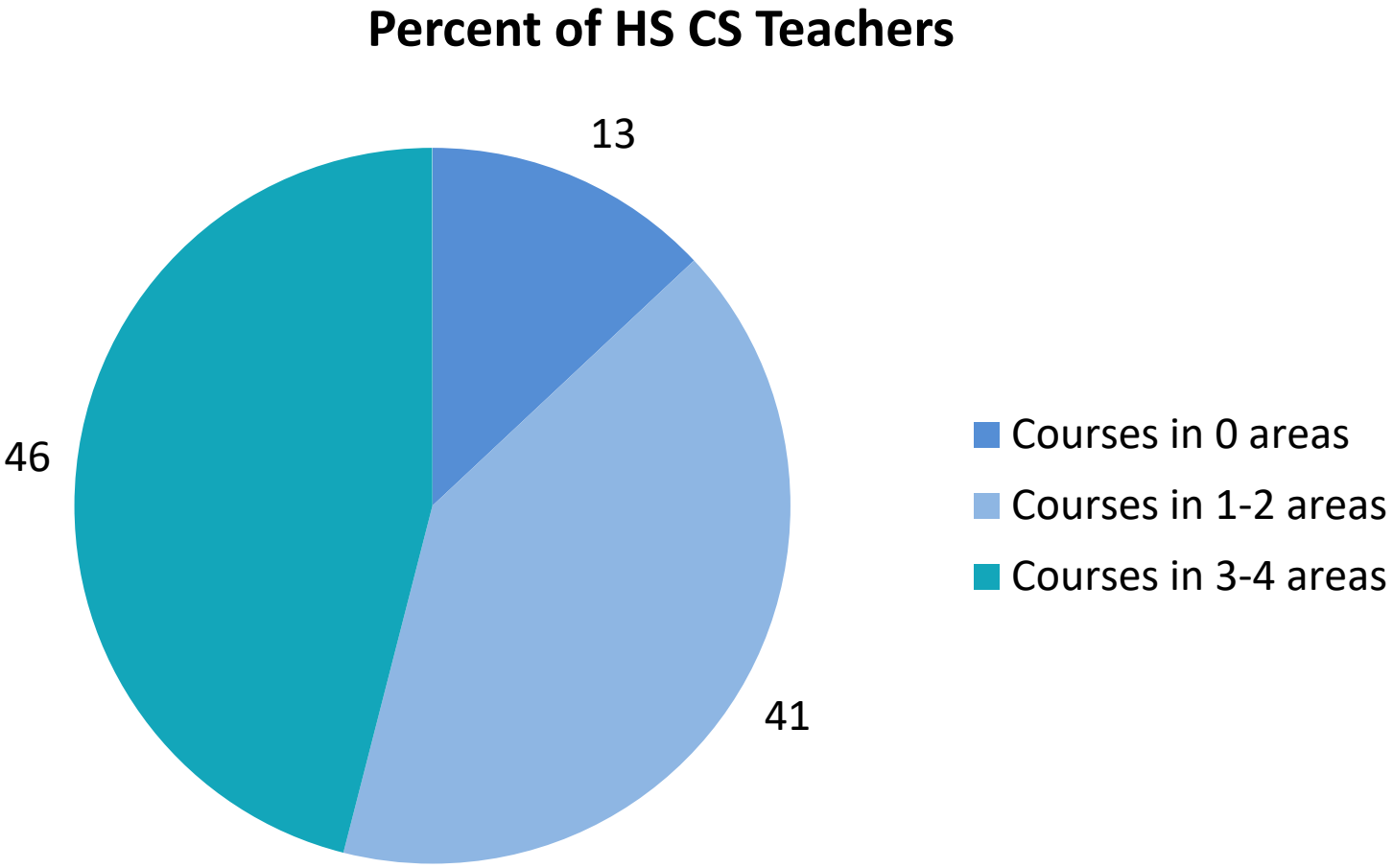
CSTA/ISTE CS Teacher Preparation Recommendations

Similar recommended content knowledge for CS educators from CSTA and ISTE

Combined, they suggest teachers have coursework in four content areas:

- Programming
- Algorithms
- Data structures
- Computer systems or networks

Coursework Related to CSTA/ISTE Course-Background Standards

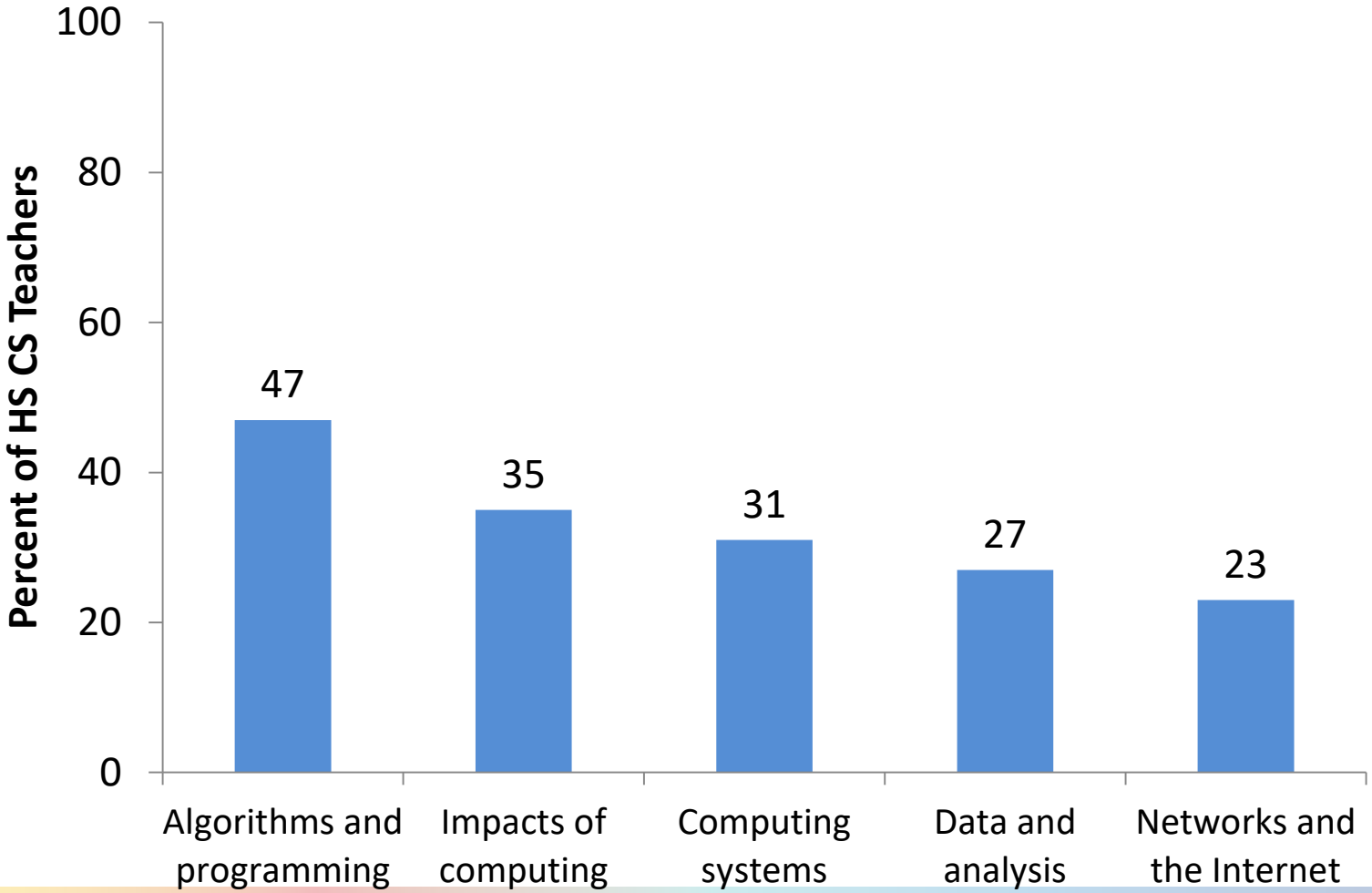


Perceptions of Preparedness

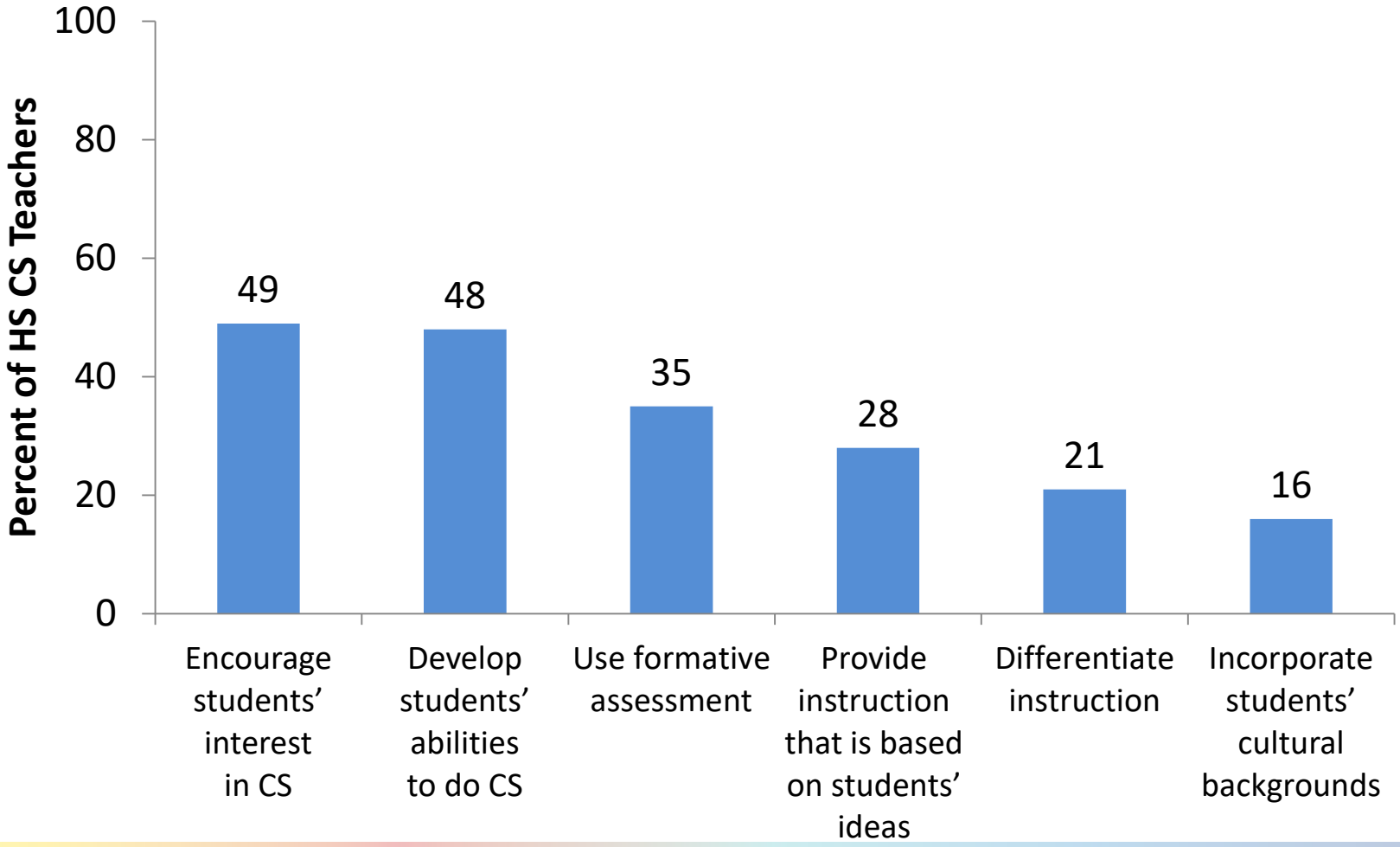
The 2018 NSSME+ included items about teachers' feelings of preparedness to:

- Teach core computer science ideas
- Use student-centered pedagogies, e.g.:
  - Use formative assessment
  - Develop student abilities to do computer science
  - Encourage student interest in computer science
  - Differentiate instruction
  - Incorporate students' cultural backgrounds into instruction

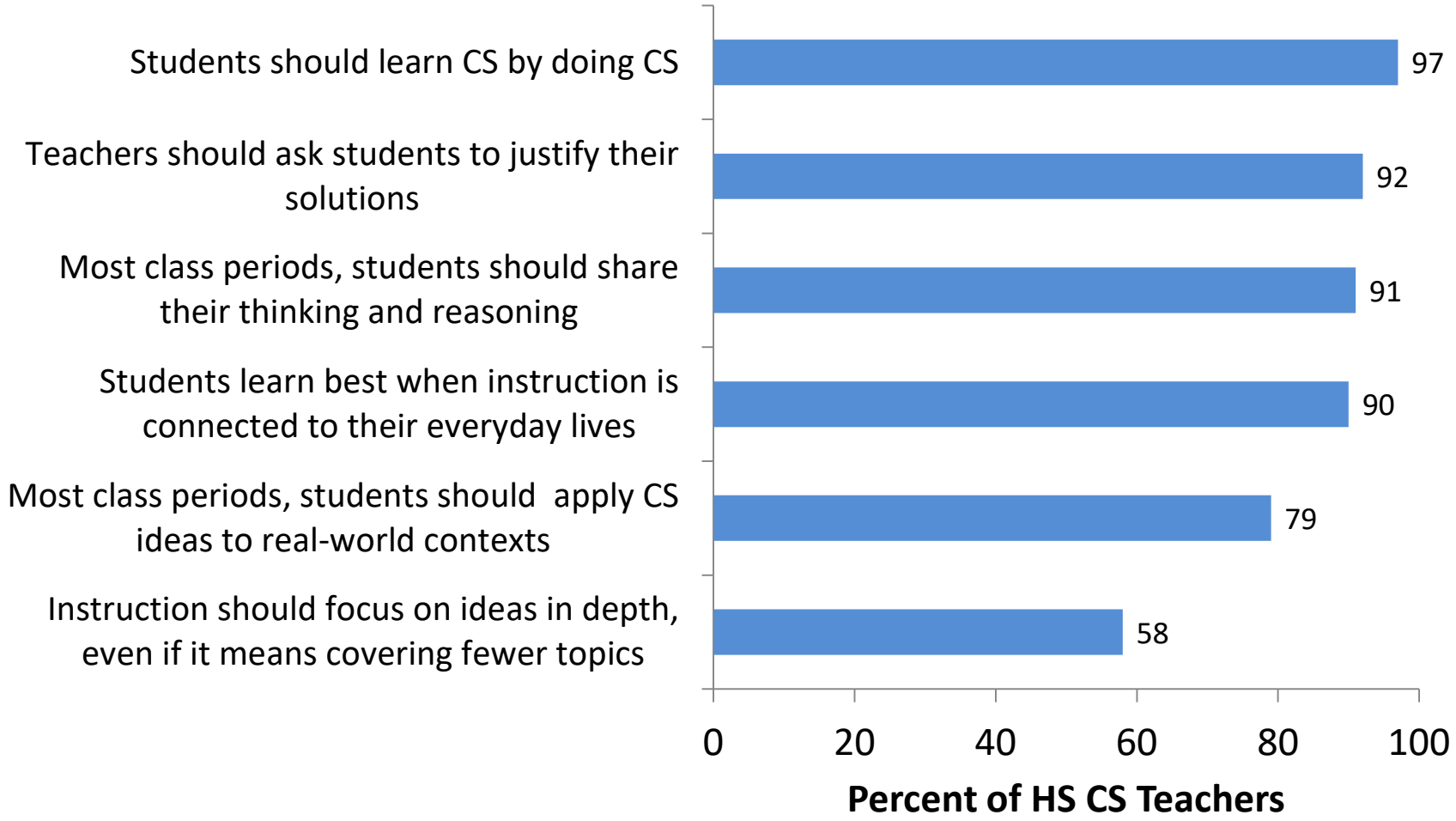
Perceptions of Preparedness: Very Well Prepared to Teach CS Topics



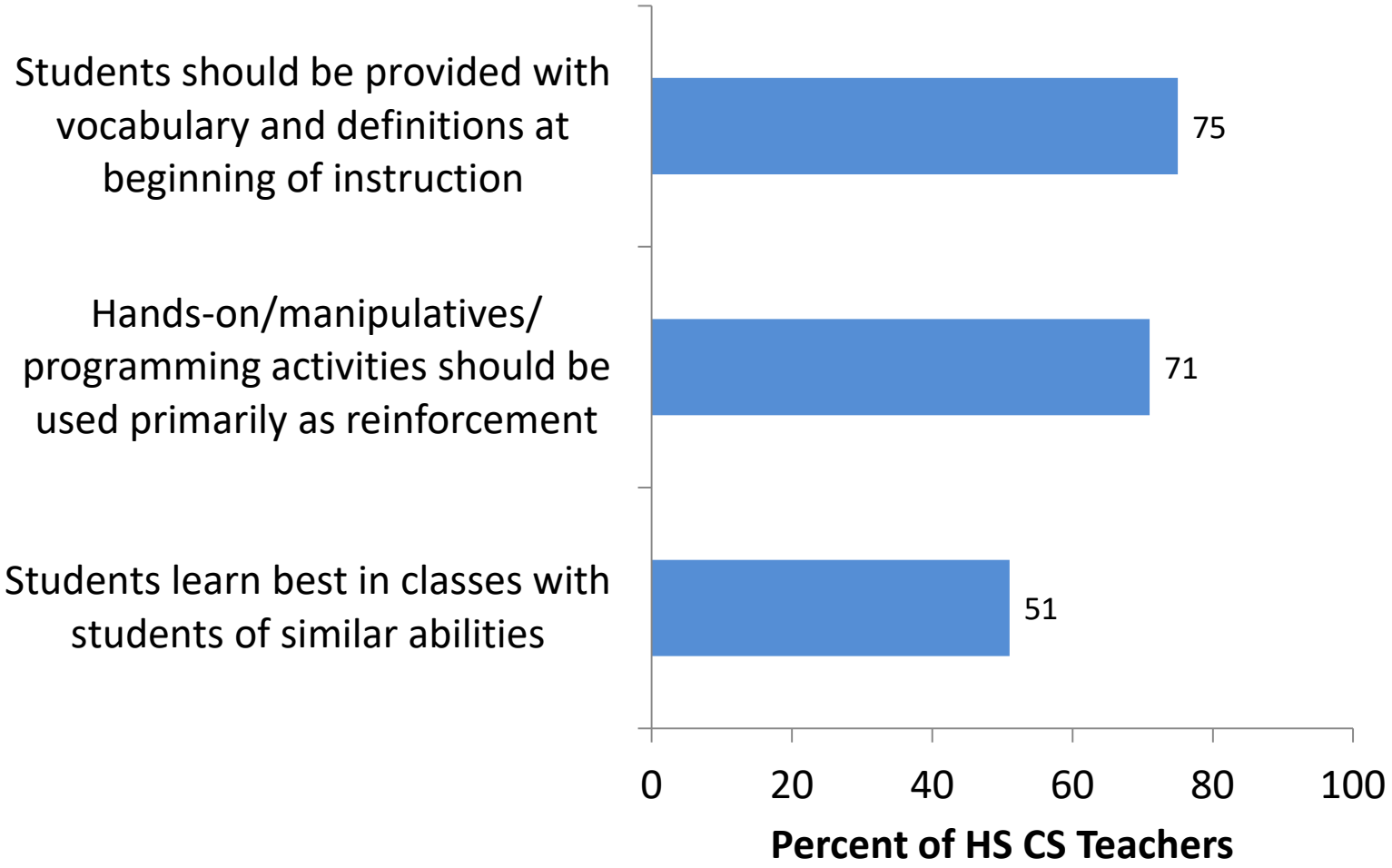
Perceptions of Preparedness: Very Well Prepared to Use Student-Centered Pedagogies



Teacher Beliefs



Teacher Beliefs



Computer Science Teachers Takeaways

Sizeable proportion of the computer science teacher workforce is newer, or new to teaching computer science, and likely still honing their craft

Many have limited preparation to teach computer science

Teachers' beliefs about teaching and learning indicate only partial alignment with what is known about how students learn

Inservice Support

The 2018 NSSME+ asked about:

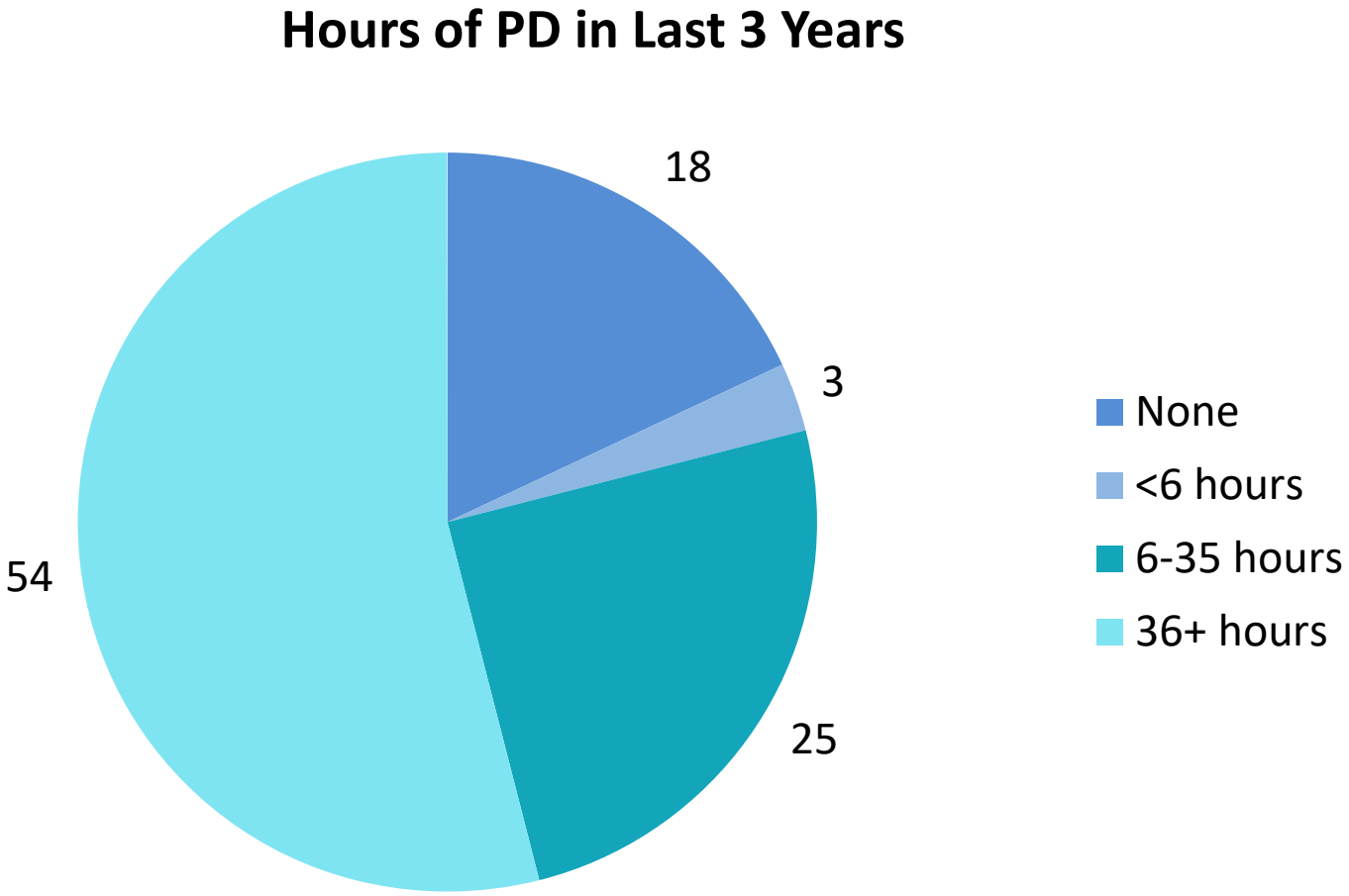
- School/district-offered induction programs
- School/district-offered professional development (workshops, study groups/PLCs, coaching)
- Teacher PD experiences

Professional Development

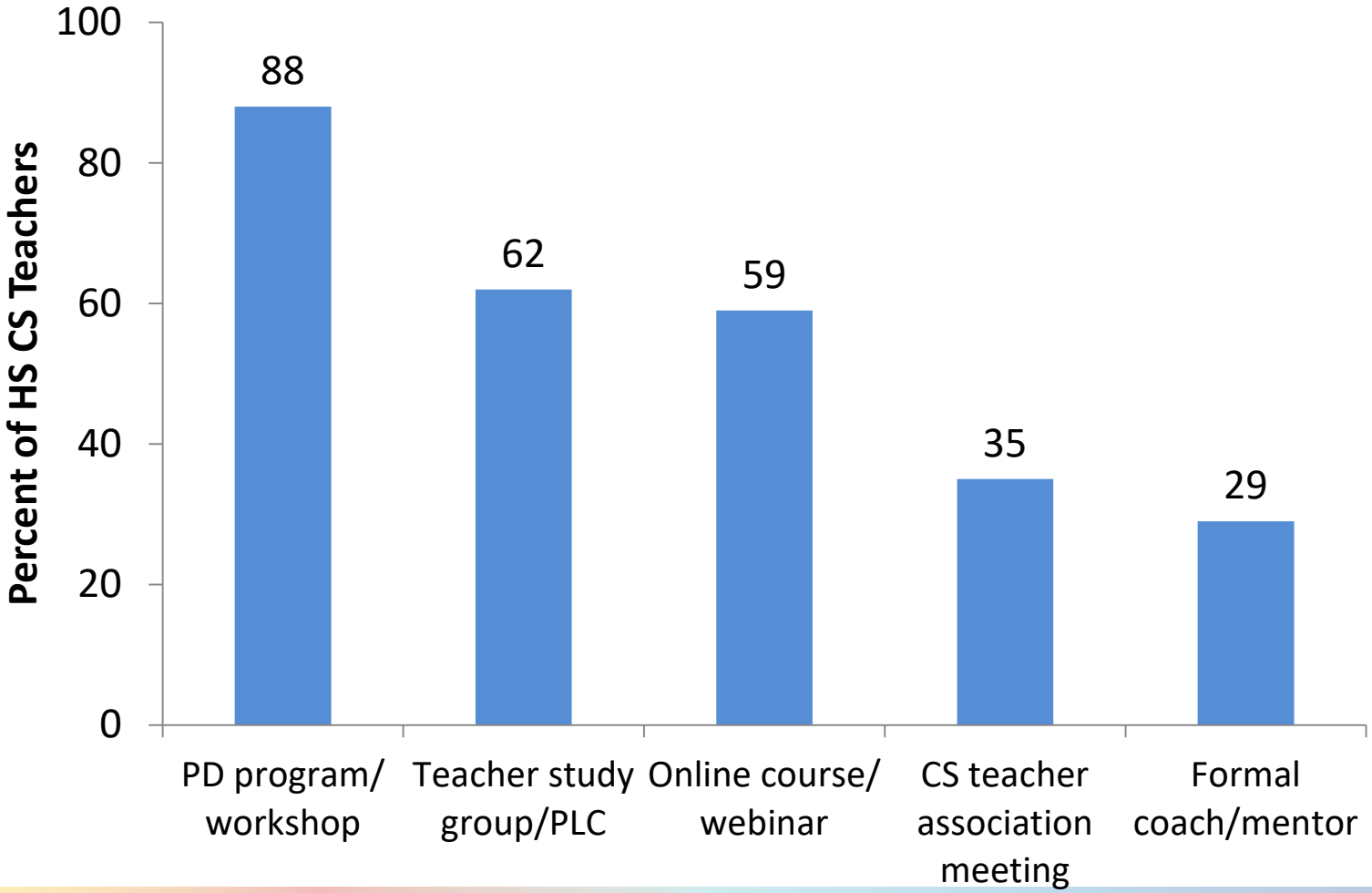
About what percentage of high school computer science teachers have had <u>any</u> computer science-related PD in the last three years?

A. 25%
B. 50%
C. 75%
D. 100%

Professional Development



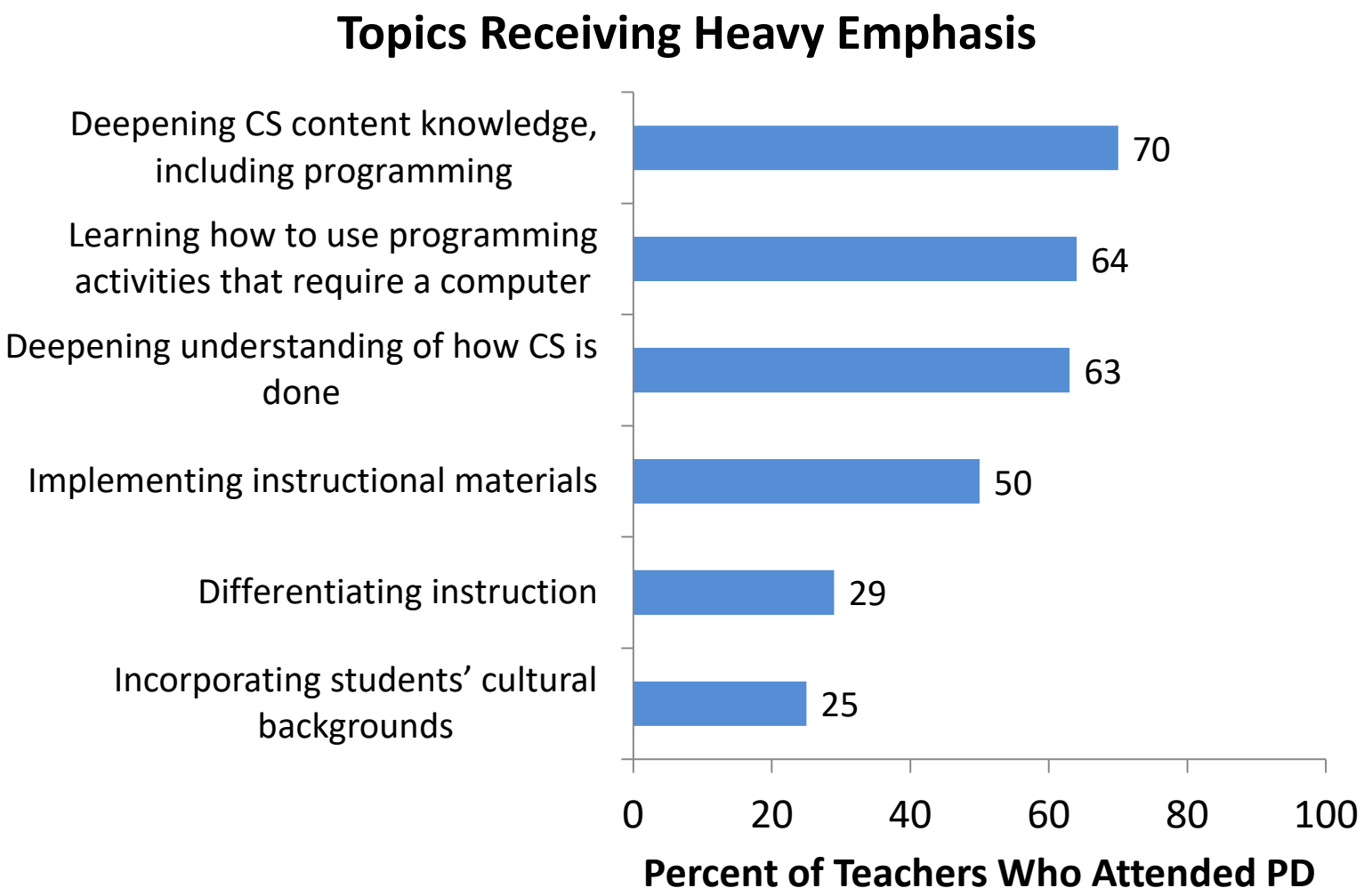
Types of Professional Development in the Past Three Years



Characteristics of PD

	Percent of HS CS Teachers Attending PD
Engage in activities to learn computer science content	76
Experience lessons as students	62
Work with those teaching the same subject/grade level	51
Examine classroom artifacts	46
Apply what they learn in classroom and come back to discuss	39
Rehearse instructional practices	31
Work closely with other teachers in school	26

Emphasis of PD



Inservice Support Takeaways

A relatively large proportion of HS CS Teachers have had substantial PD experiences in the last three years; still, many others have not

PD is mostly engaging teachers in CS activities, often with the goals of increasing their own content knowledge

Less emphasis on helping teachers improve their instructional practice or encourage and support students from diverse backgrounds

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K–12 Mathematics

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K–12 Mathematics Instruction

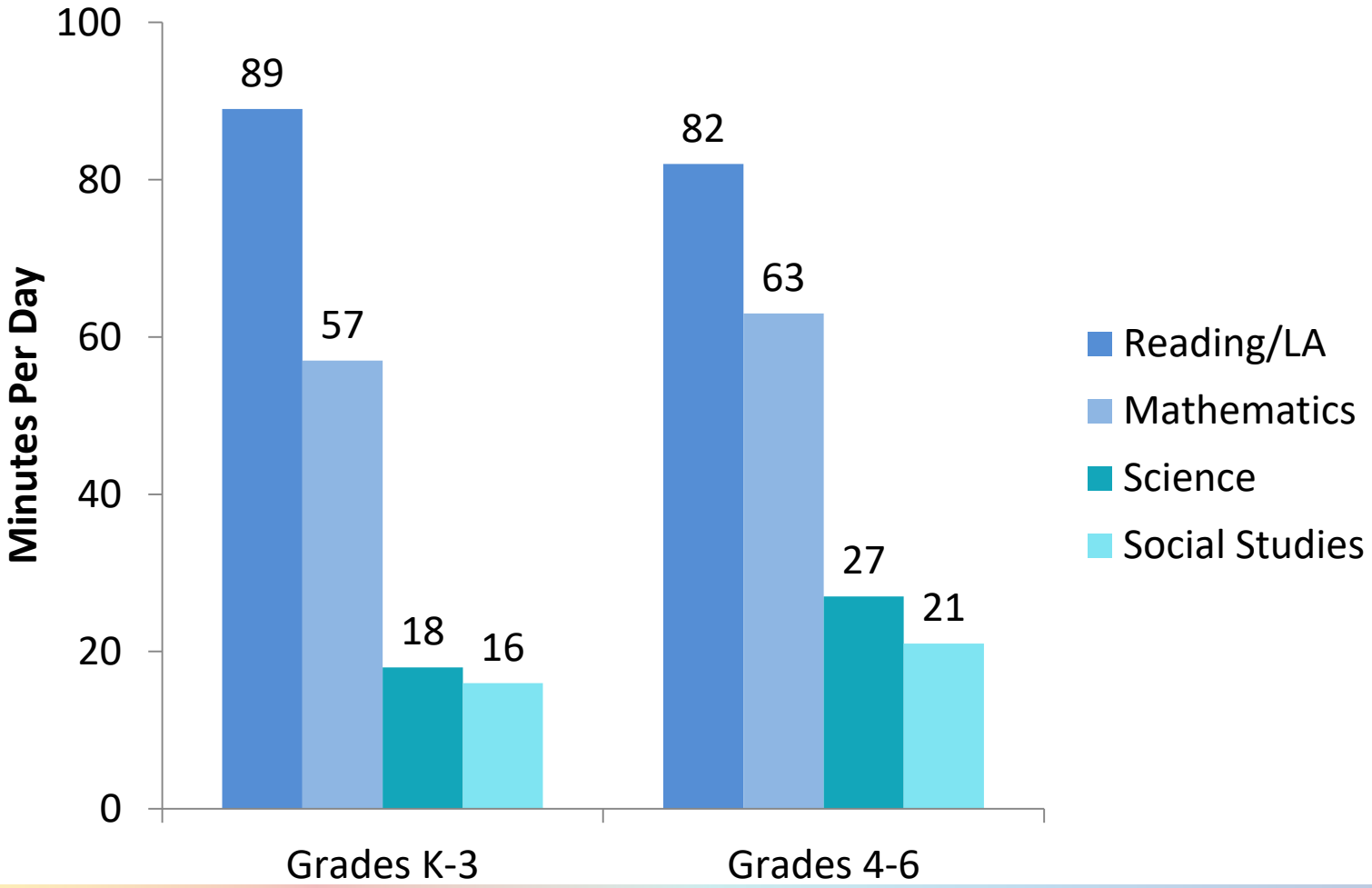
- **What is the current status of K–12 mathematics instruction?**
- **Who has access to mathematics instruction?**
- **Why might instruction look the way it does?**

Mathematics Instruction

The 2018 NSSME+ collected data about:

- Instructional time
- Course offerings
- Instructional objectives
- Pedagogies
- Mathematical practices
- Amount of homework and external testing

Instructional Time: Elementary



Course Offerings and Enrollment

- **About three-fourths of middle schools have at least some students completing Algebra 1 prior to 9th grade**
- **8th graders in low FRL schools are more likely than those in high FRL schools to complete Algebra 1 before 9th grade**
- **Differences are also evident by community type (S>U>R)**

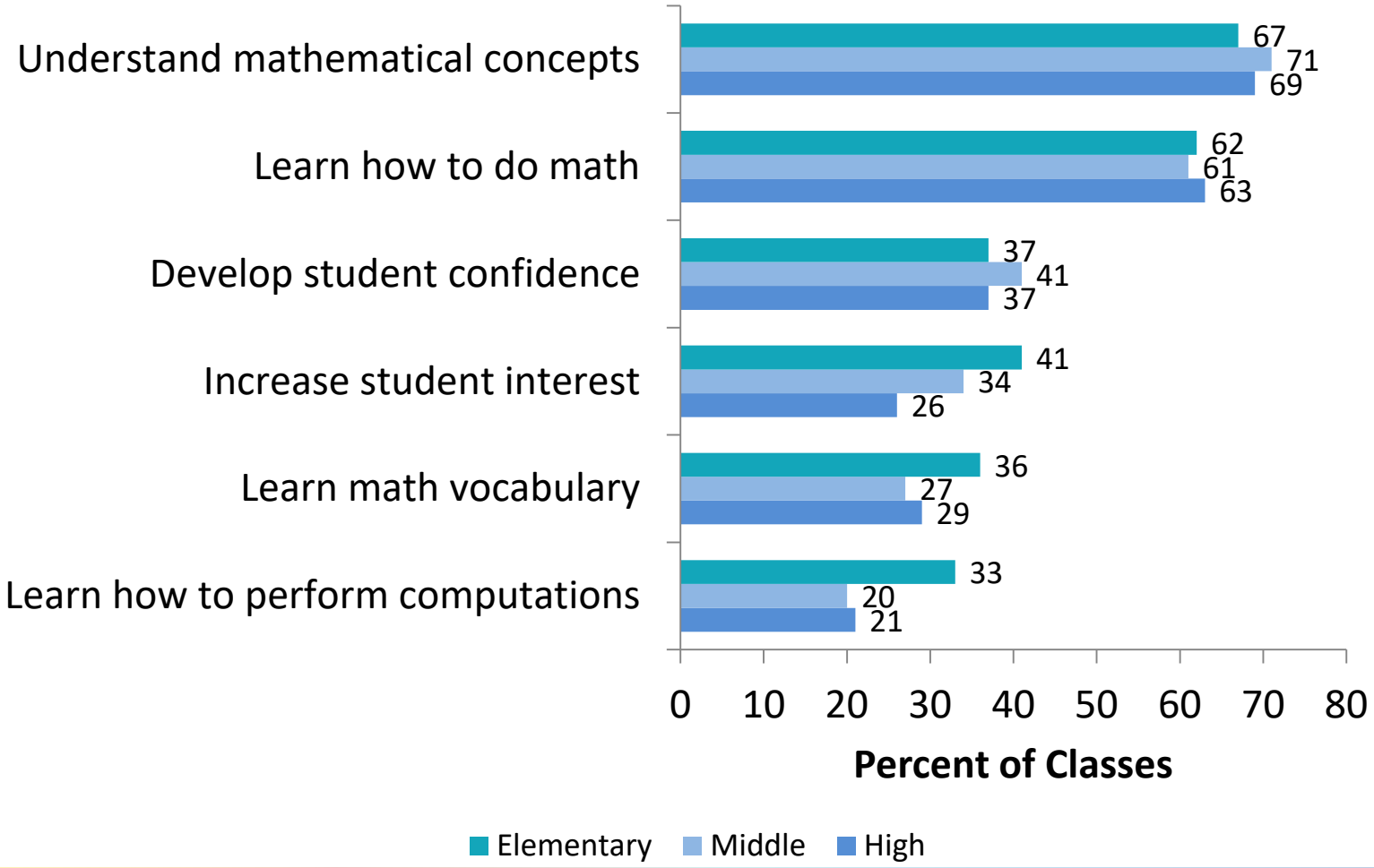
High Schools Offering Various Mathematics Courses

	Percent of Schools
Non-college prep (e.g., Remedial Math, General Math, Consumer Math)	79
Formal/College prep level 1 (e.g., Algebra 1, Integrated Math 1)	98
Formal/College prep level 2 (e.g., Geometry, Integrated Math 2)	93
Formal/College prep level 3 (e.g., Algebra 2, Algebra and Trigonometry)	91
Formal/College prep level 4 (e.g., Pre-Calculus, Algebra 3)	90
Courses that might qualify for college credit (e.g., AP Calculus, AP Statistics)	72

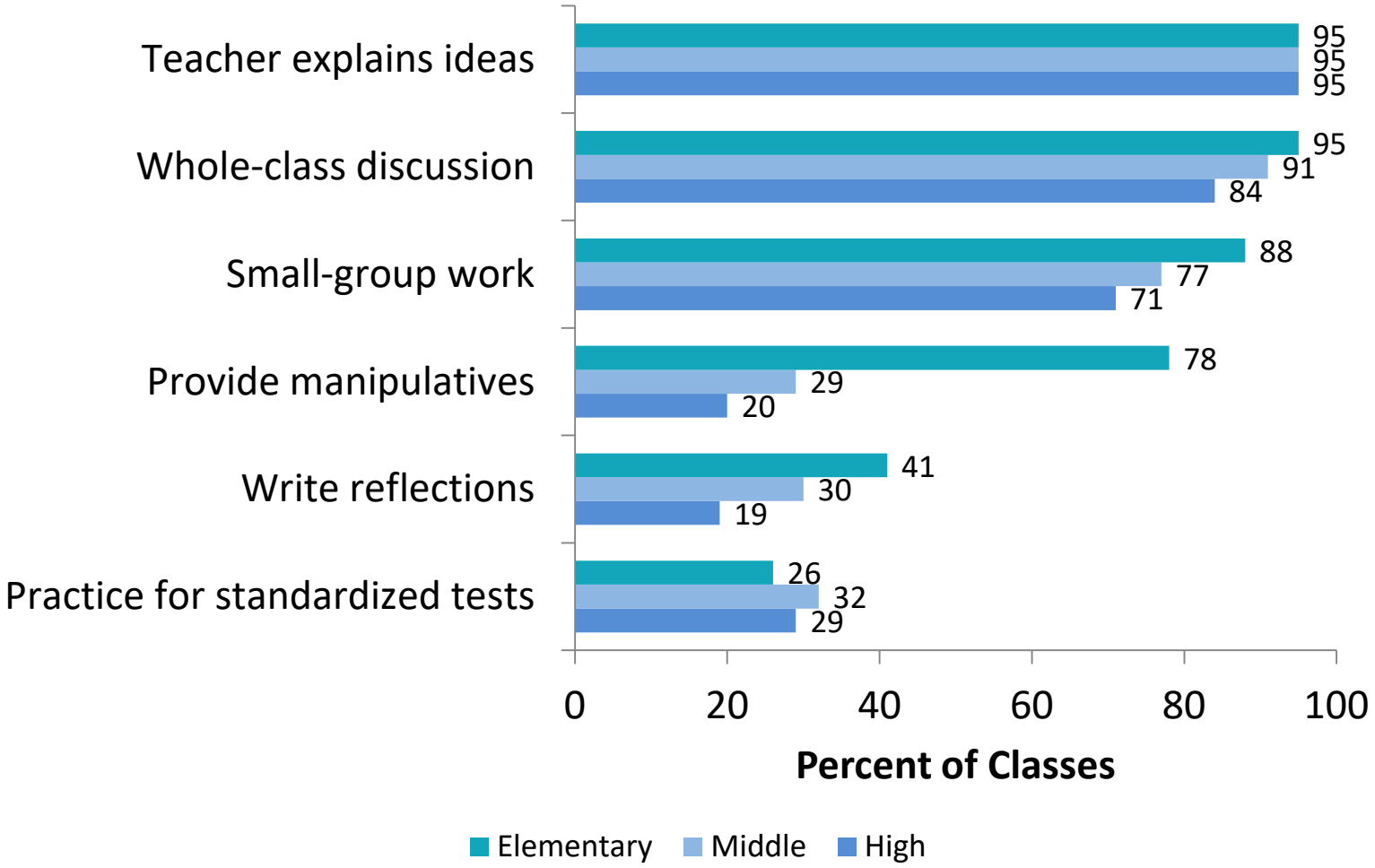
Average Percentages of HU Students in High School Mathematics Courses

	Percent 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

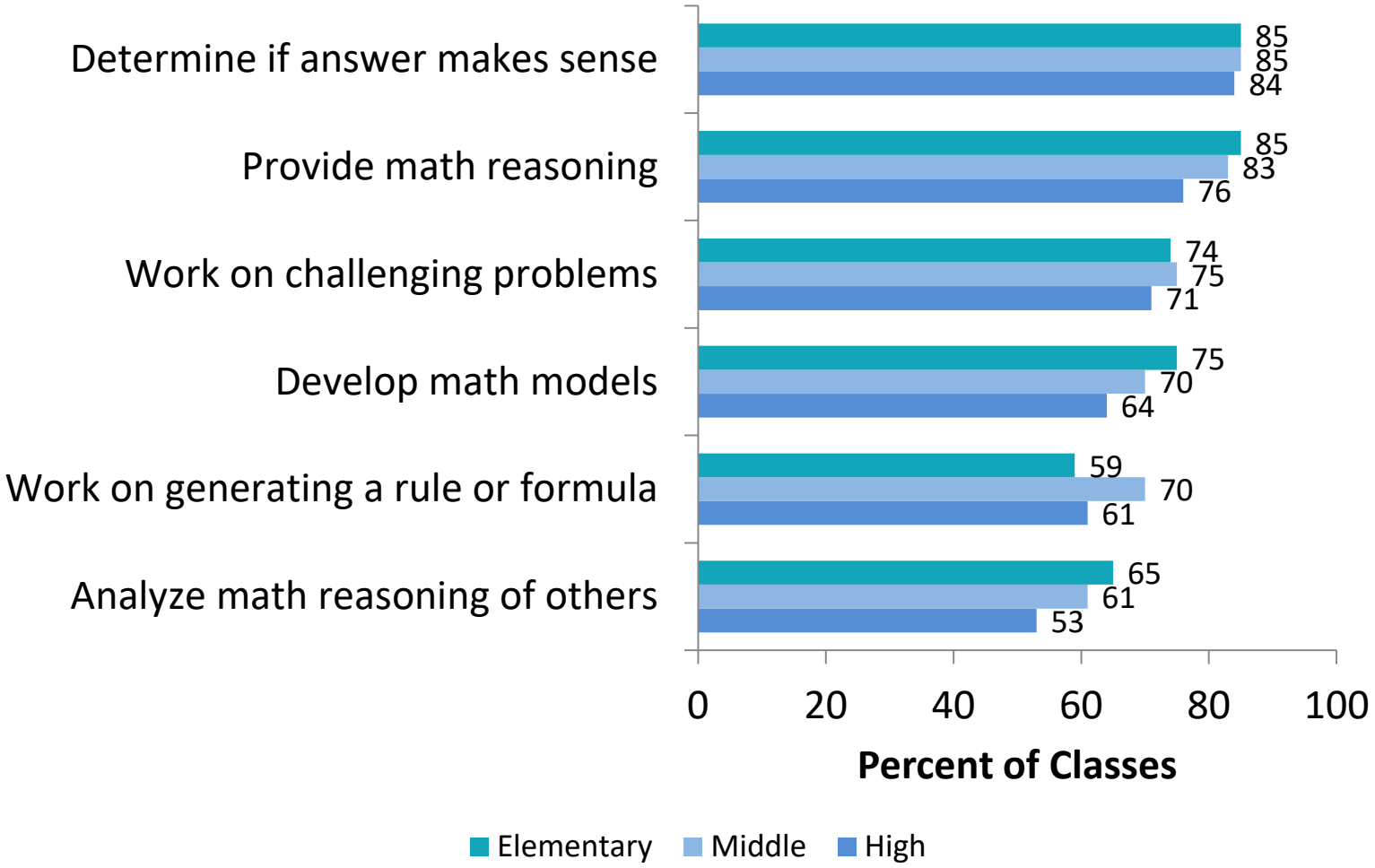
Objectives Receiving a Heavy Emphasis



Instructional Activities: Weekly



Standards for Mathematical Practice: Weekly



Required External Mathematics Testing

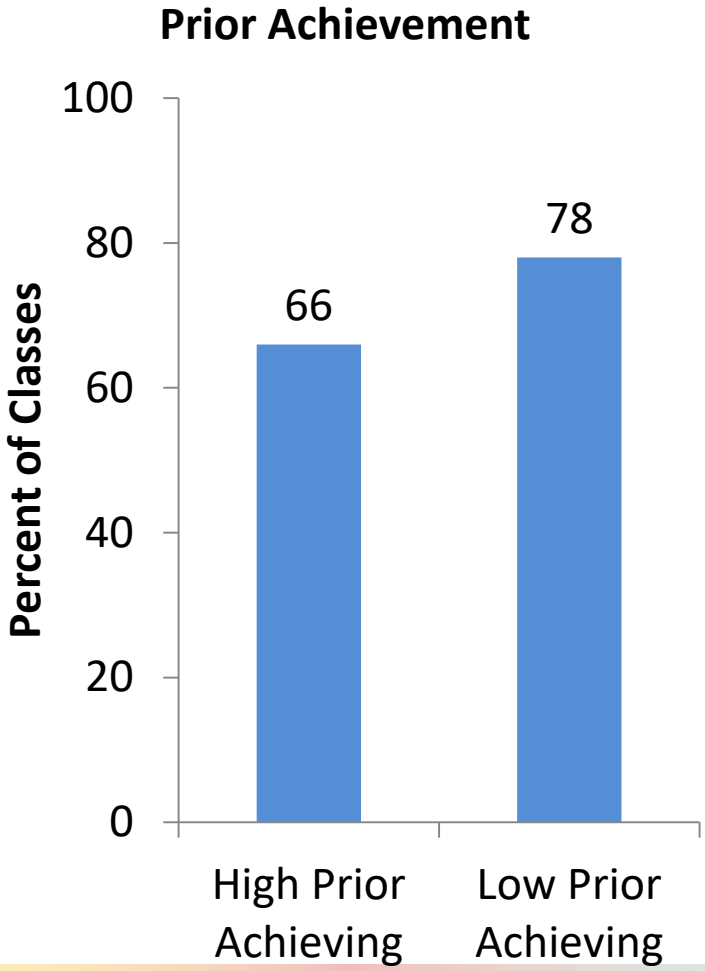
Approximately what percentage of elementary classes are required to take three or more state/district mathematics assessments in a year?

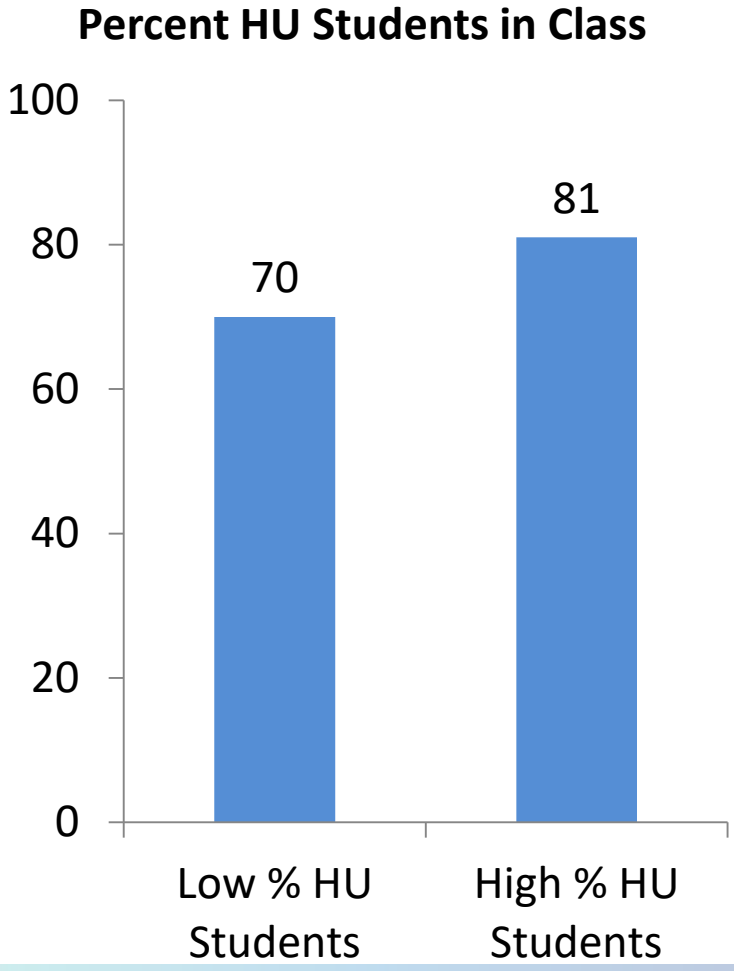
A. 25%
B. 50%
C. 75%
D. 100%

Required External Mathematics Testing

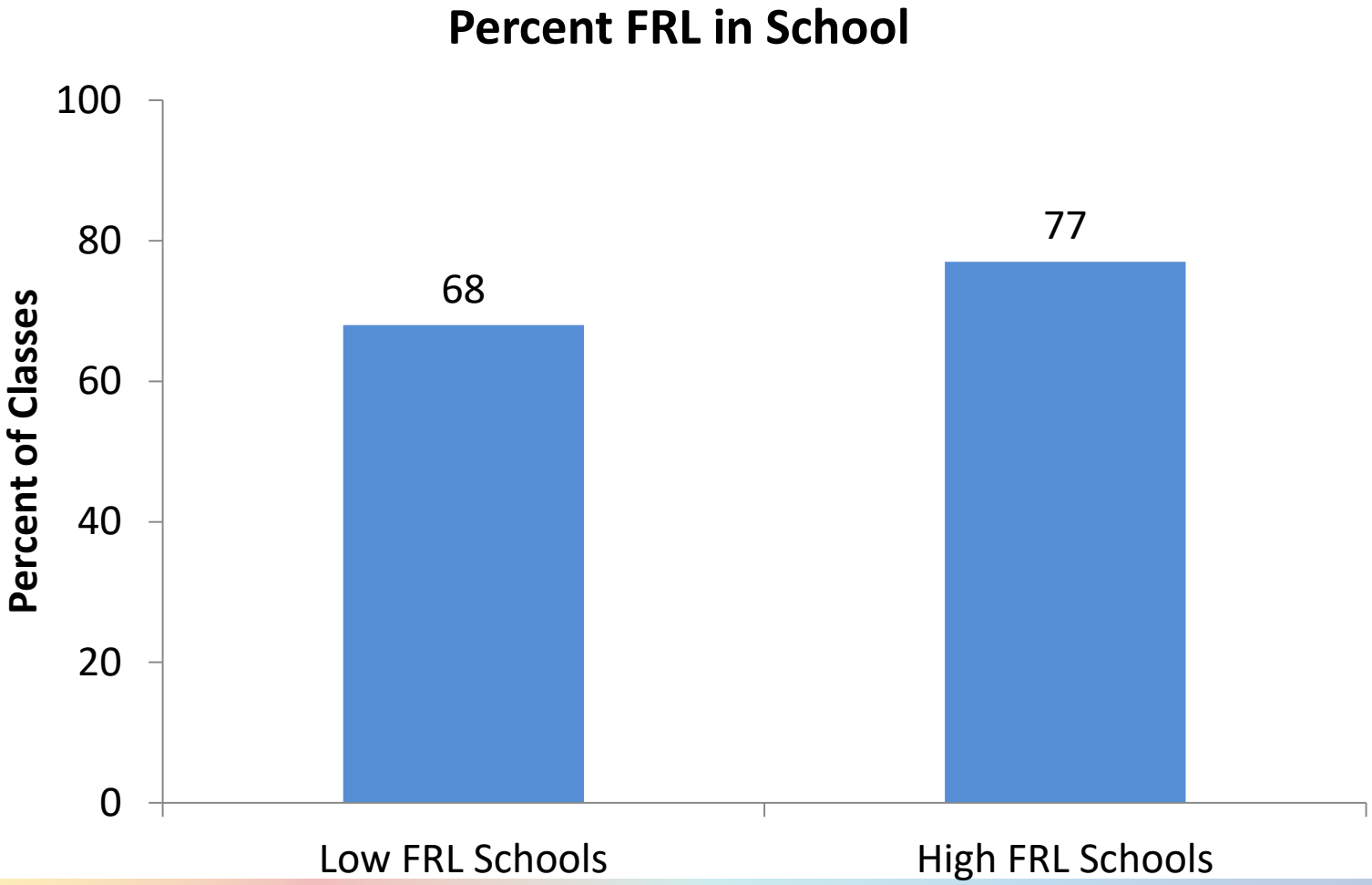
	Percent of Classes		
	Elementary	**Middle**	**High**
Never	9	1	20
Once a year	9	12	25
Twice a year	9	11	22
Three or four times a year	48	43	24
Five or more times a year	25	33	10

Equity Analyses: Classes Required to Take Two or More External Mathematics Assessments Per Year





Equity Analyses: Classes Required to Take Two or More External Mathematics Assessments Per Year



Instruction Takeaways

Heavy emphasis on developing conceptual understanding and on how mathematics is done, but not developing student confidence or interest in mathematics.

Lecture and whole class discussion are common activities.

Most classes engage with the Standards for Mathematical Practice on a weekly basis.

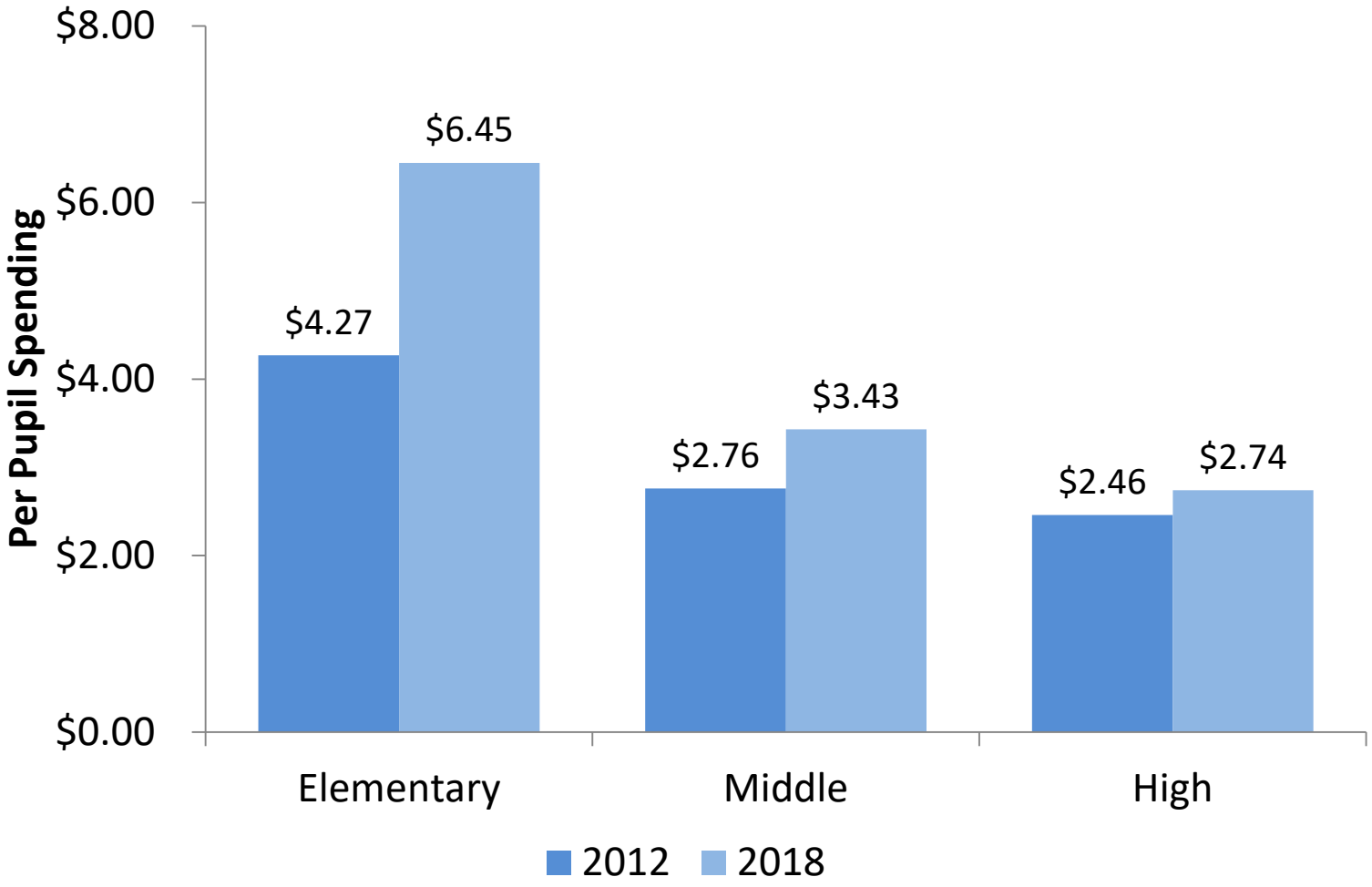
External testing is prevalent and more common in classes of low prior achievers and high percent HU students.

Why Might Instruction Look This Way?

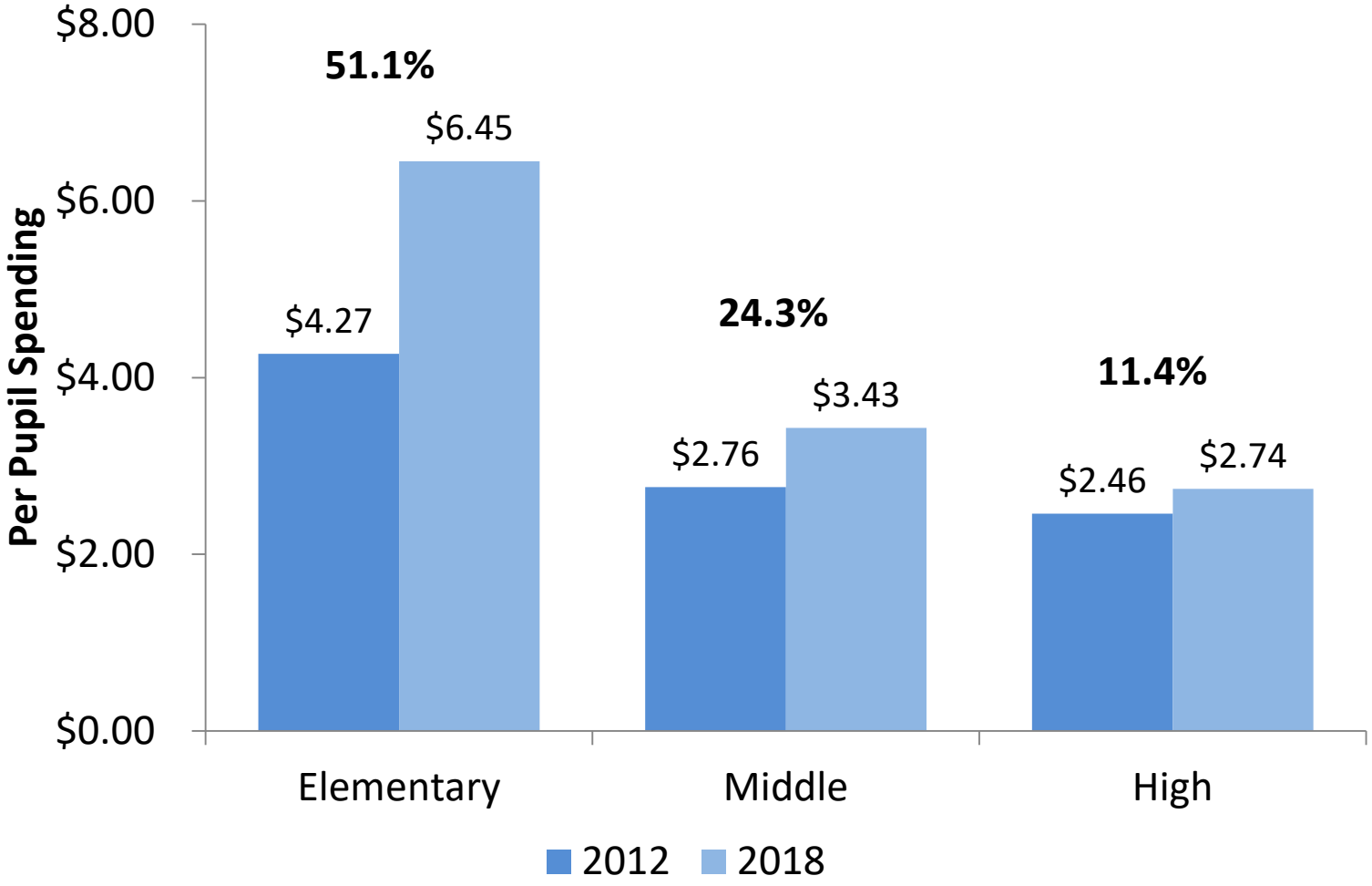
The 2018 NSSME+ asked about:

- School spending
- Availability of resources, including instructional materials
- Adequacy of resources
- Instructional materials used

Median School Spending Per Pupil for Mathematics



Median School Spending Per Pupil for Mathematics

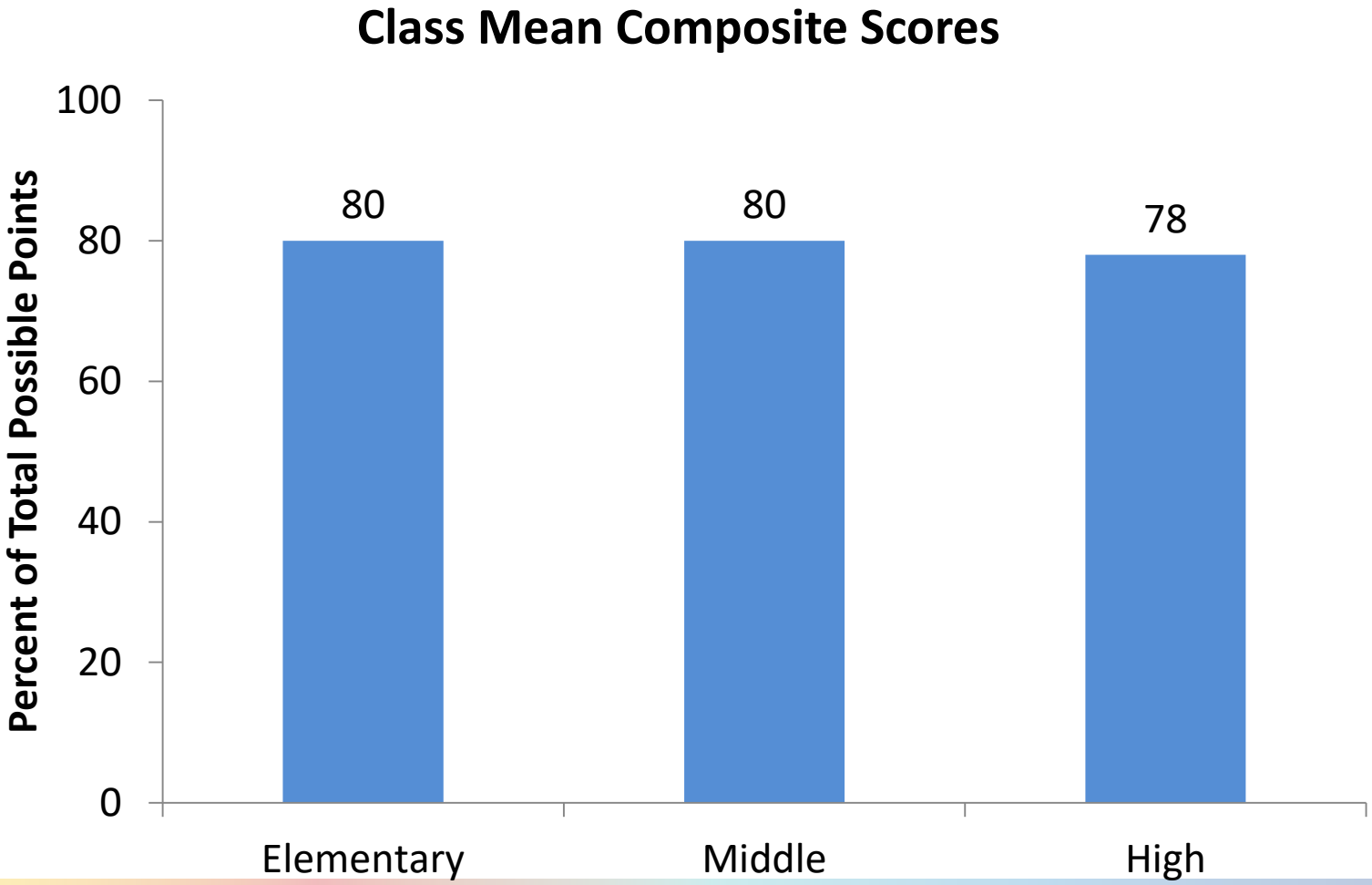


Adequacy of Resources for Mathematics Instruction

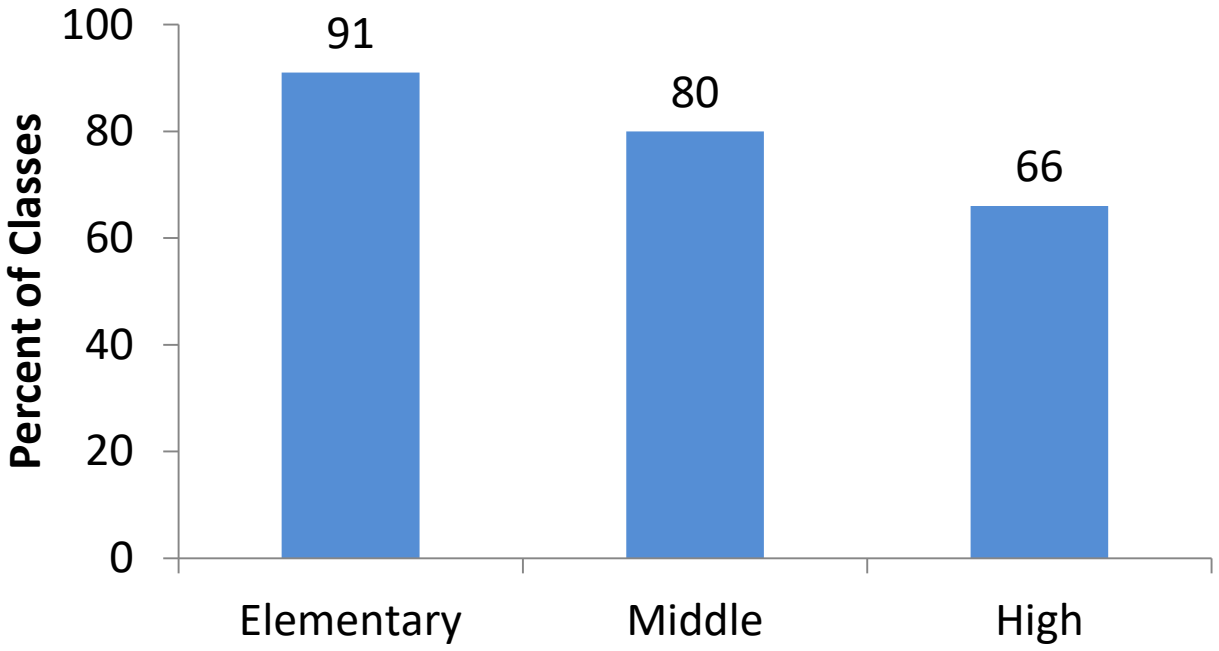
Teachers rated the adequacy of their

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

Teachers' Views of Adequacy of Resources



Designated Instructional Materials



What Is Designated

	Percent of Classes		
	Elementary	**Middle**	**High**
Commercially published textbooks	89	88	91
State, county, or district-developed units or lessons	44	37	32
Lessons or resources from websites that are free	28	30	24
Lessons or resources from websites that have a subscription fee or cost	31	22	15
Self-paced online courses or units	33	33	13

Instructional Materials

Approximately what percentage of secondary classes use a commercially published textbook on a weekly basis?

A. 20%
B. 40%
C. 60%
D. 80%

What Teachers Use (Weekly)

	Percent of Classes		
	Elementary	**Middle**	**High**
Commercially published textbooks	76	65	61
Teacher-developed units or lessons	44	65	78
Units or lessons from other sources (e.g., conferences, colleagues)	30	31	35
Lessons or resources from websites that are free	37	39	27
State, county, or district-developed units or lessons	41	26	23
Lessons or resources from websites that have a cost	54	34	19
Self-paced online courses or units	36	24	12

Resources Takeaways

Spending on resources for mathematics instruction has outpaced inflation at the elementary and middle school levels.

Mathematics teachers have positive views about their resources for mathematics instruction.

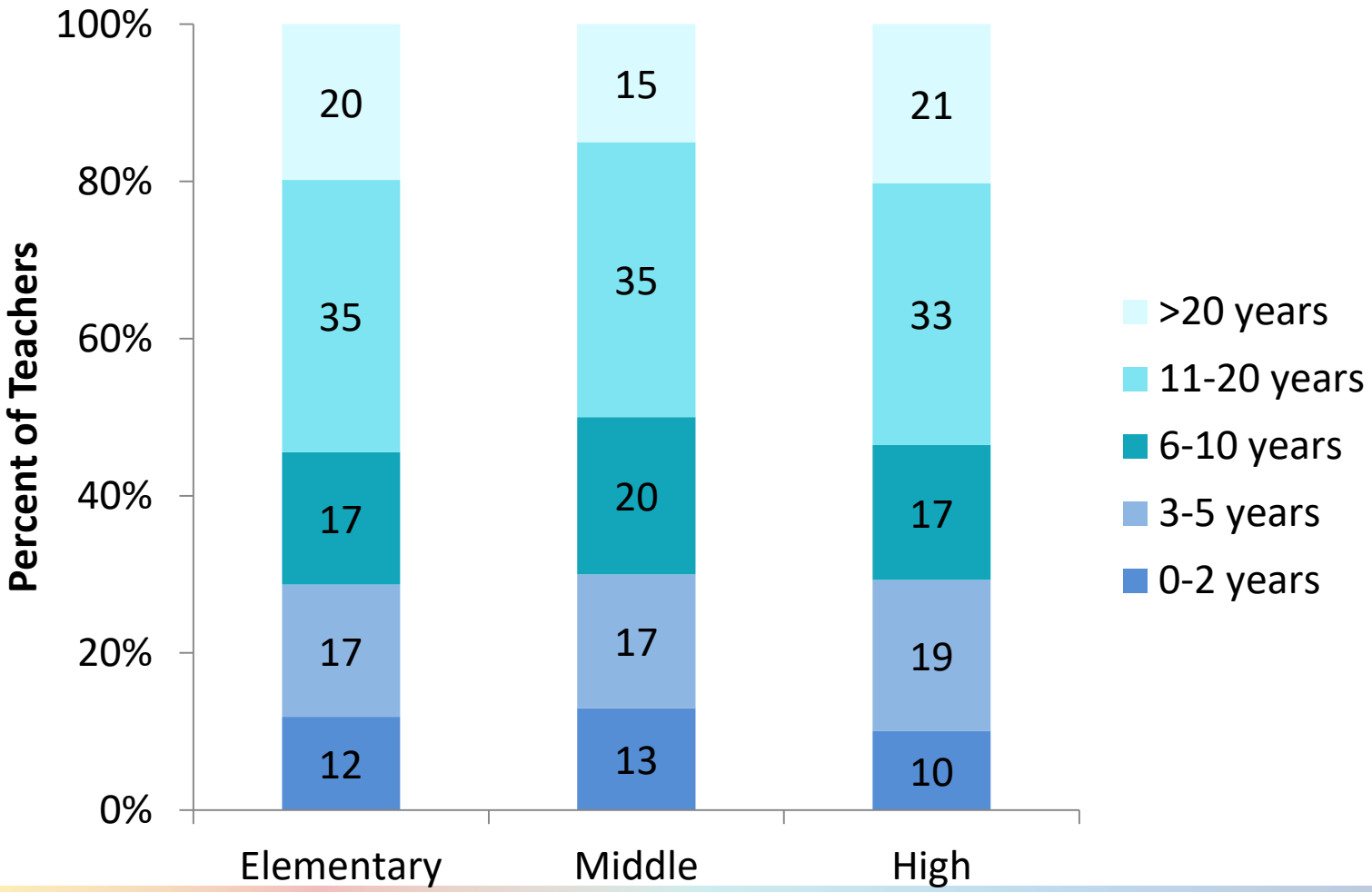
Teachers use a hodgepodge of instructional materials raising questions about quality and coherence.

The Mathematics Teaching Force

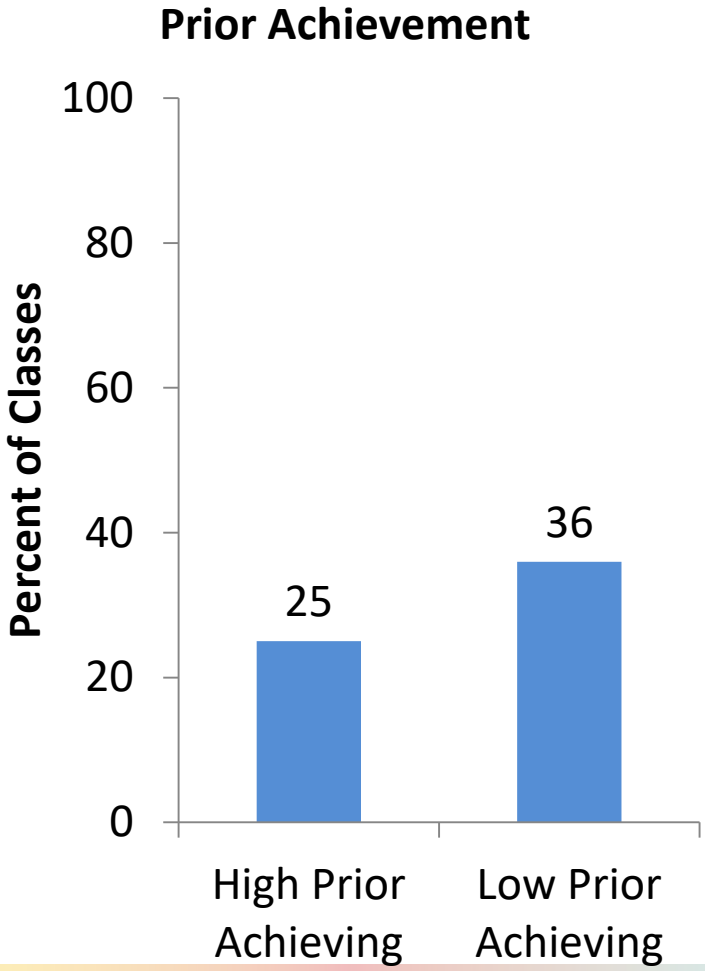
The 2018 NSSME+ collected data about:

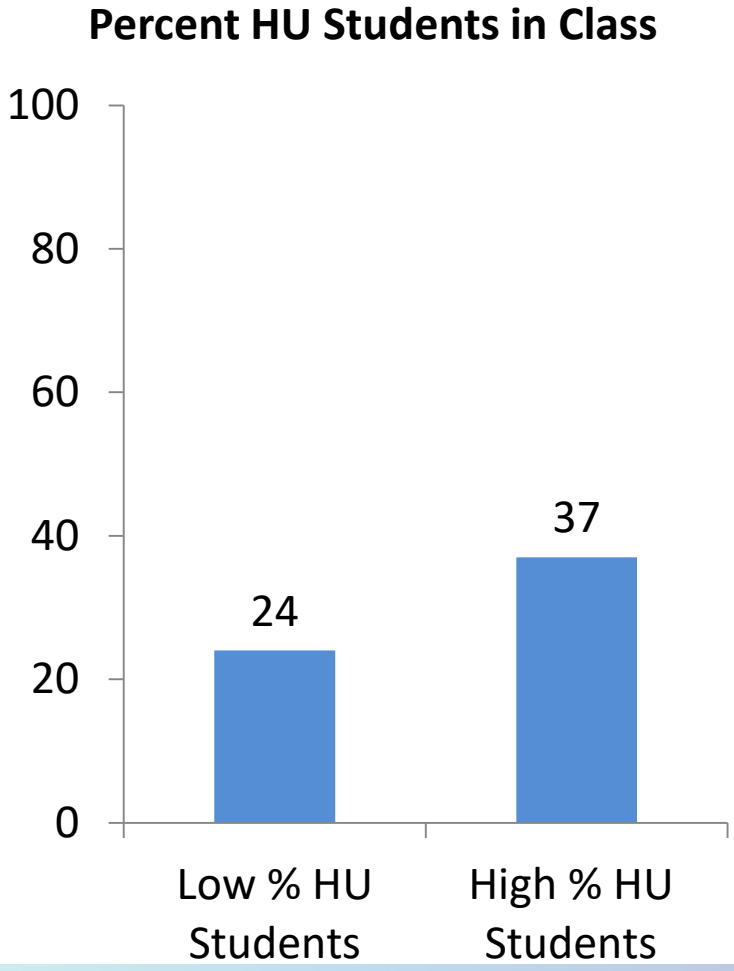
- Demographic of teachers
- Path to certification
- College coursework
- Beliefs about teaching and learning
- Feelings of preparedness

Teaching Experience

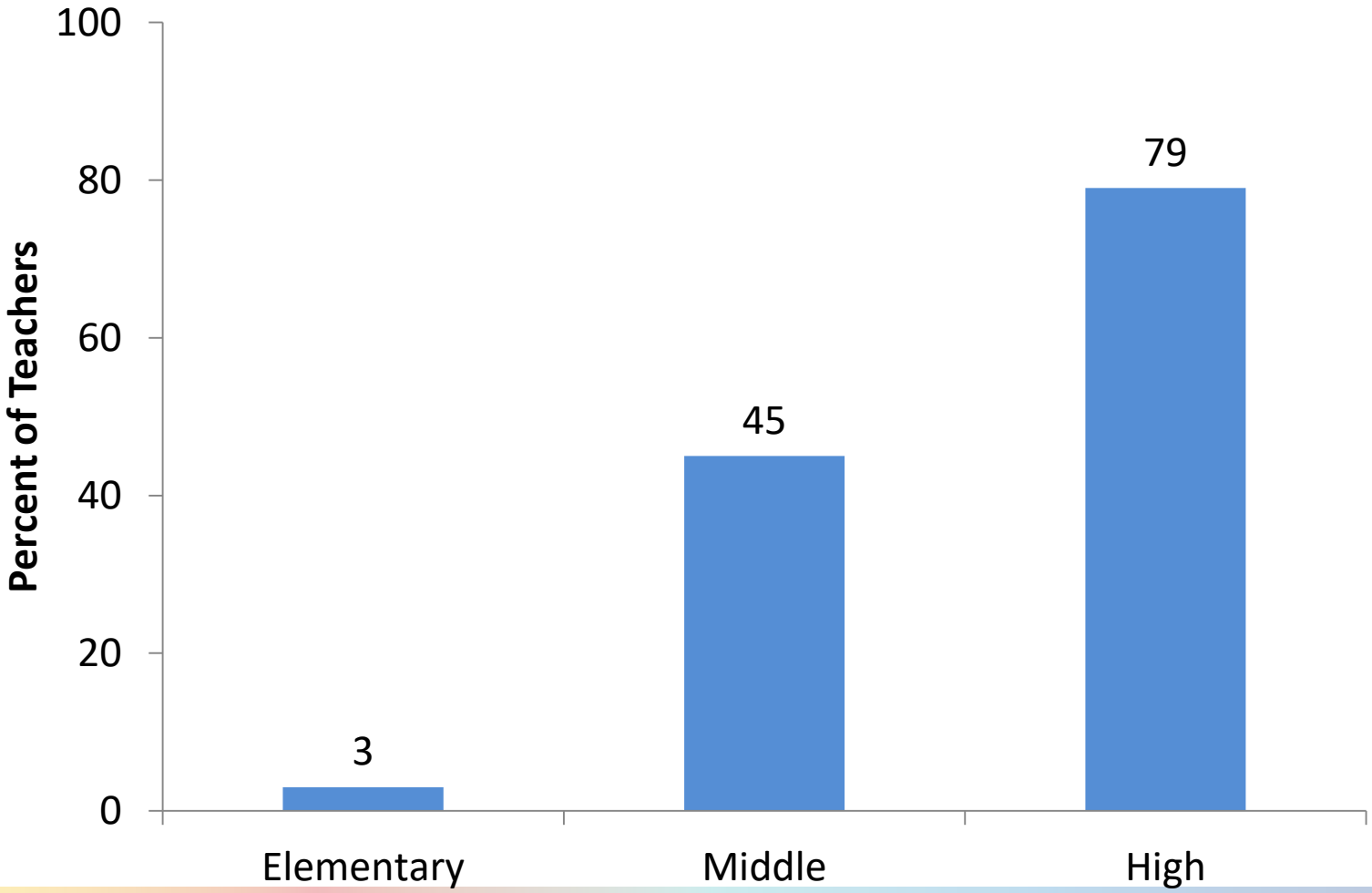


Equity Analyses: Classes Taught by Novice Teachers

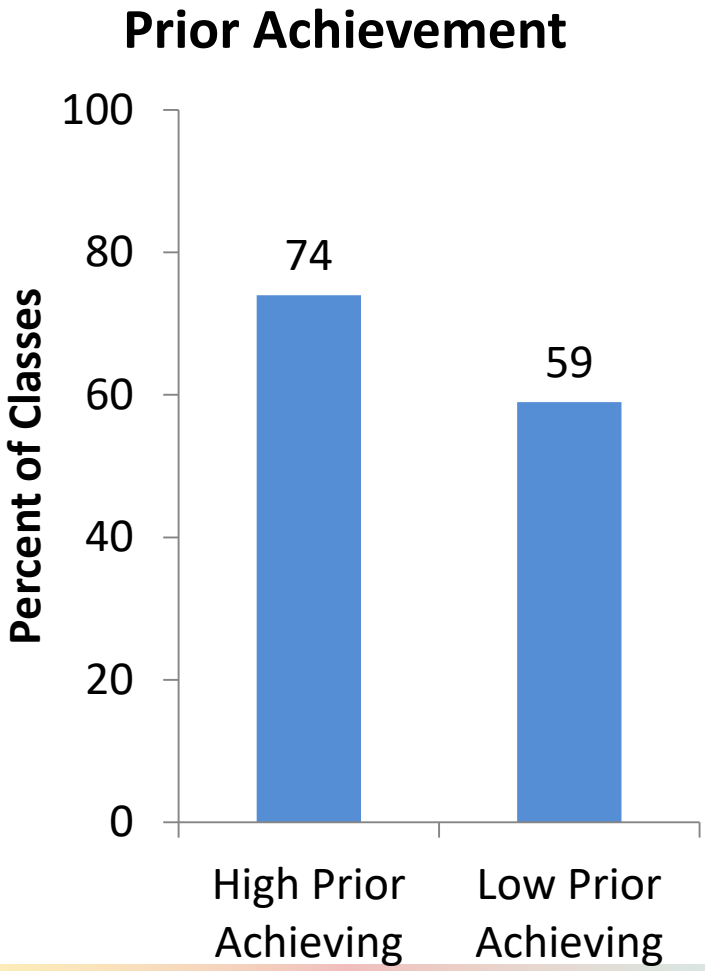


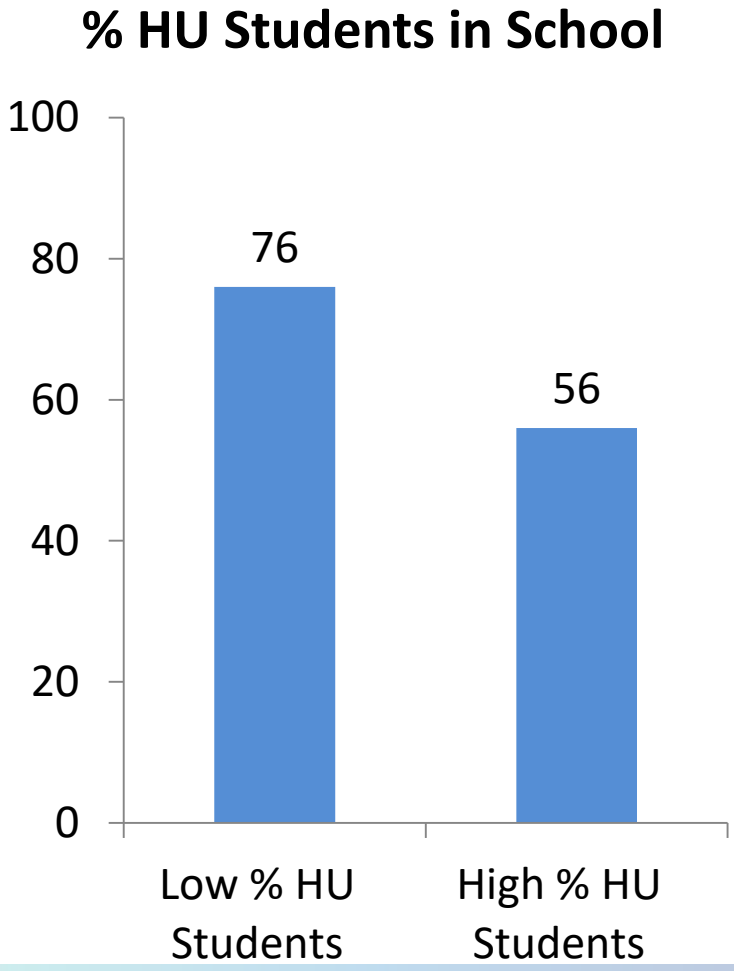


Degree in Mathematics or Mathematics Education

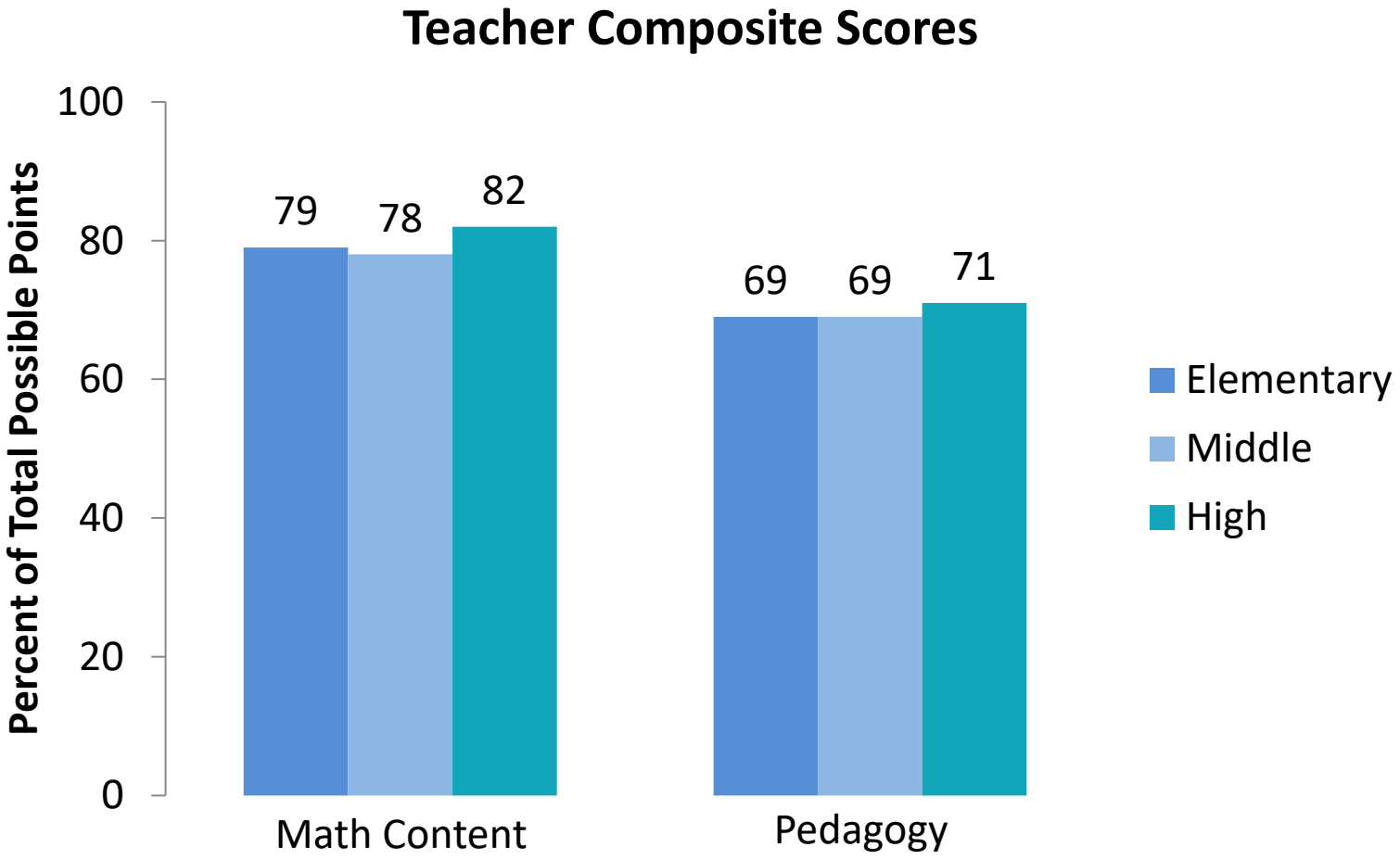


Equity Analyses: Secondary Teachers With a Degree in Mathematics or Mathematics Education

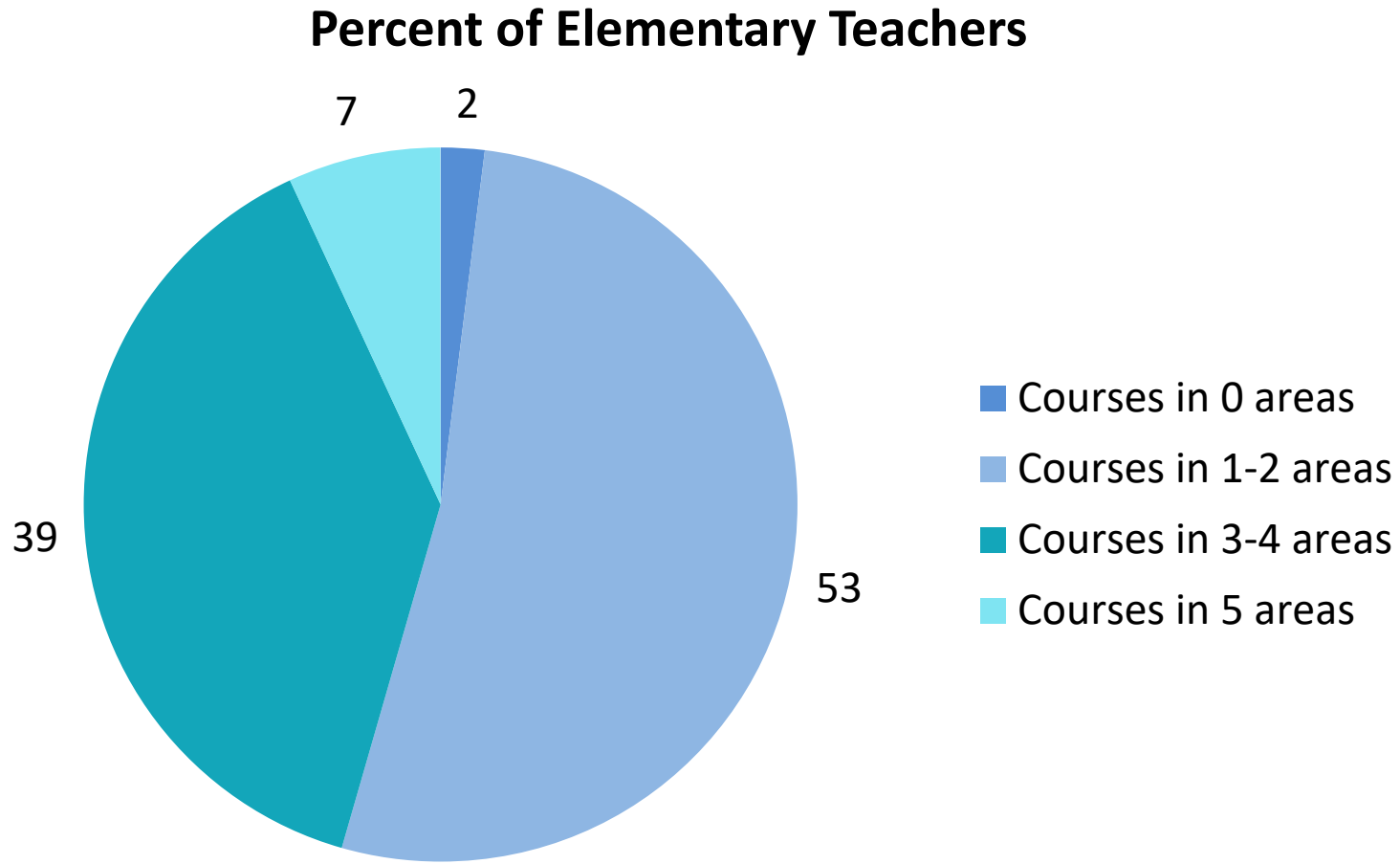




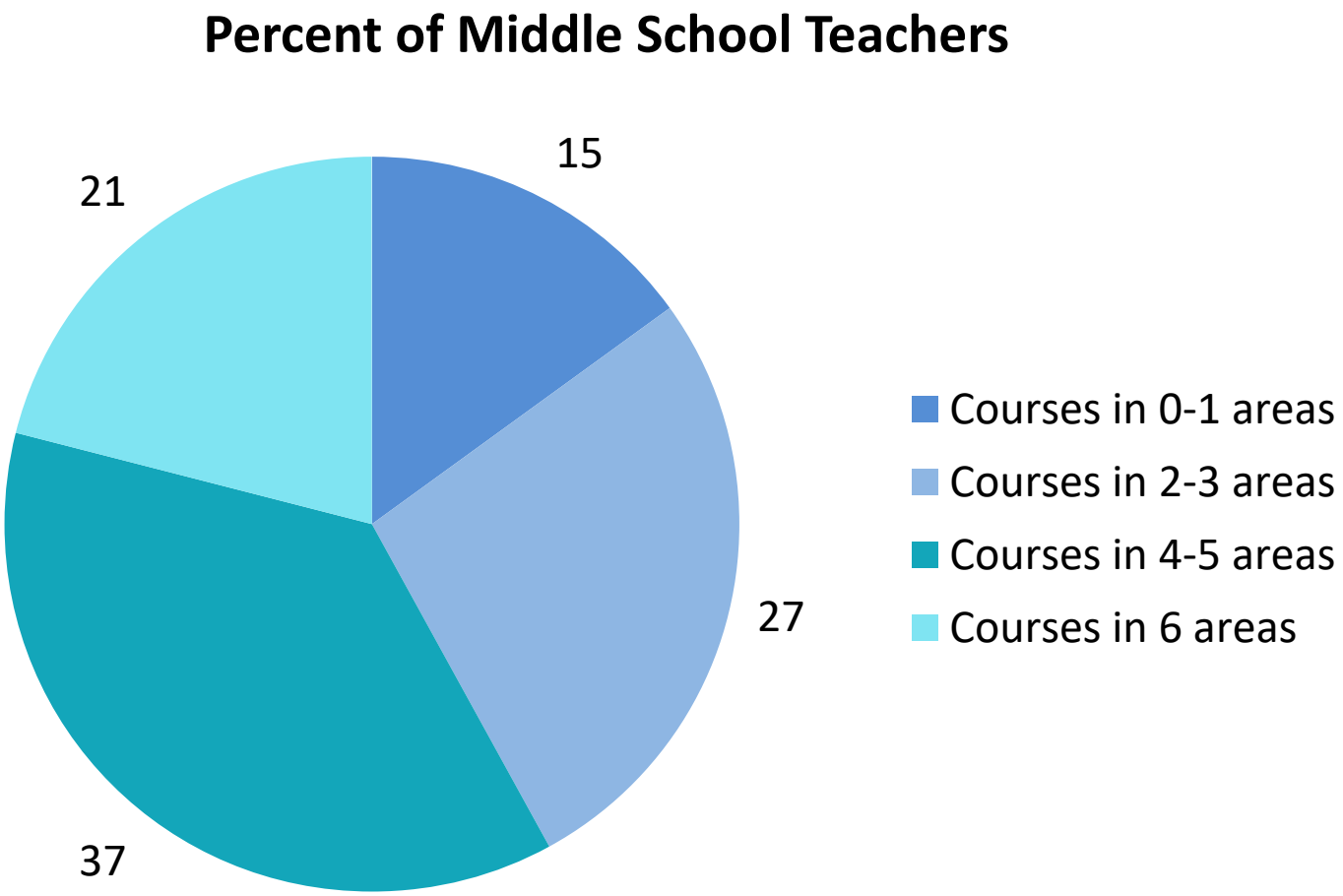
Perceptions of Preparedness



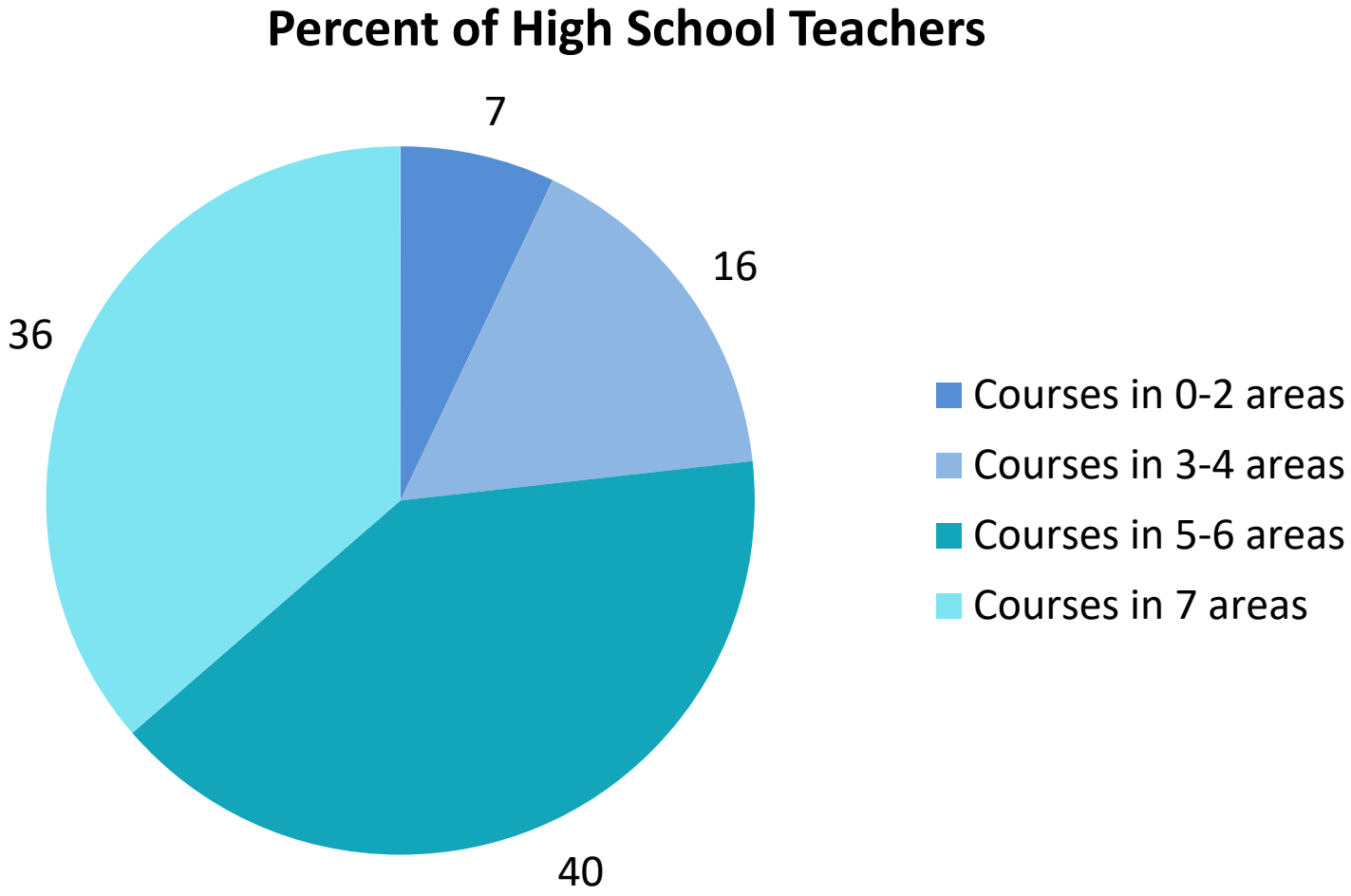
Elementary Mathematics Teachers' Coursework Related to NCTM Preparation Standards



Middle School Mathematics Teachers' Coursework Related to NCTM Preparation Standards



High School Mathematics Teachers' Coursework Related to NCTM Preparation Standards

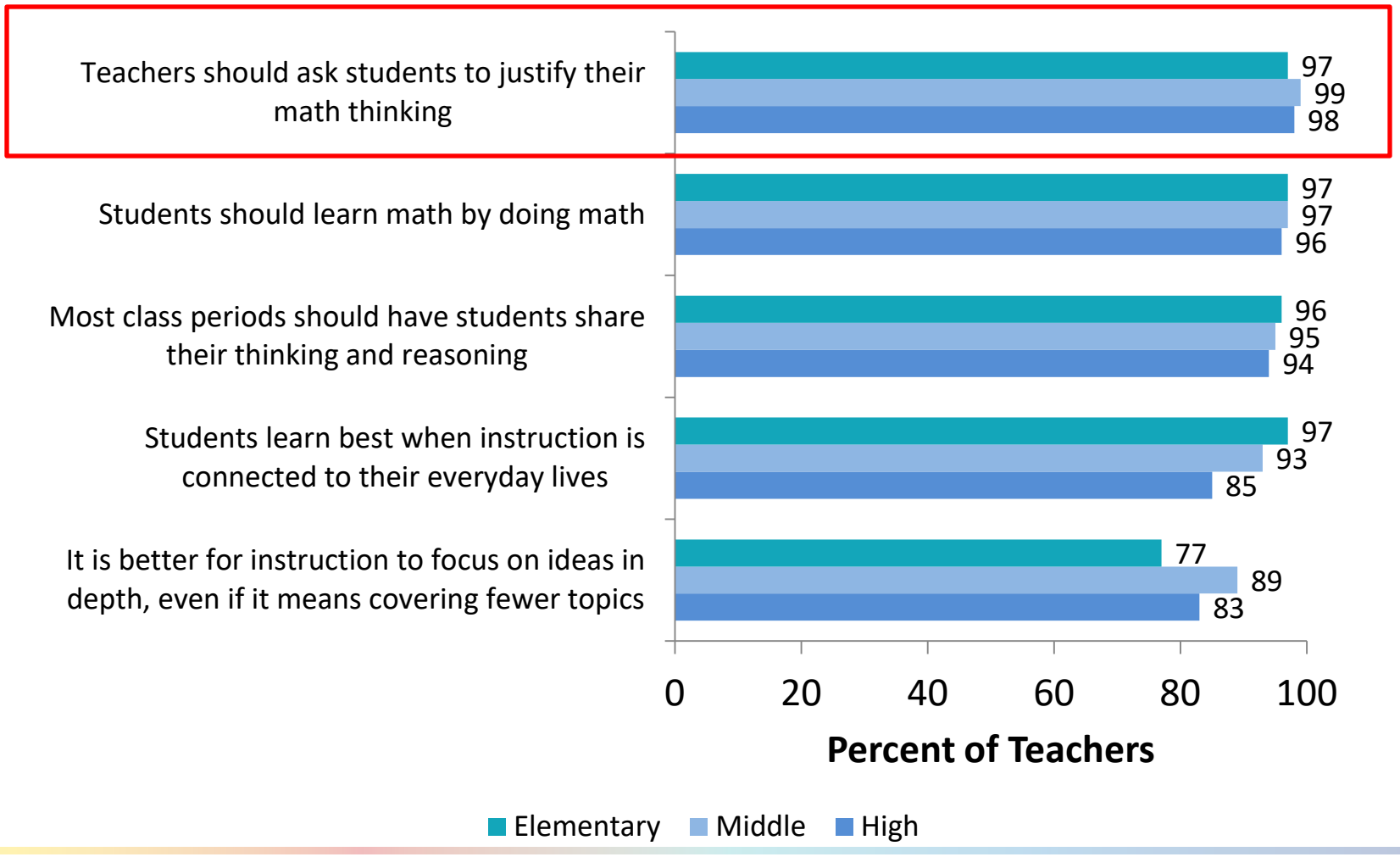


Teacher Beliefs

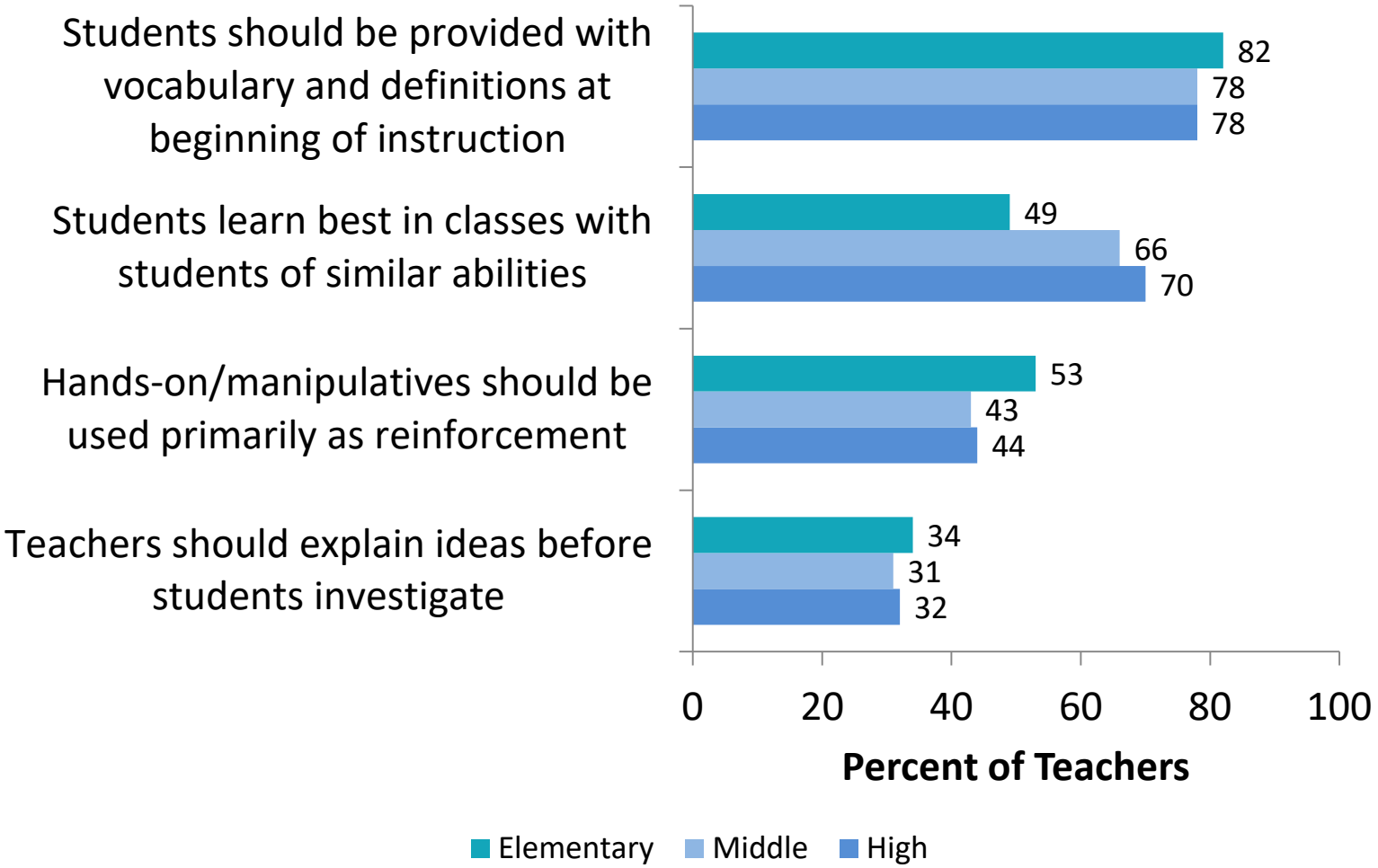
What percentage of teachers believe they should ask students to justify their mathematical thinking?

A. 25%
B. 50%
C. 75%
D. 100%

Teacher Beliefs



Teacher Beliefs



Mathematics Teaching Force Takeaways

Classes of mostly low-prior-achieving students and those with the highest proportion of historically underrepresented in STEM are more likely to be taught by novice teachers and those without mathematics or mathematics education degrees.

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

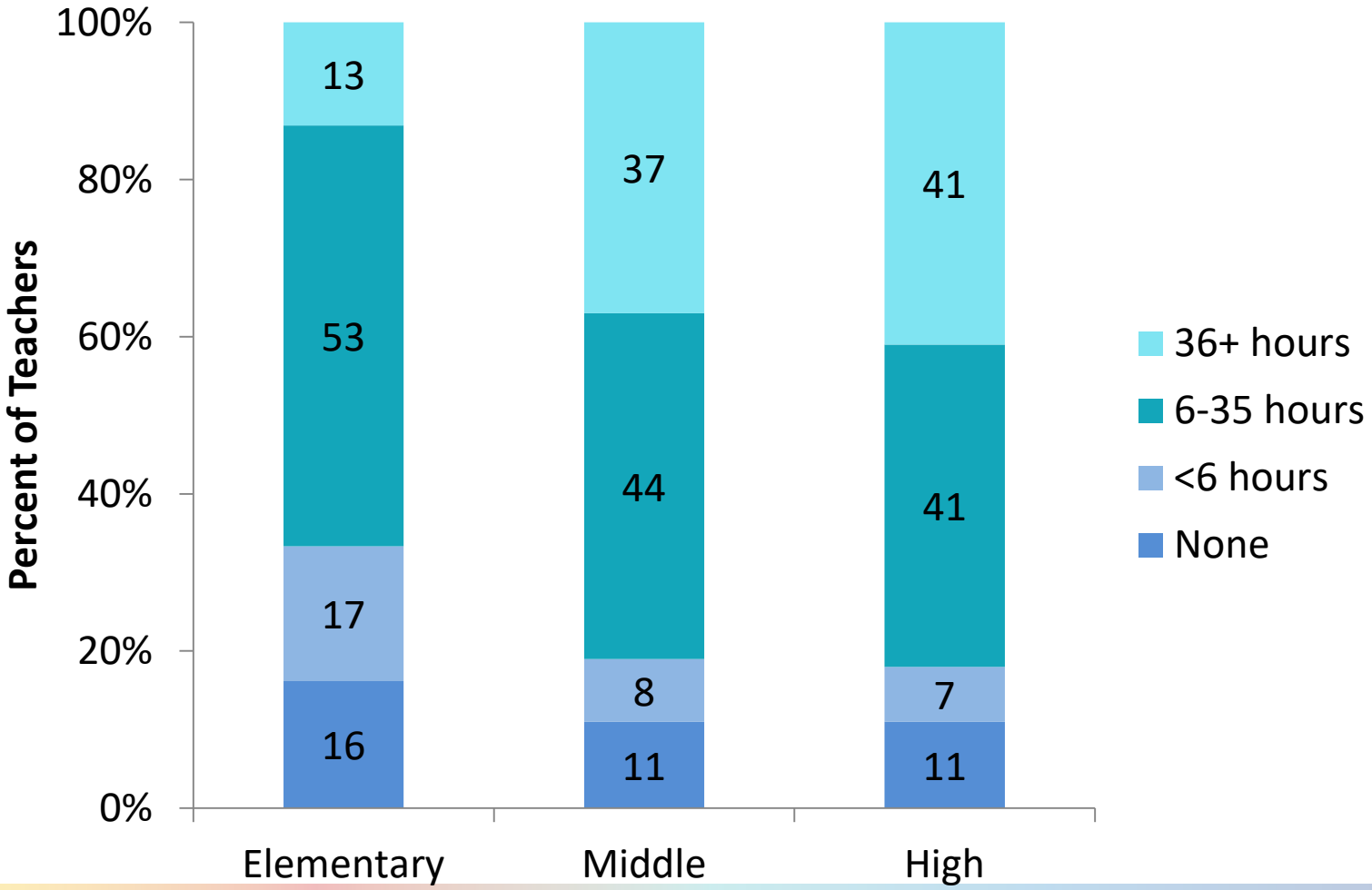
Teachers' beliefs about teaching and learning indicate only partial alignment with what is known about how students best learn mathematics.

Inservice Support

The 2018 NSSME+ asked about:

- Teacher professional development experiences
- School/district-offered professional development programs
- School/district-offered induction programs

Hours of Mathematics Professional Development in Last Three Years



Characteristics of Mathematics Professional Development

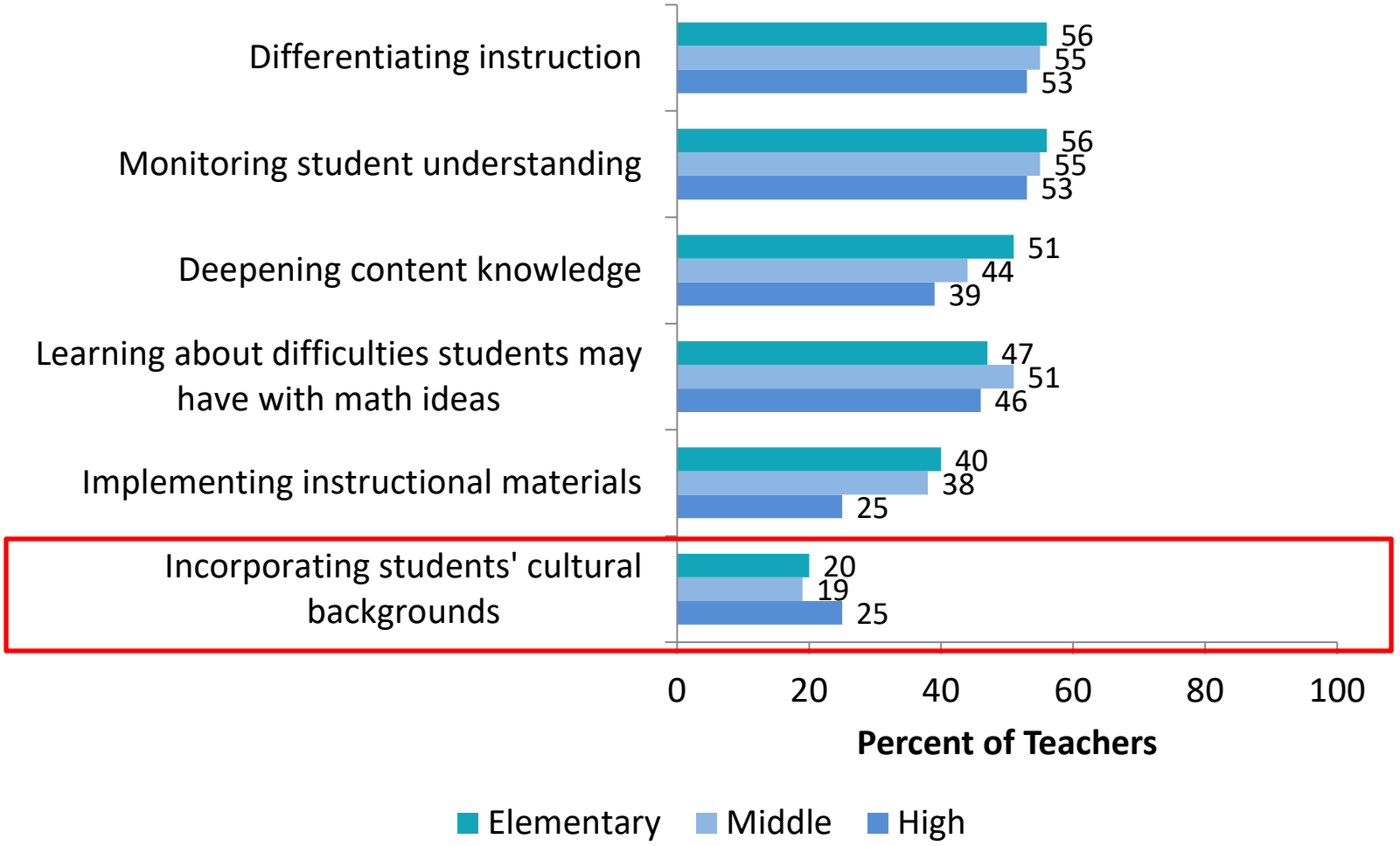
	Percent of Teachers		
	Elementary	**Middle**	**High**
Work closely with teachers in school	69	72	67
Work with those teaching same subject or grade level	56	58	57
Apply what they learn in classroom and come back to discuss	44	46	46
Examine classroom artifacts	46	49	44
Engage in math investigations	46	47	43
Experience lessons as students	48	45	42
Rehearse instructional practices	35	34	32

Emphasis of Mathematics Professional Development

What area do you think is receiving a heavy emphasis in mathematics professional development?

A. Deepening content knowledge
B. Differentiating instruction
C. Incorporating students' cultural backgrounds
D. Implementing instructional materials

Heavy Emphasis of Mathematics Professional Development



Inservice Support Takeaways

A majority of teachers have had some mathematics focused professional development in the last three years, but it may not be sufficient, especially for elementary teachers.

Professional development often has characteristics identified as high quality.

Professional development is emphasizing key areas such as differentiating instruction and monitoring student understanding, but is less likely to focus on culturally responsive teaching.

NSSME | THE NATIONAL SURVEY OF SCIENCE & MATHEMATICS EDUCATION

The 2018 NSSME+

JUNE 11, 2019

K–12 Science

horizon RESEARCH, INC.

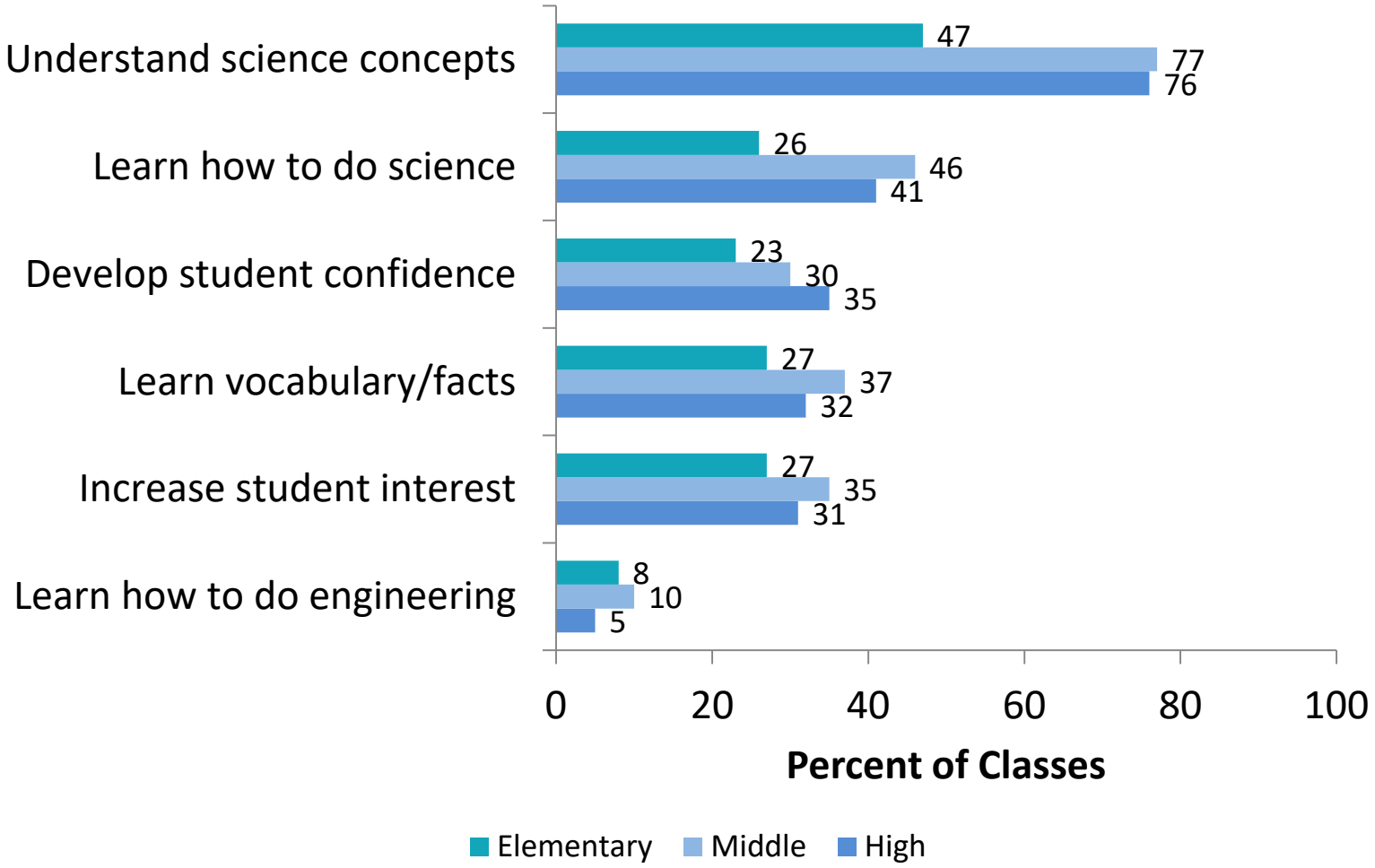
NSSME and NGSS

- **This presentation follows a similar structure to the computer science and mathematics, except for occasional analyses by NGSS adoption status**
  - 2013–14: 15 states and DC (early adopters)
  - 2015–17: 24 states (late adopters)
  - 11 states had not adopted as of August 2018
- **The 2012 NSSME data are baseline with regard to NGSS.**

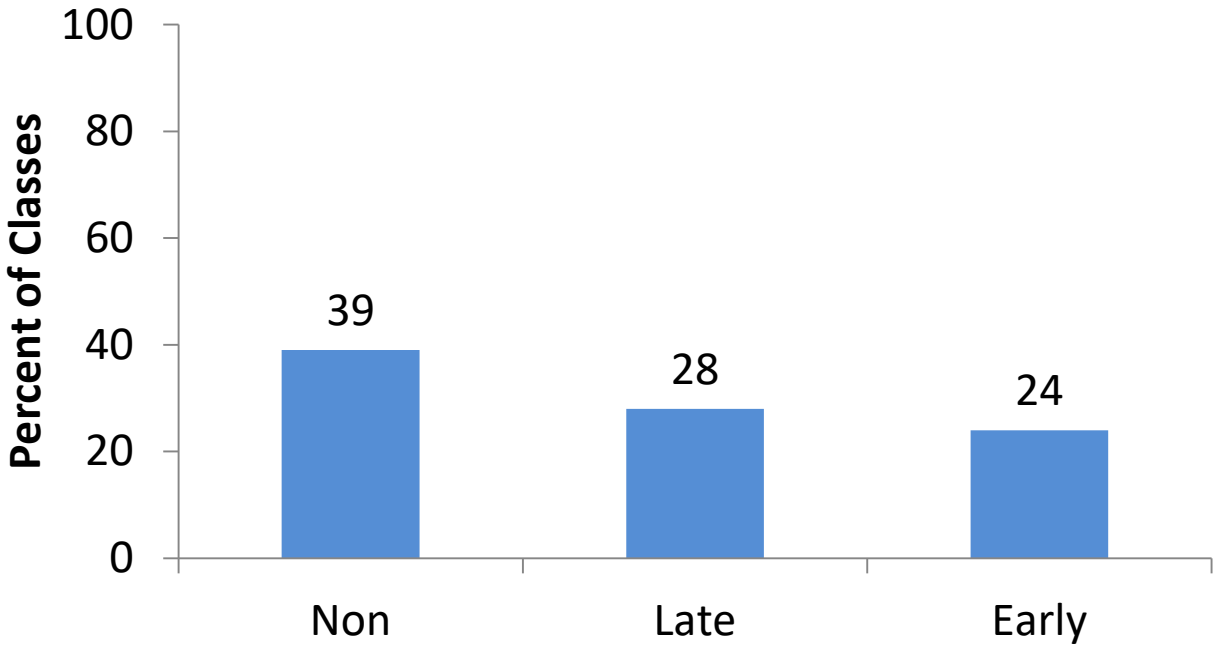
Science Instruction

- **Instructional objectives**
- **Science instructional time (elementary)**
- **Engagement with science practices**
- **Instructional activities**

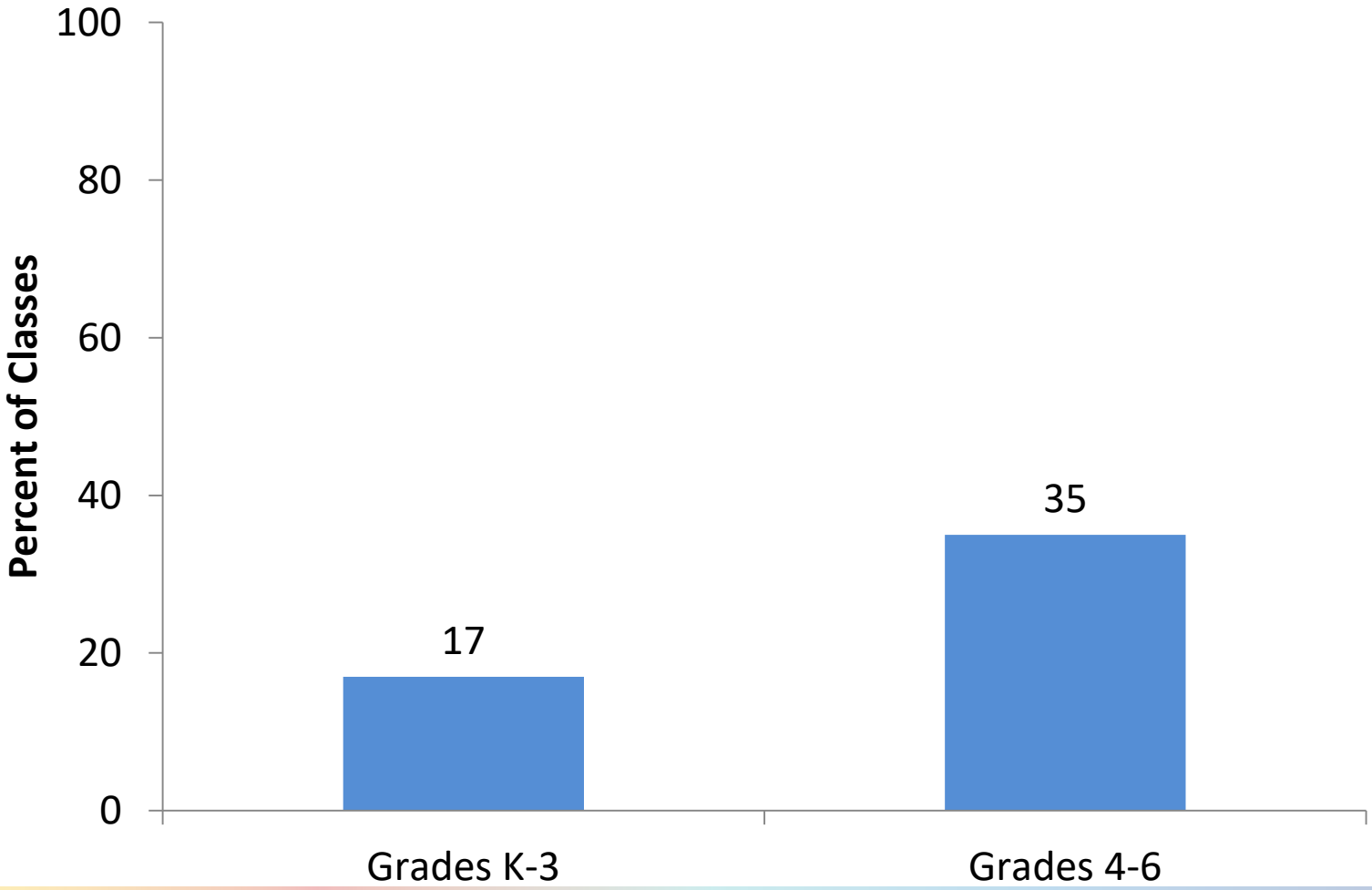
Objectives Receiving a Heavy Emphasis



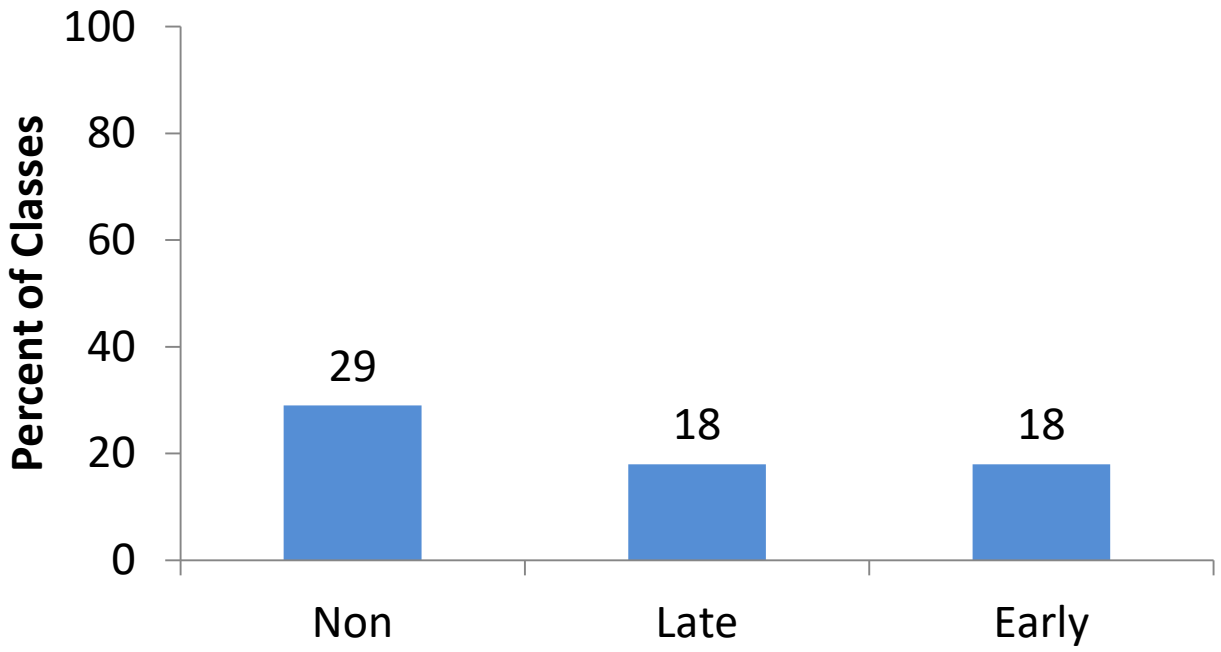
Heavy Emphasis on Learning Science Vocabulary/Facts



Elementary Classes Receiving Science Instruction All/Most Days



Elementary Classes Receiving Science Instruction All/Most Days

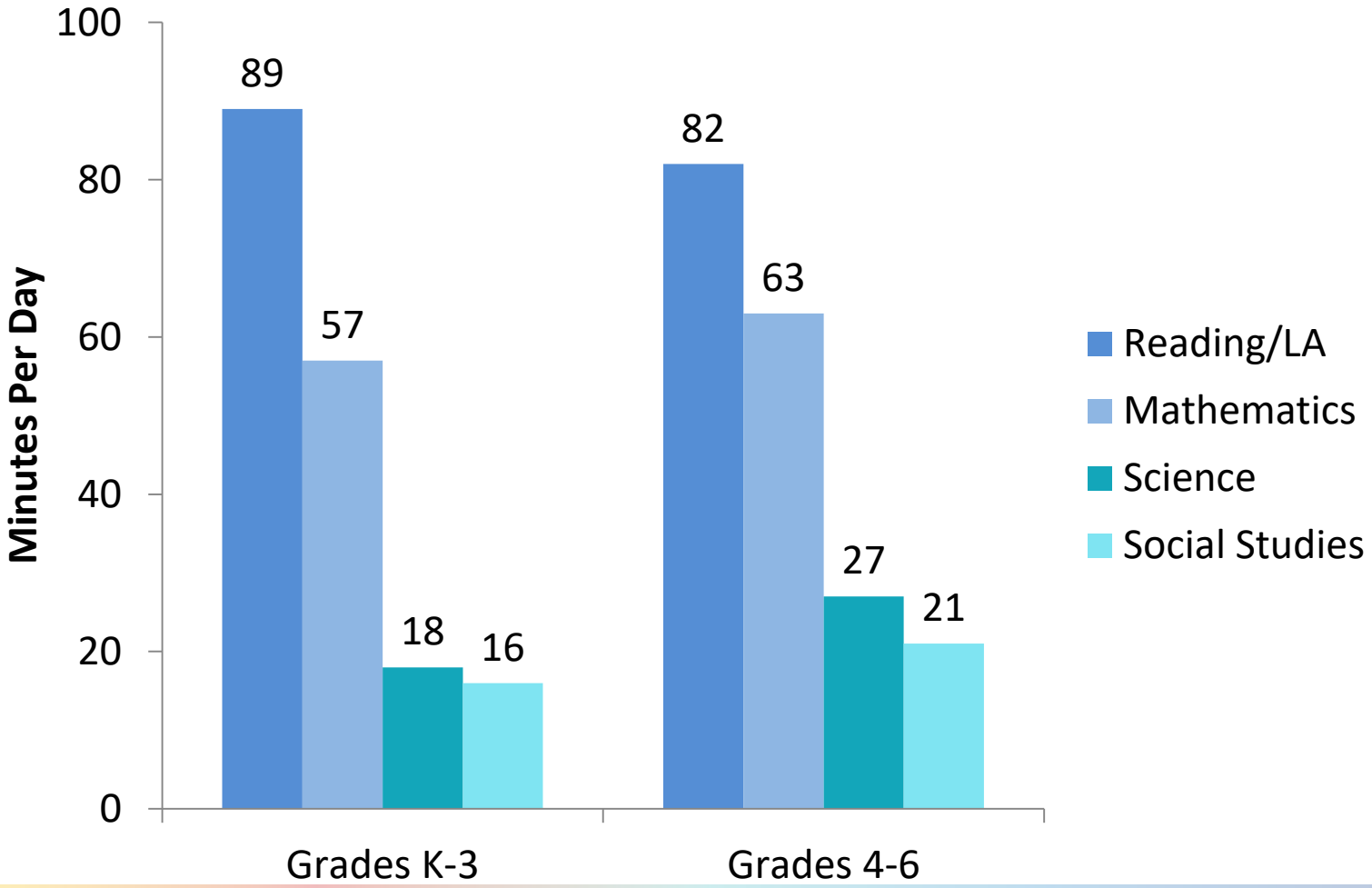


Instructional Time: Elementary

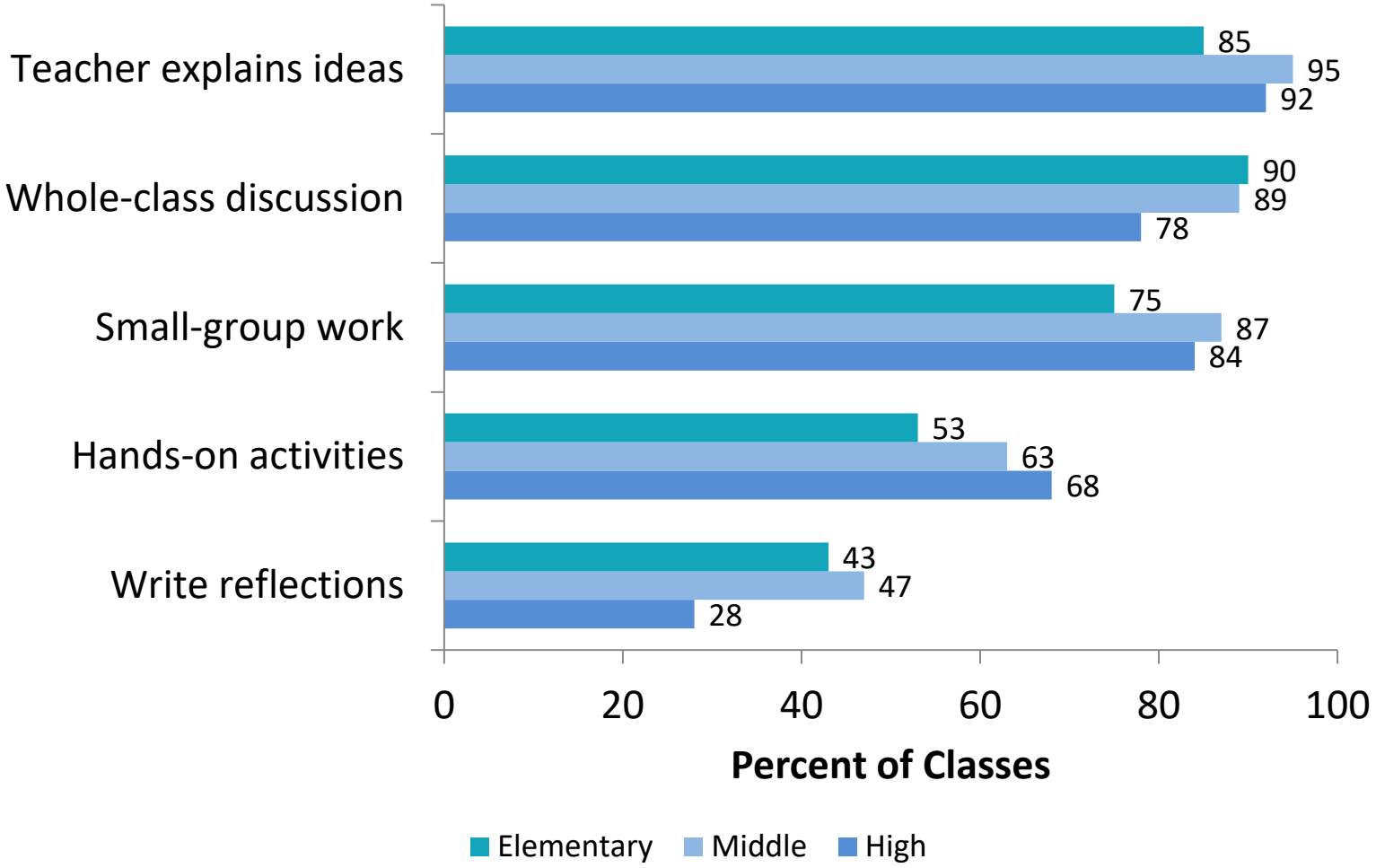
About how much time does the typical elementary class spend on science instruction each day?

A. 10 minutes
B. 20 minutes
C. 30 minutes
D. 40 minutes

Instructional Time: Elementary



Instructional Activities: Weekly



Engagement in Science Practices

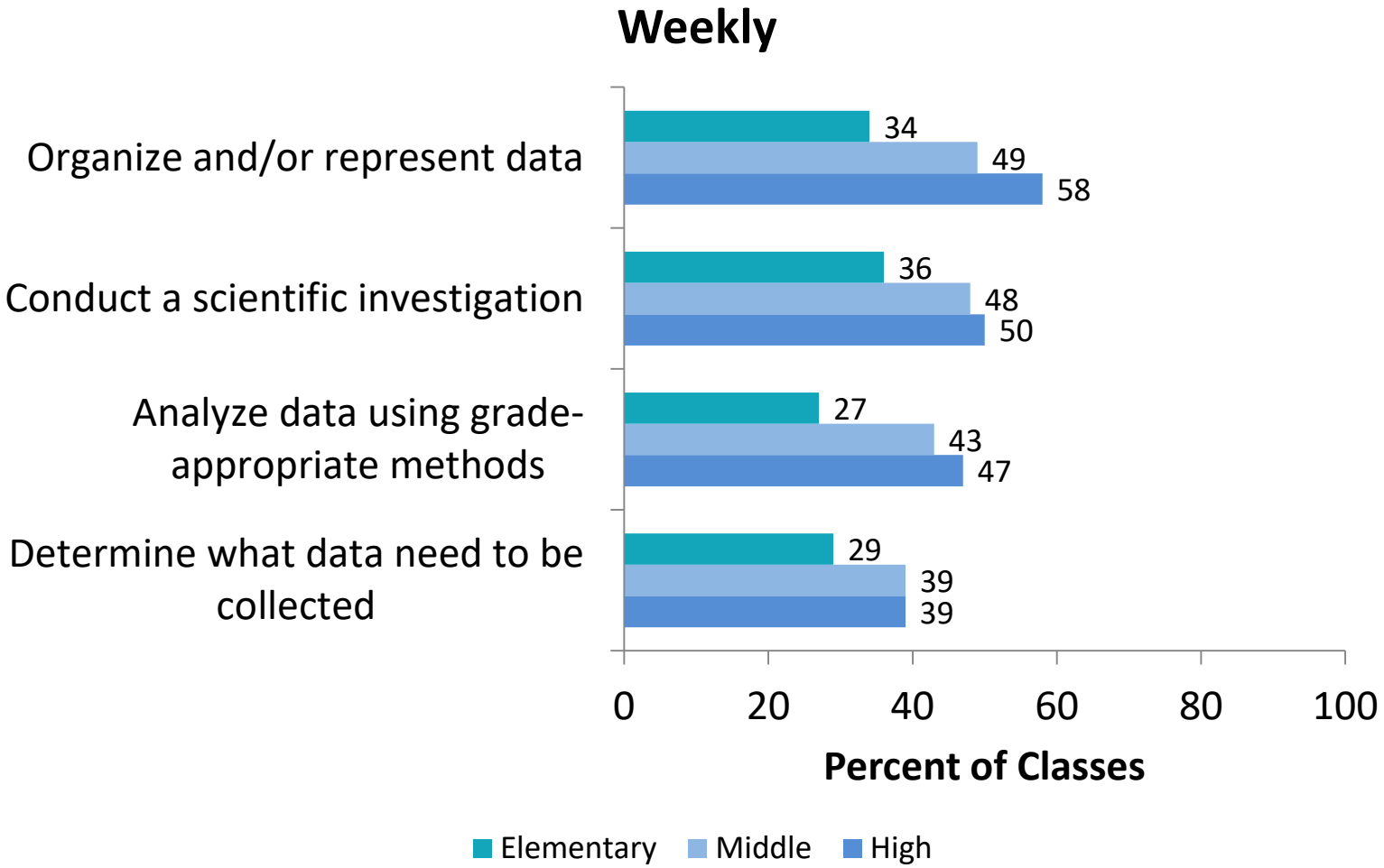
The 2018 NSSME+ included a series of items asking how often students were engaged in aspects of the science practices:

1. Asking questions/defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations/designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Engagement in Science Practices

Students are often engaged in aspects of science related to conducting investigations and analyzing data.

Conducting Investigations and Analyzing Data

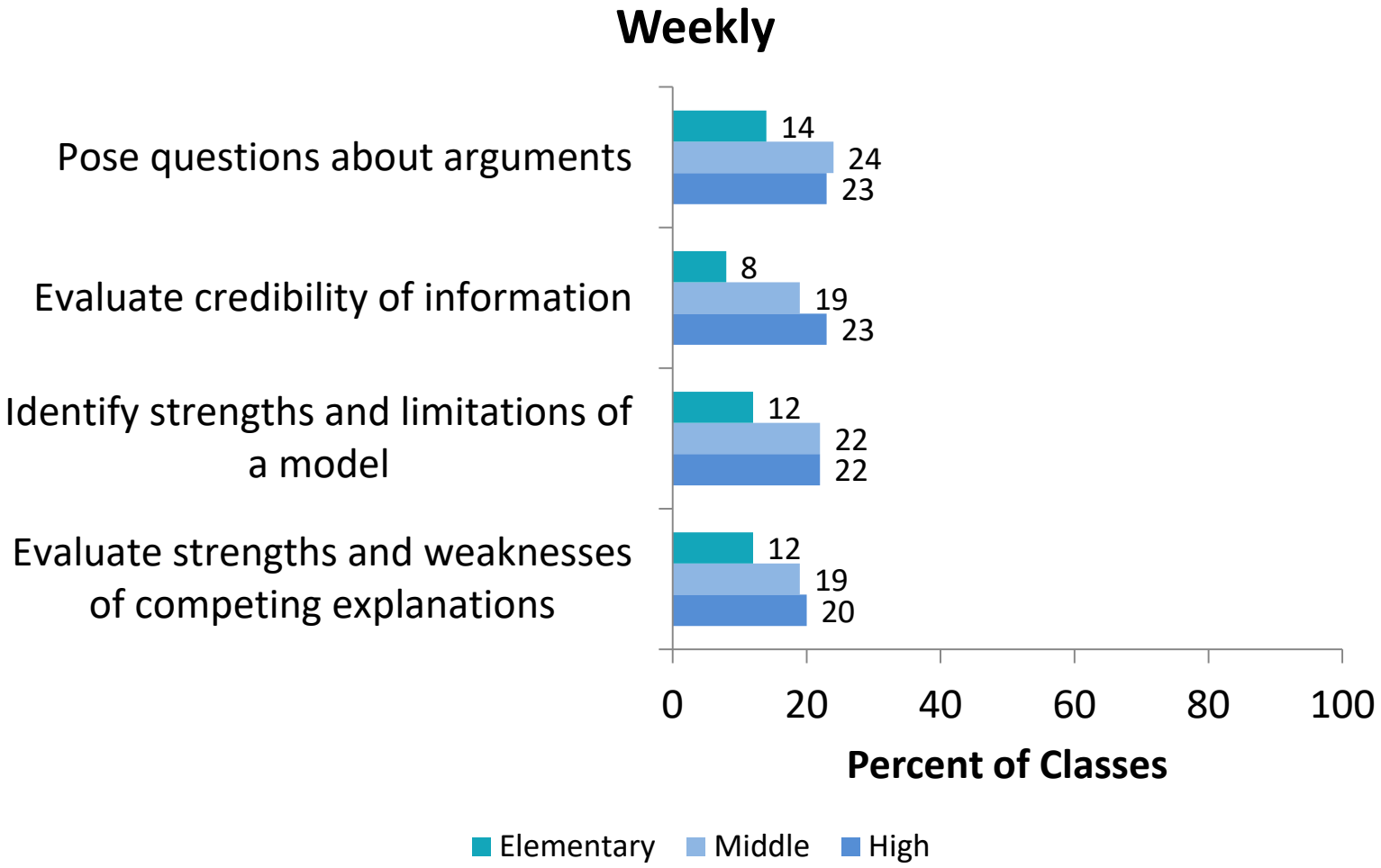


Engagement in Science Practices

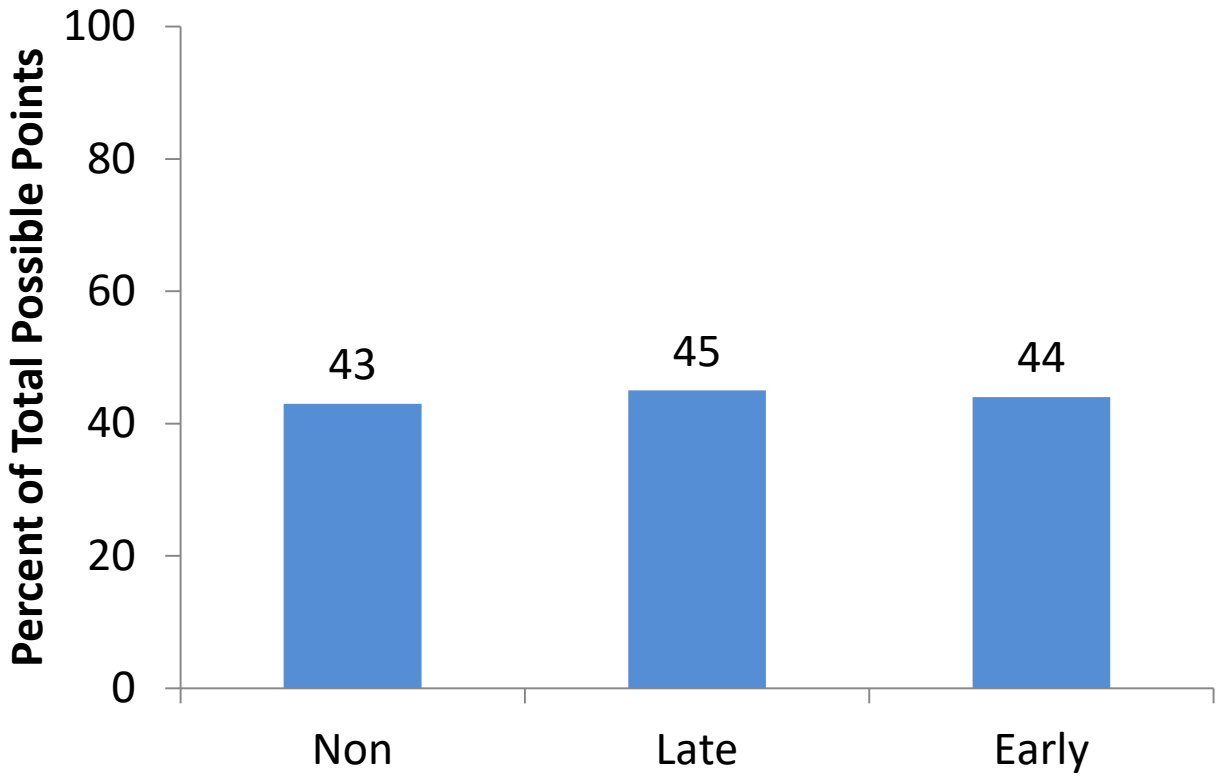
Students are often engaged in aspects of science related to conducting investigations and analyzing data.

Students tend to not be engaged very often in aspects of science related to evaluating the strengths/limitations of evidence and the practice of argumentation.

Evaluating Evidence and Arguing



Engaging Students in the Practices of Science Composite



Instruction Takeaways

Instructional time for science at the elementary still relatively low

Heavy emphasis on developing conceptual understanding, but not on how science is done, or how knowledge is generated and revised

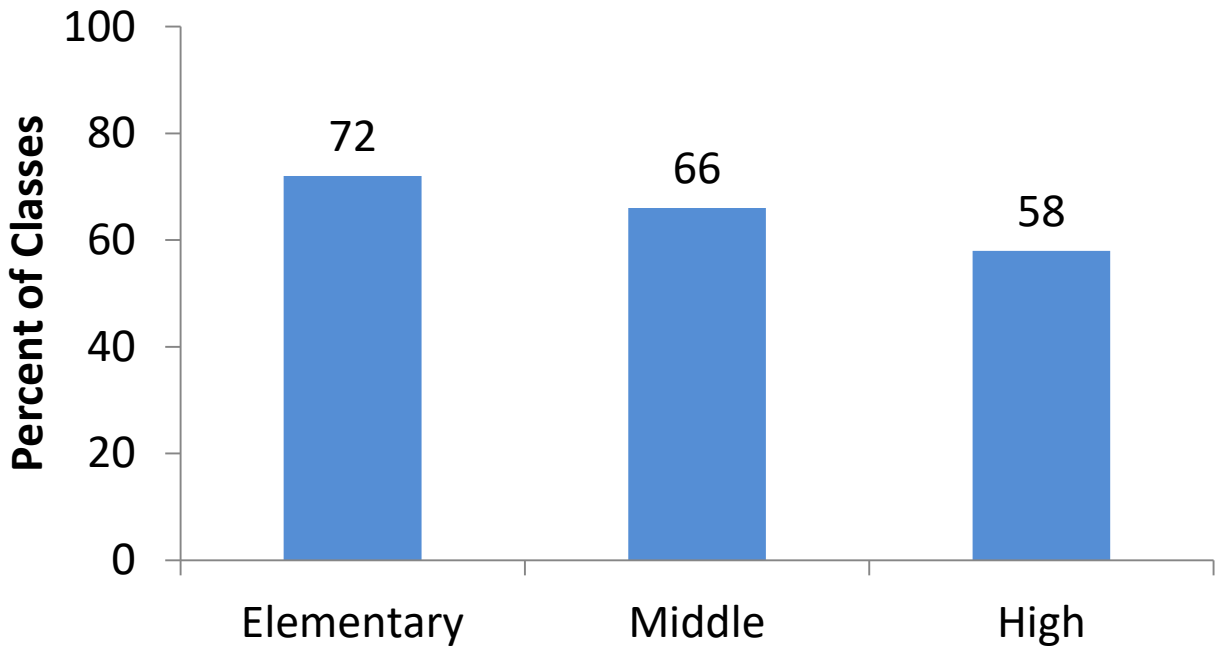
Students conduct investigations and analyze data fairly often, but not asked to think critically nearly as often

Resources for Instruction

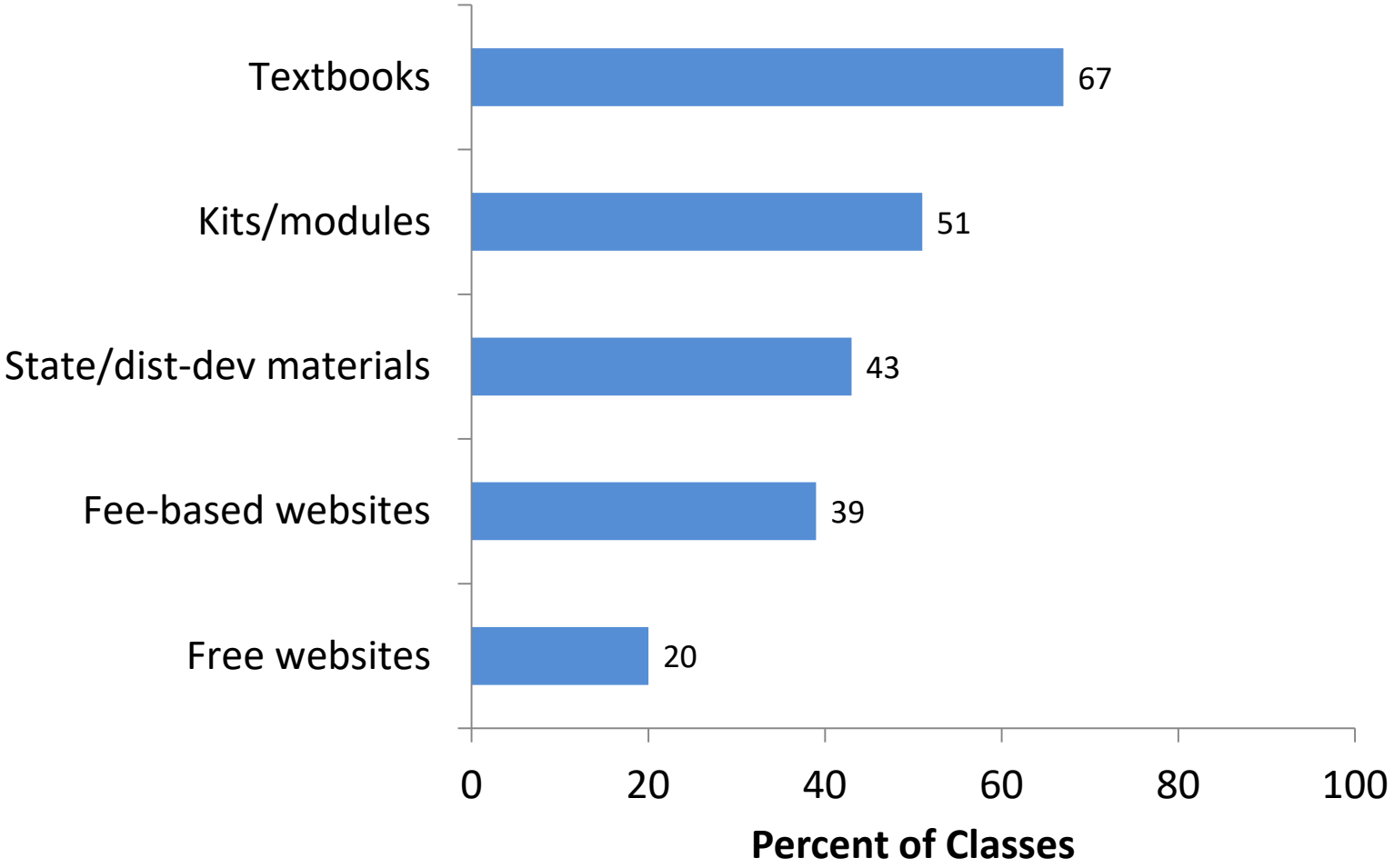
- **Instructional materials**
- **Other resources**

Instructional Materials

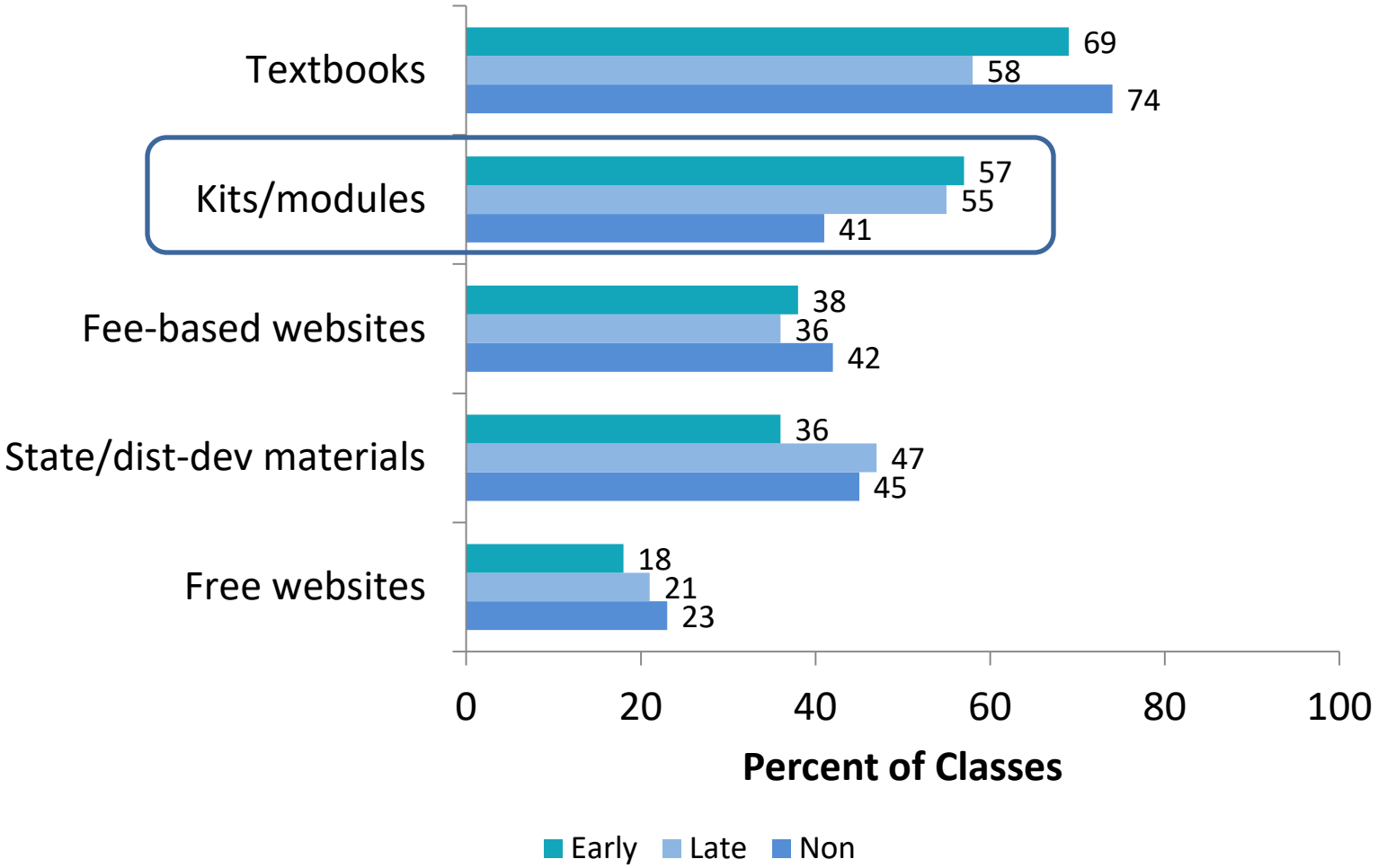
For most classes, districts designate instructional materials to be used:



Designated Instructional Materials—All Grades

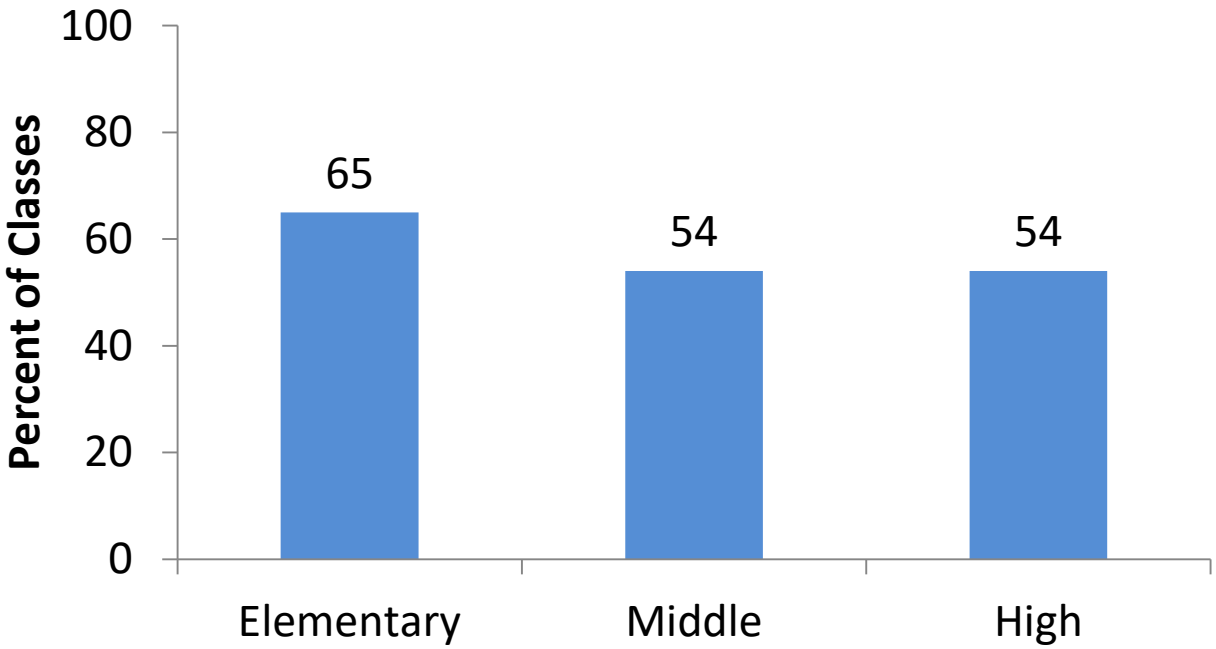


Designated Instructional Materials—Elementary



Instructional Materials

For most classes, the most recent unit was based on a commercially published textbook or a material developed by the state/district.

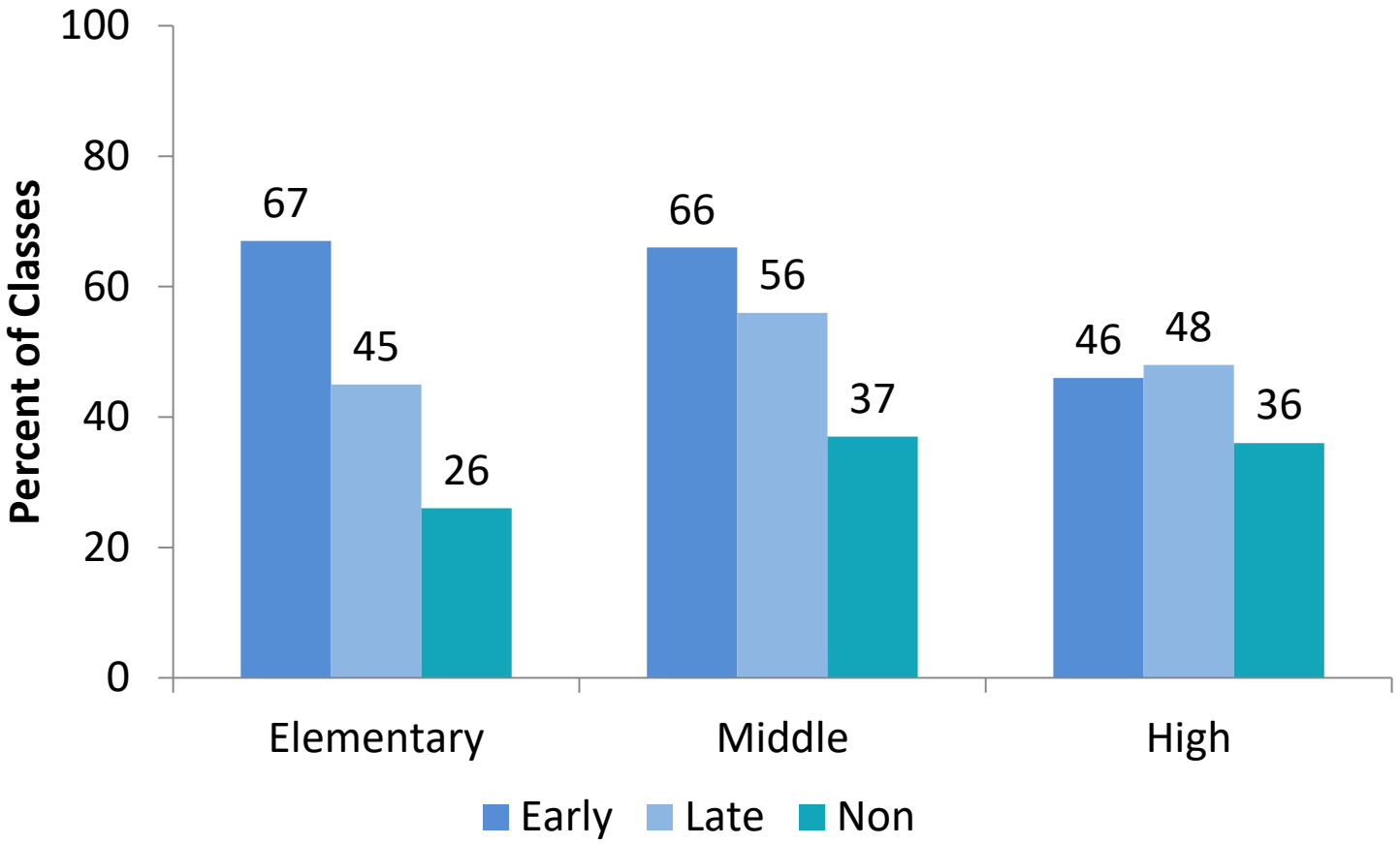


Instructional Materials

About what percentage of science classes use instructional materials published before 2010?

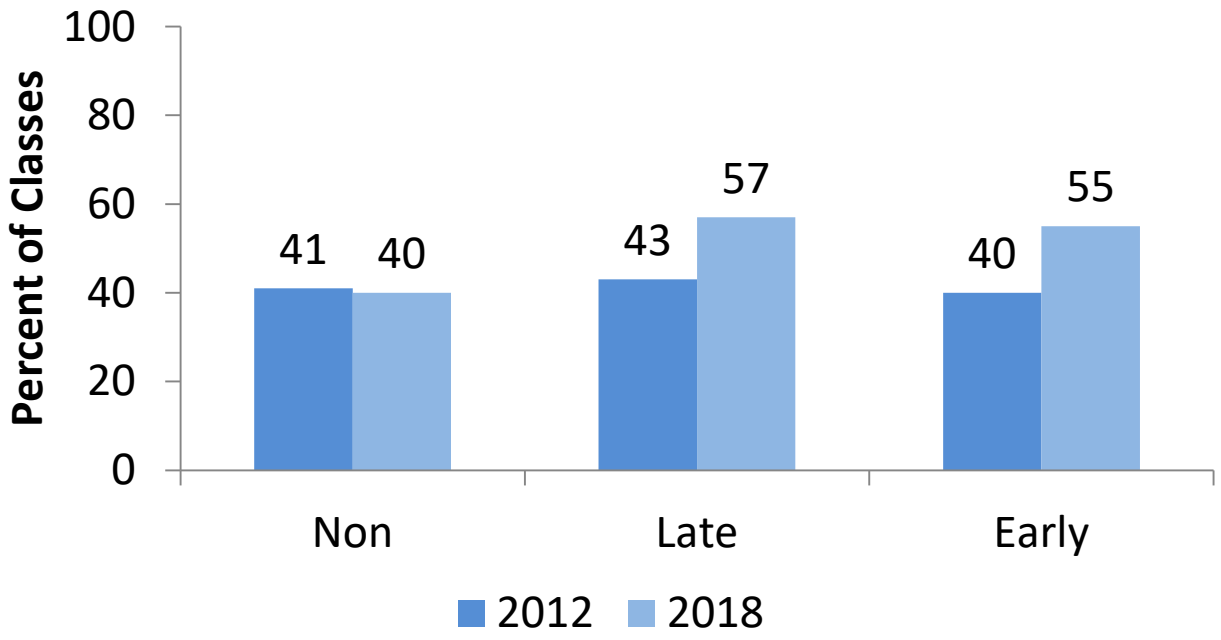
A. 30%
B. 40%
C. 50%
D. 60%

Science Classes Using Textbooks Published before 2010

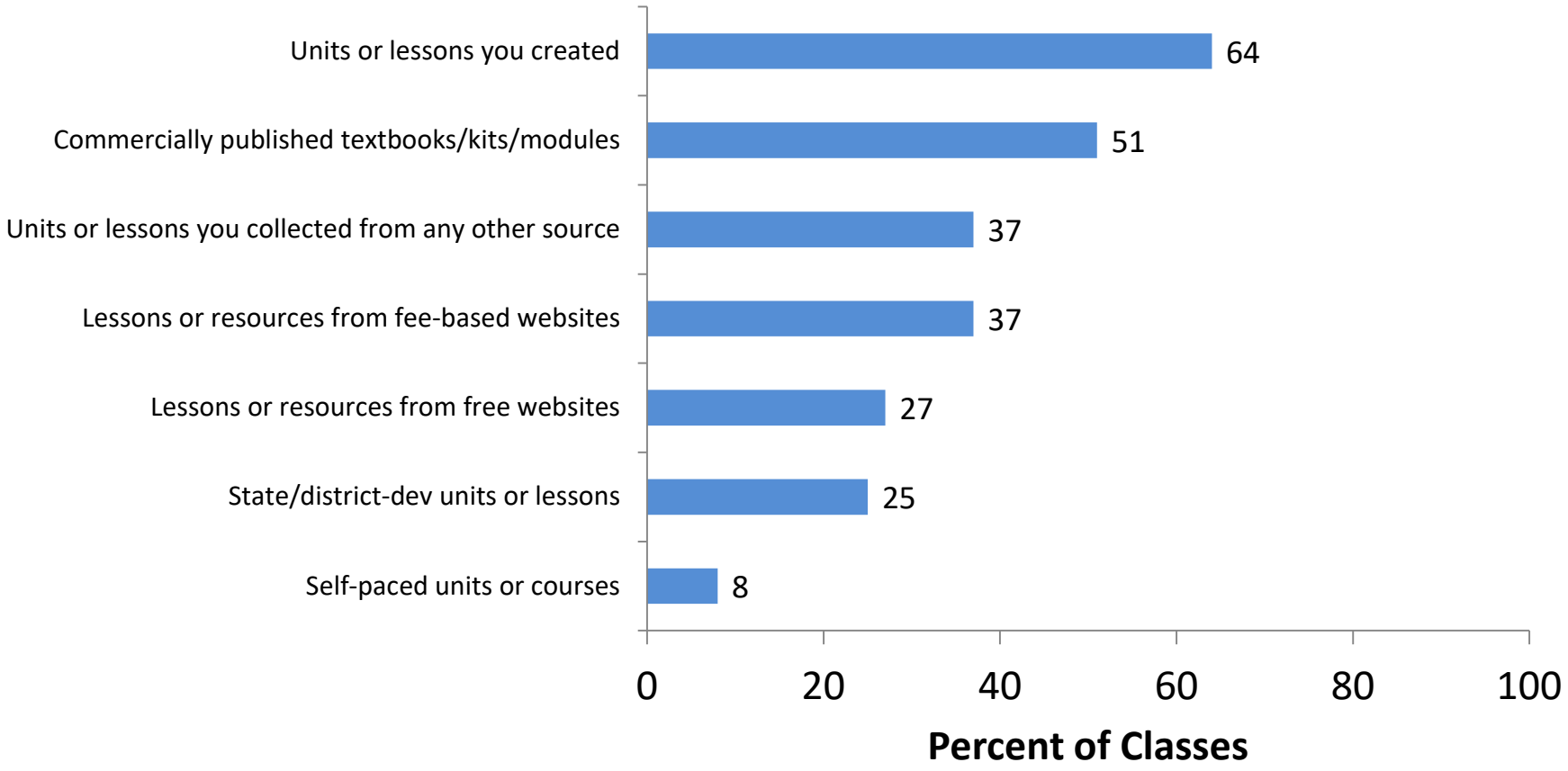


Ways Elementary Teachers Used Their Textbook in Most Recent Unit

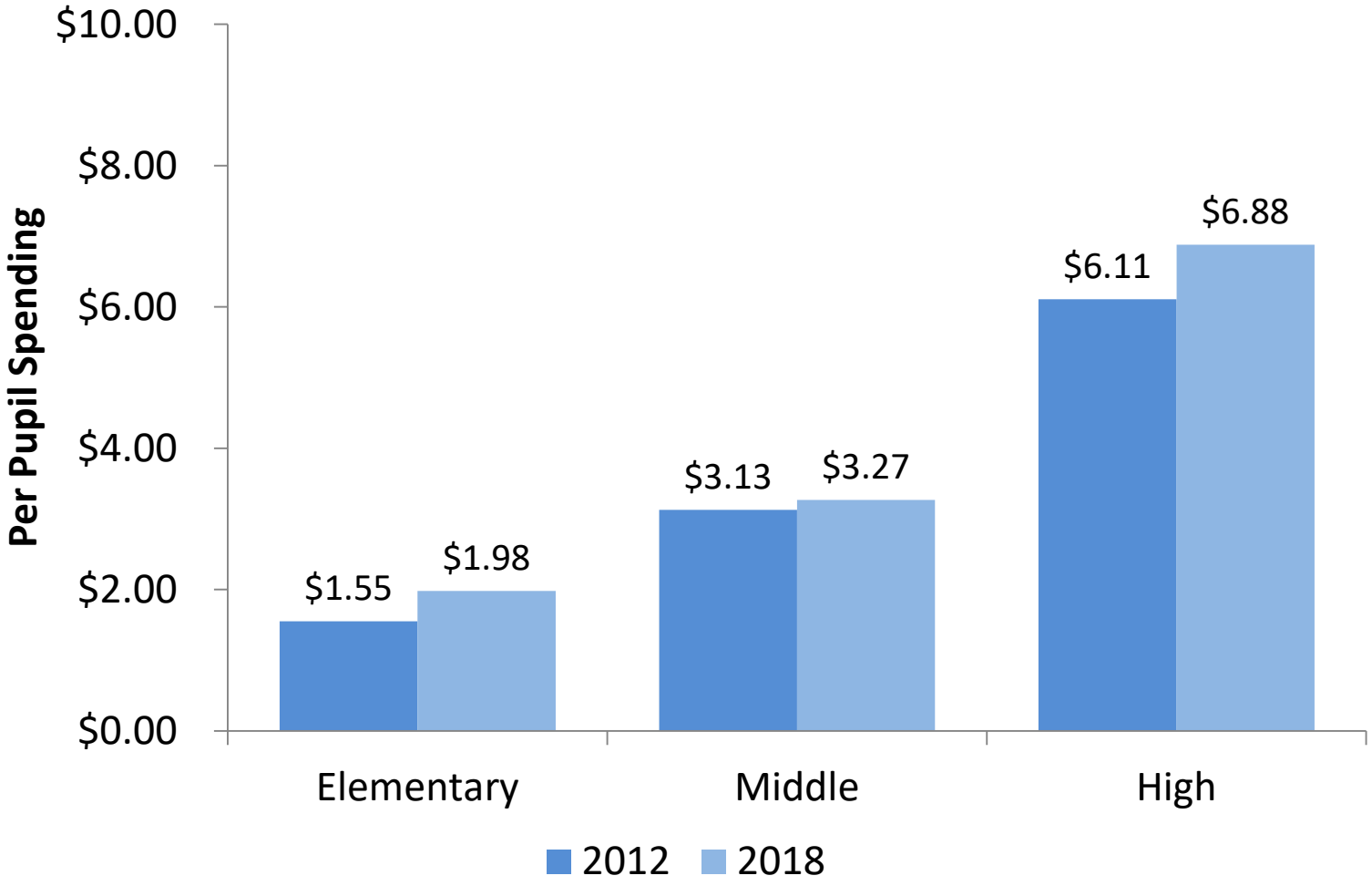
I picked what was important and skipped the rest.



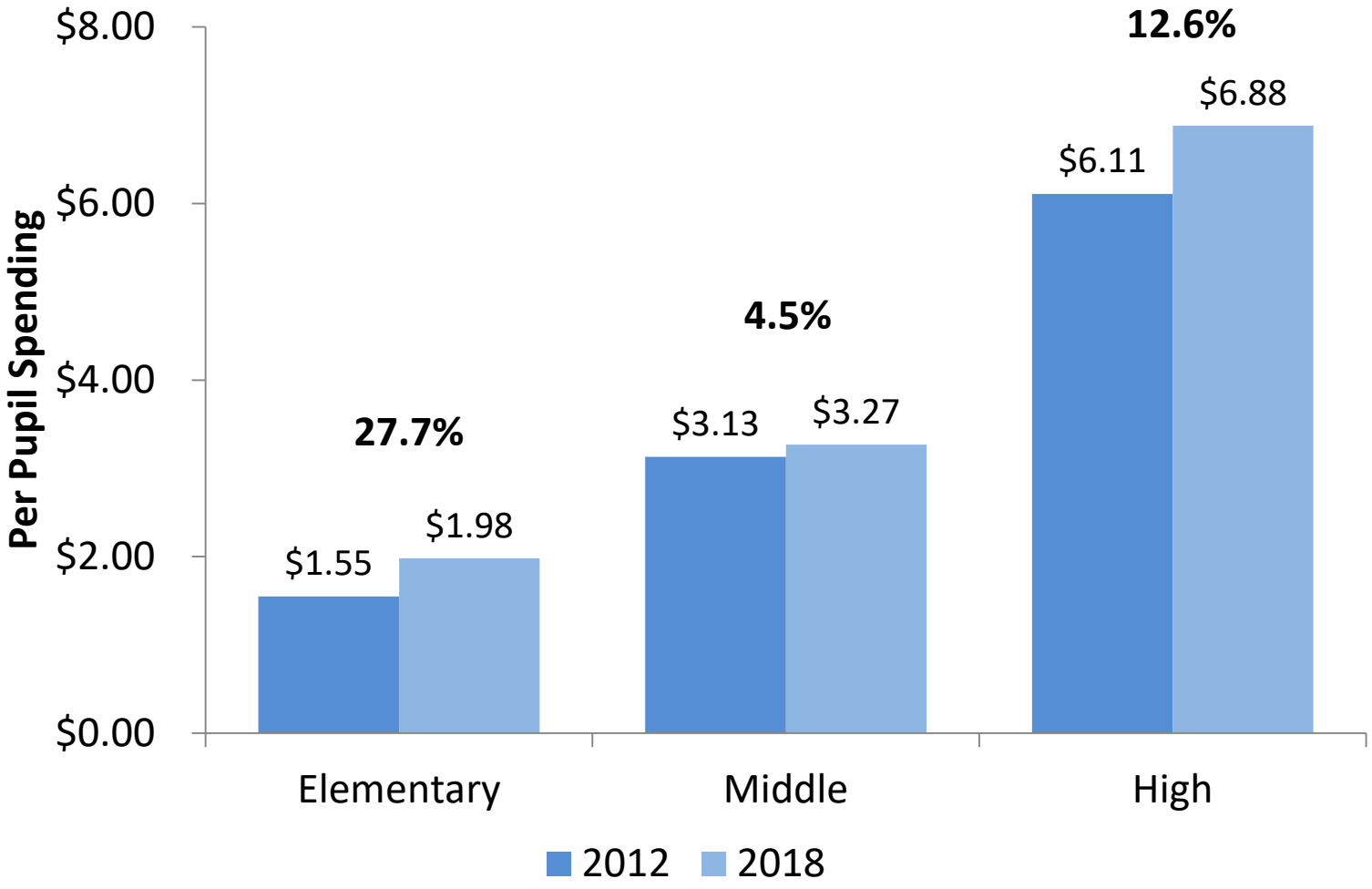
Science Classes Basing Instruction on Various Instructional Resources at Least Once a Week



Median School Spending Per Pupil for Science

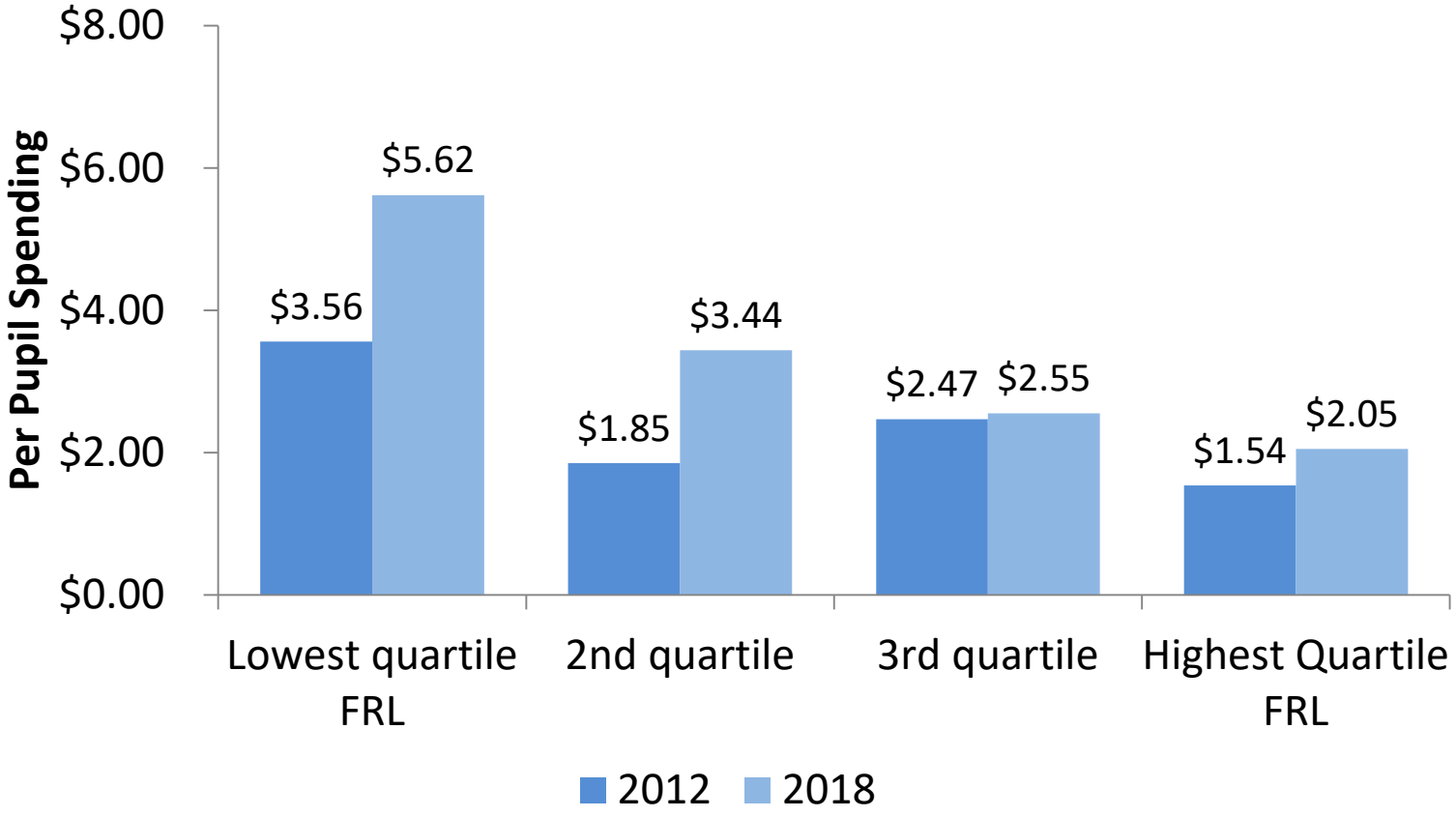


Median School Spending Per Pupil for Science



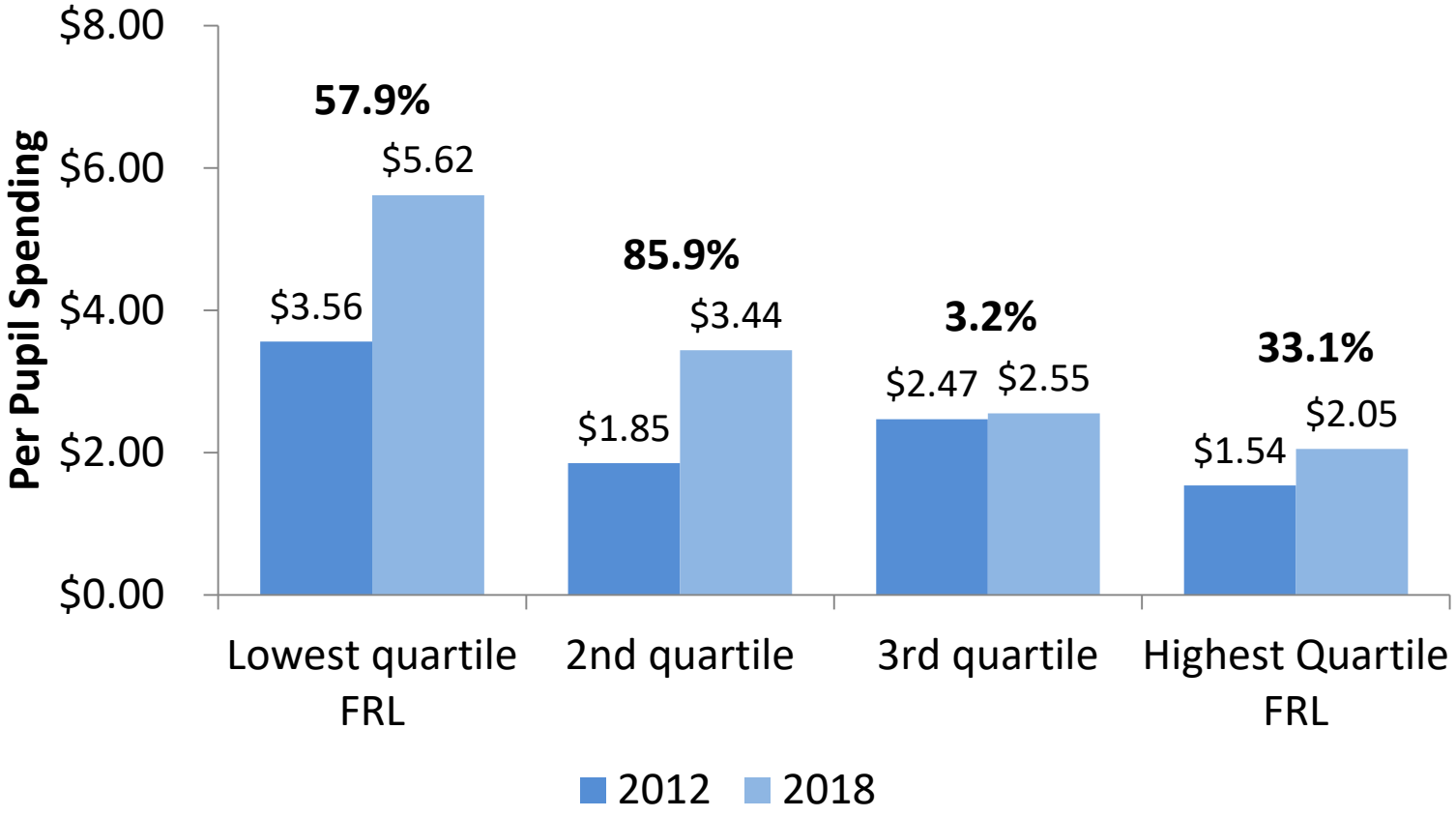
Equity Analysis

Spending by percentage of students eligible for FRL in school



Equity Analysis

Spending by percentage of students eligible for FRL in school



Resources Takeaways

Commercially published materials heavily influence instruction.

Large proportions of classes in NGSS-adopting states use pre-NGSS materials.

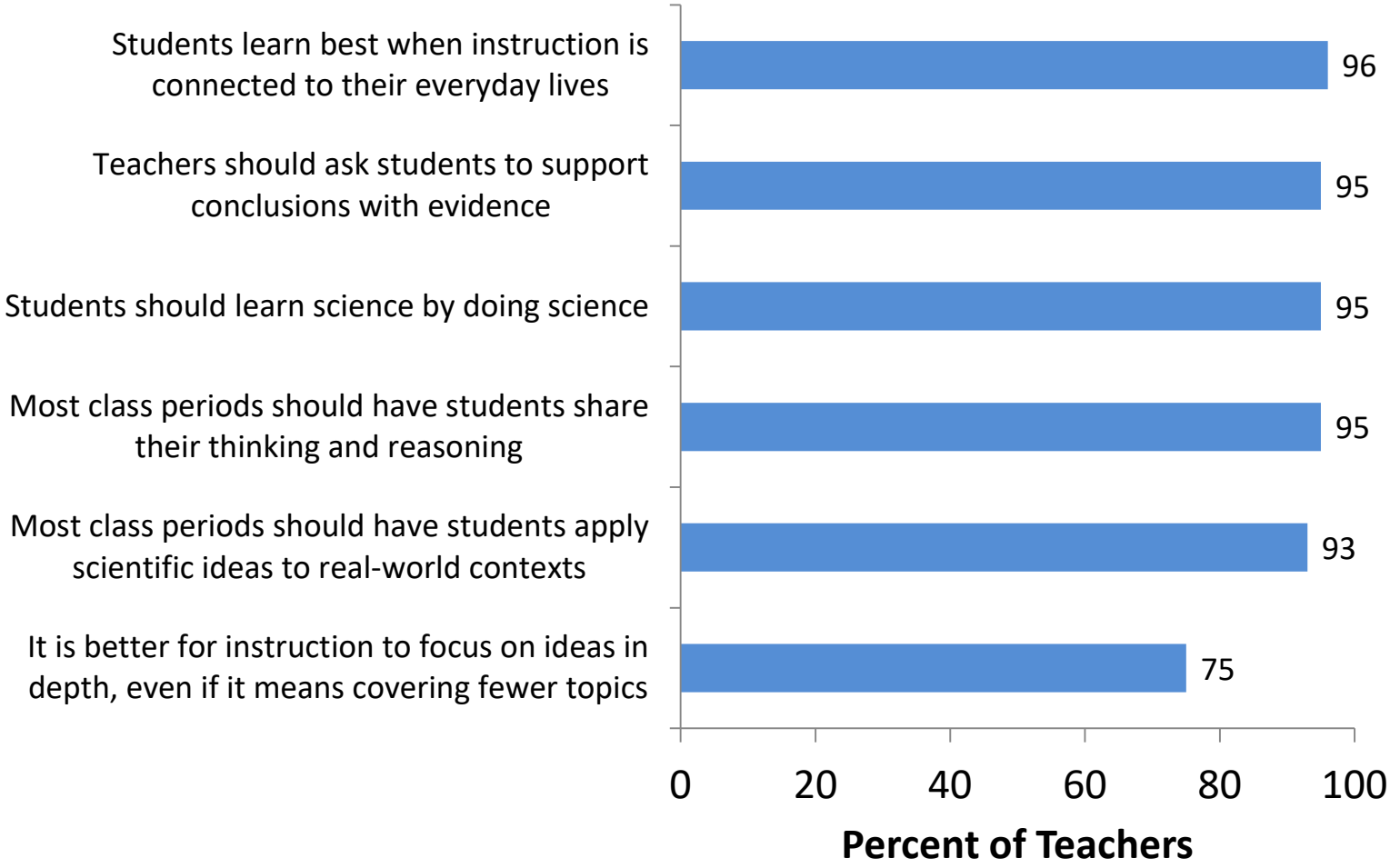
Schools with high percentages of students eligible for FRL spend substantially less per pupil than schools with fewer students eligible for FRL.

The Science Teaching Force

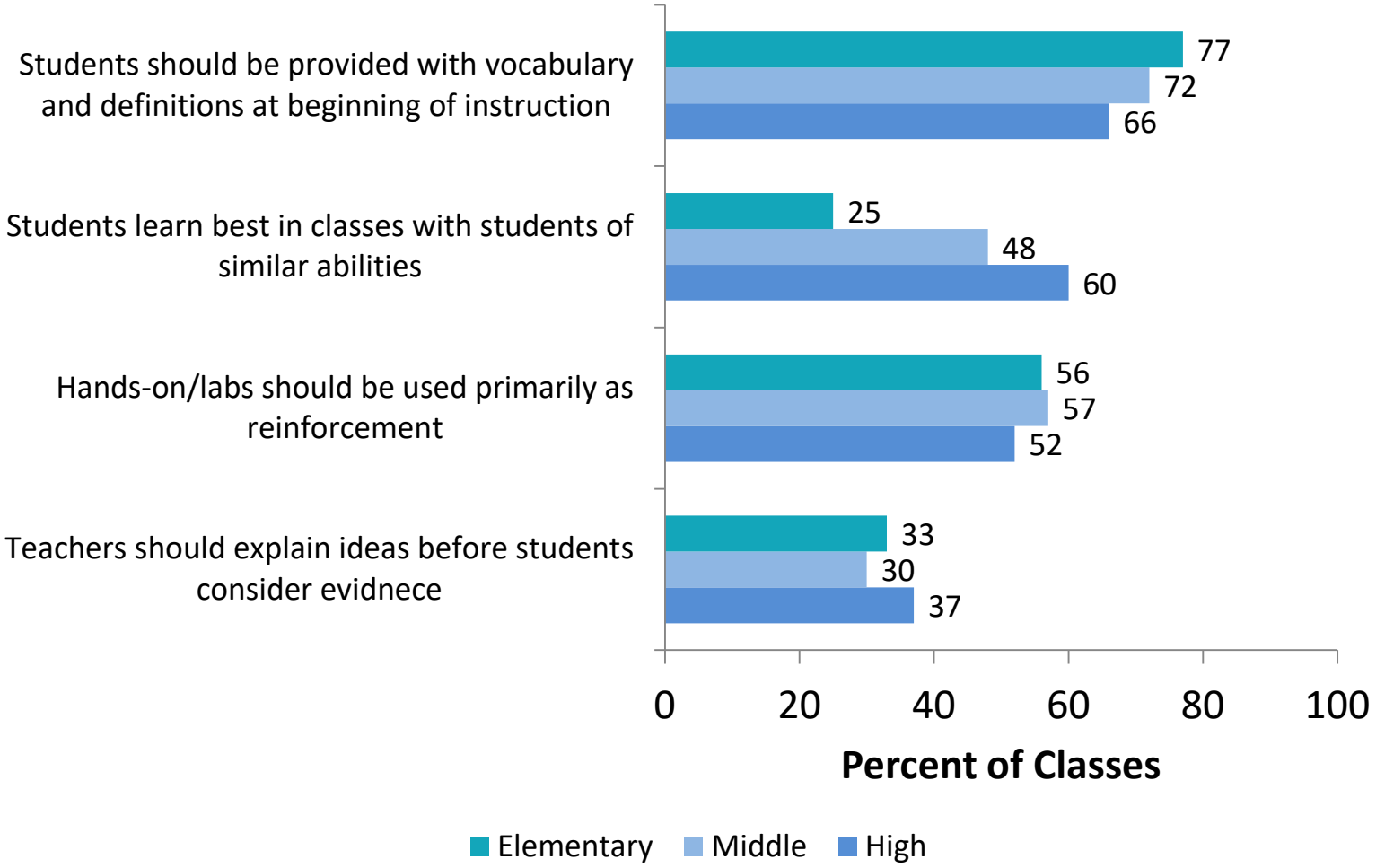
The 2018 NSSME+ collected data about:

- Beliefs about teaching and learning
- Feelings of preparedness
- Path to certification
- College coursework

Teachers Agreeing With Reform-Oriented Beliefs About Instruction

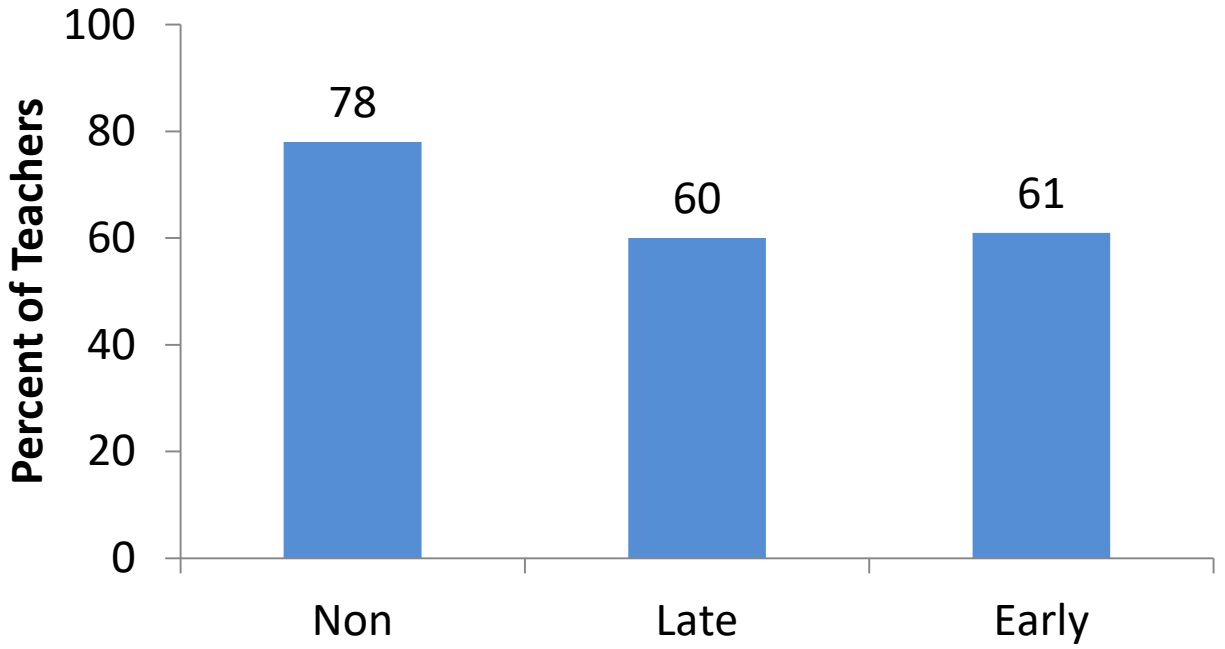


Teacher Beliefs



High School Teachers

At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.

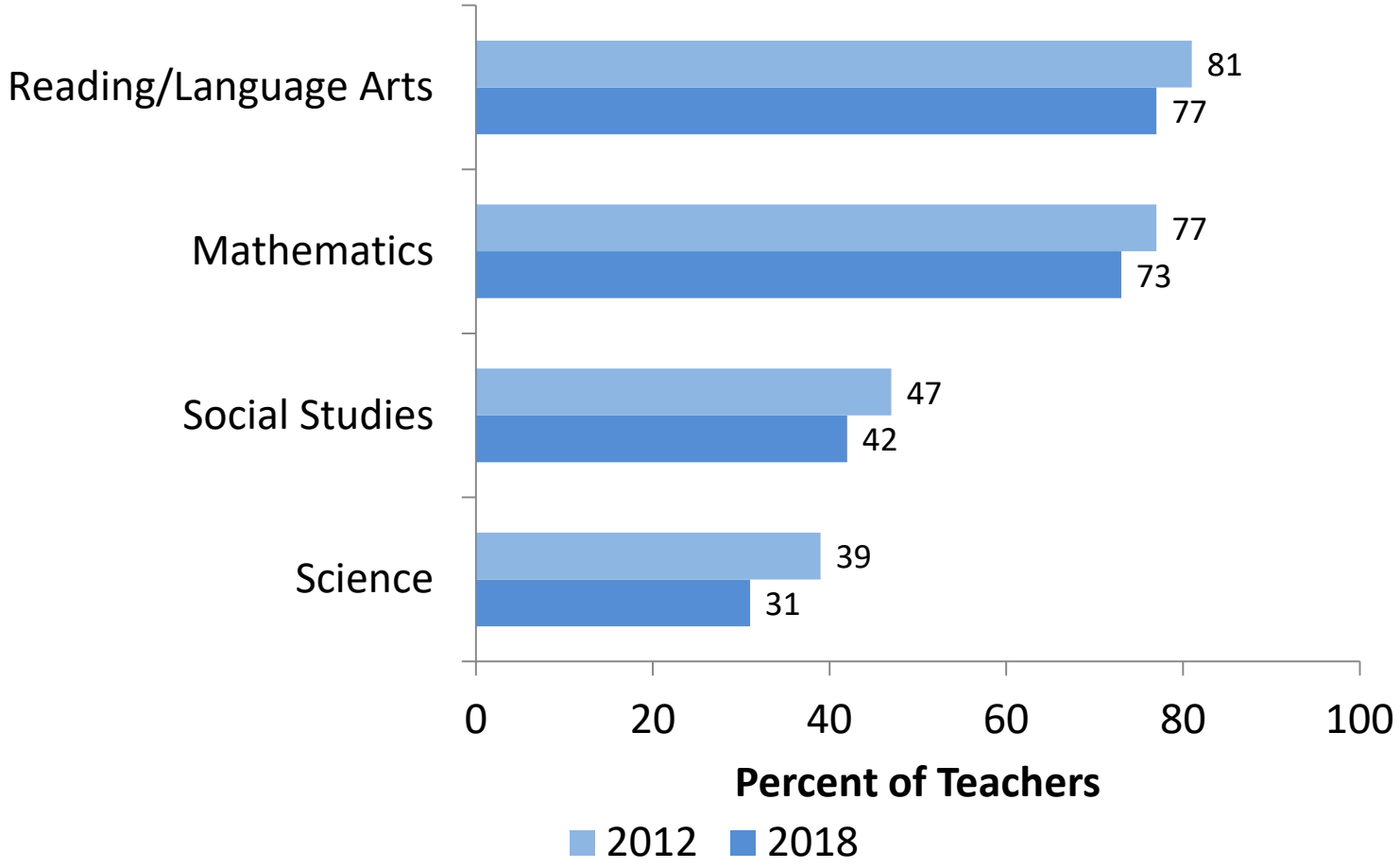


Perceptions of Preparedness

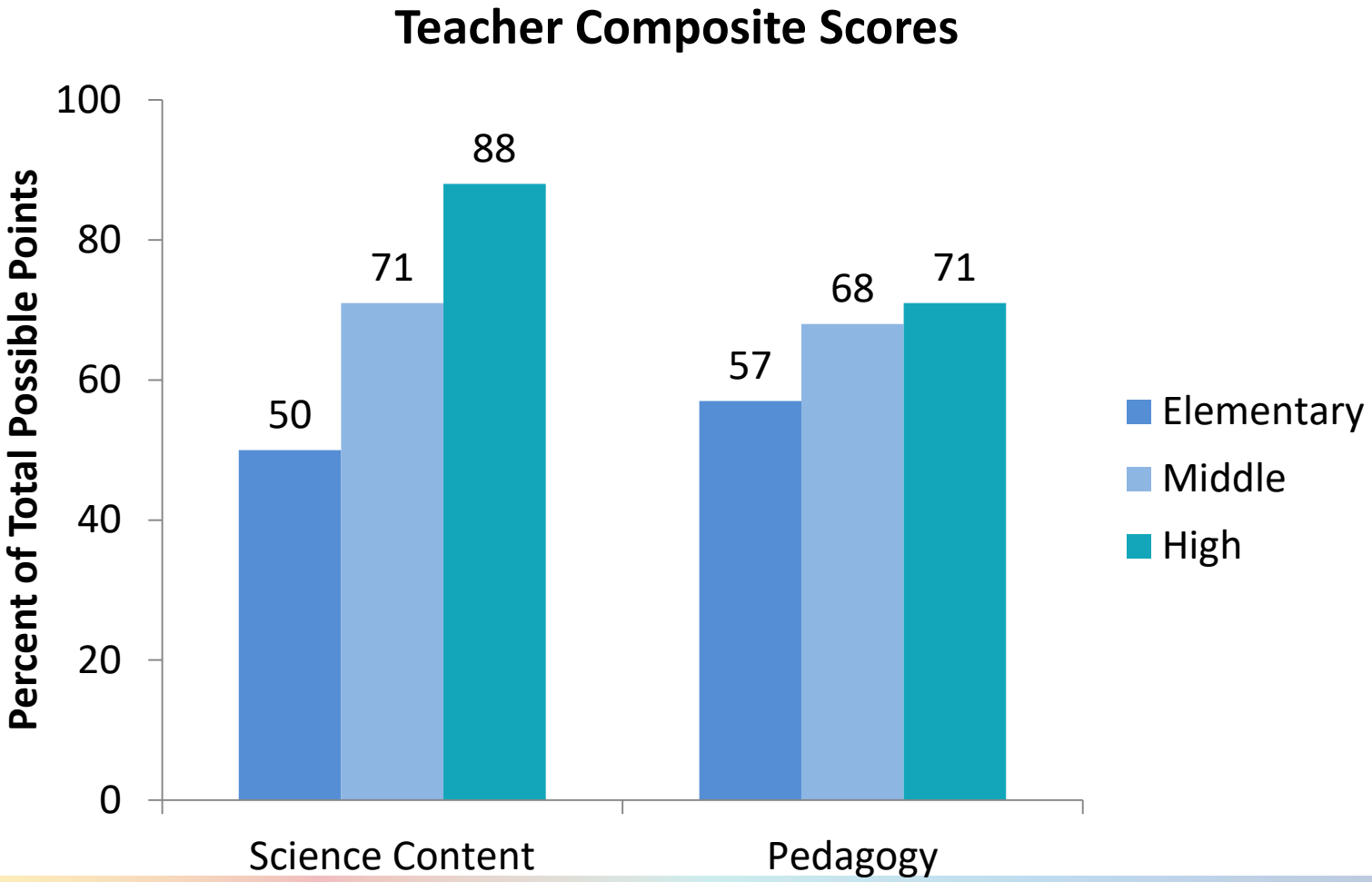
The 2018 NSSME+ included items about teachers' feelings of preparedness to:

- Teach the science content of their class
- Use student-centered pedagogies, e.g.:
  - Use formative assessment
  - Develop student abilities to do science
  - Encourage student interest in science
  - Differentiate instruction
  - Incorporate students' cultural backgrounds into instruction

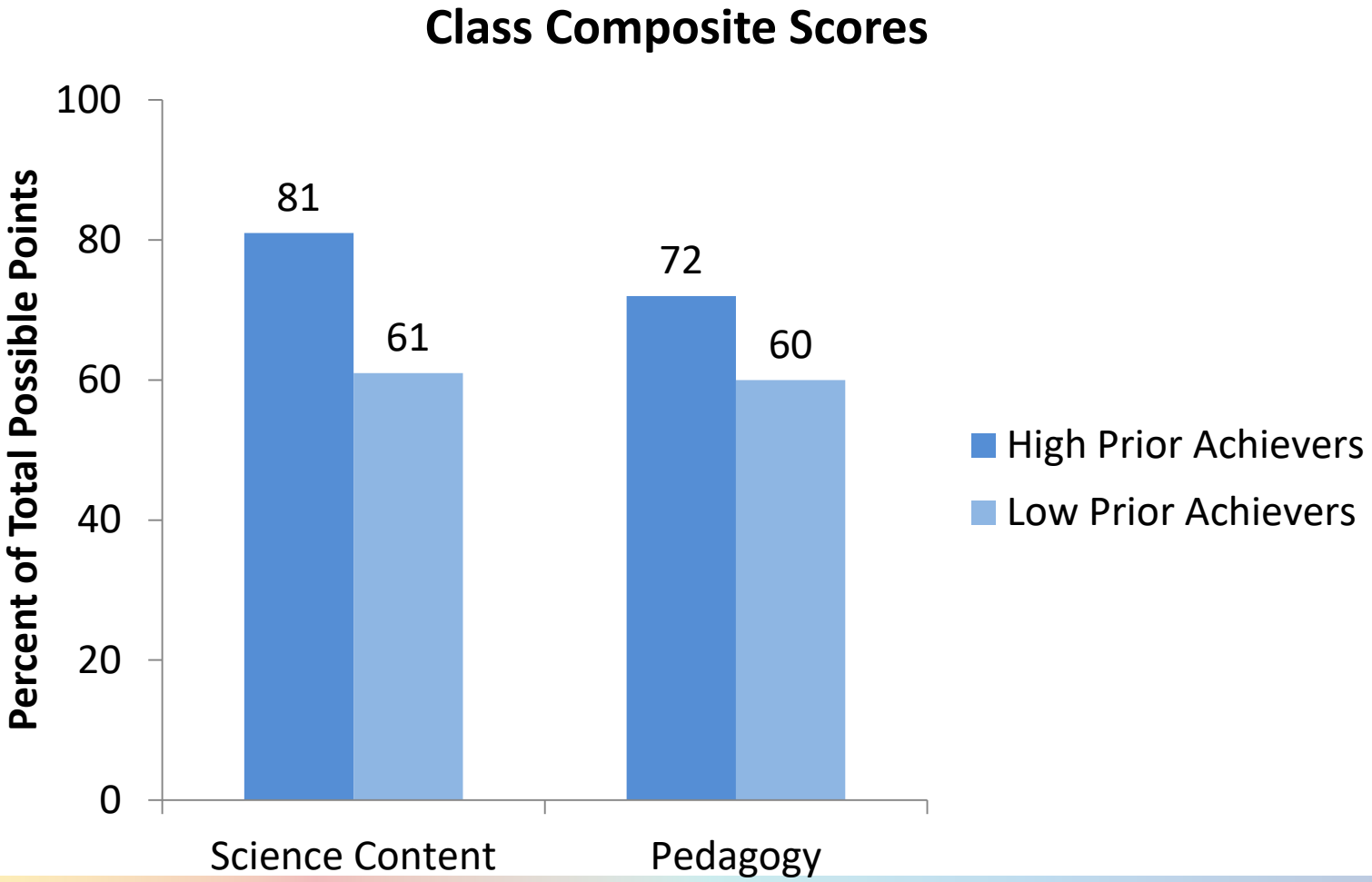
Elementary Teachers' Considering Themselves Very Well Prepared to Teach Each Subject



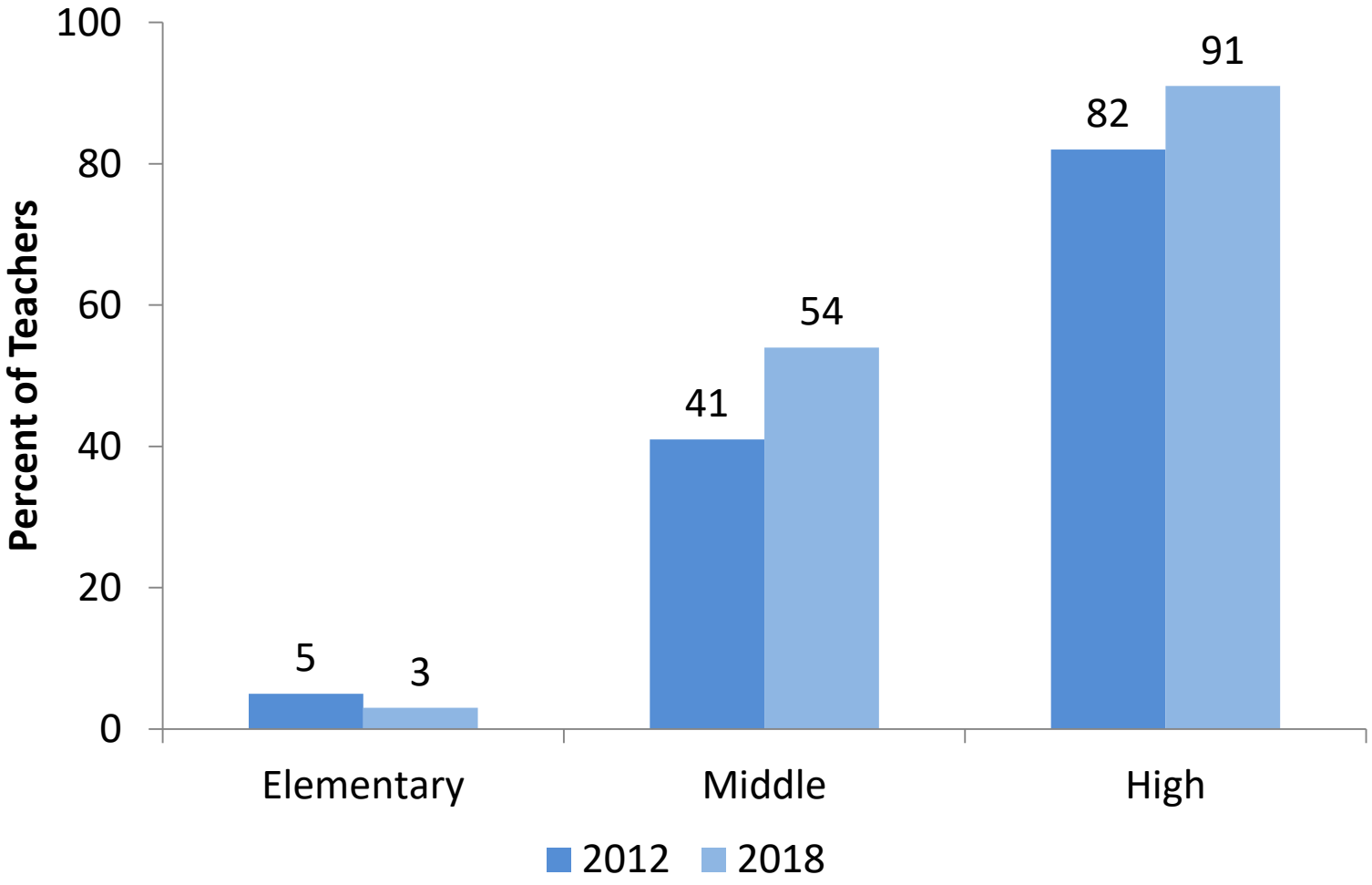
Perceptions of Preparedness



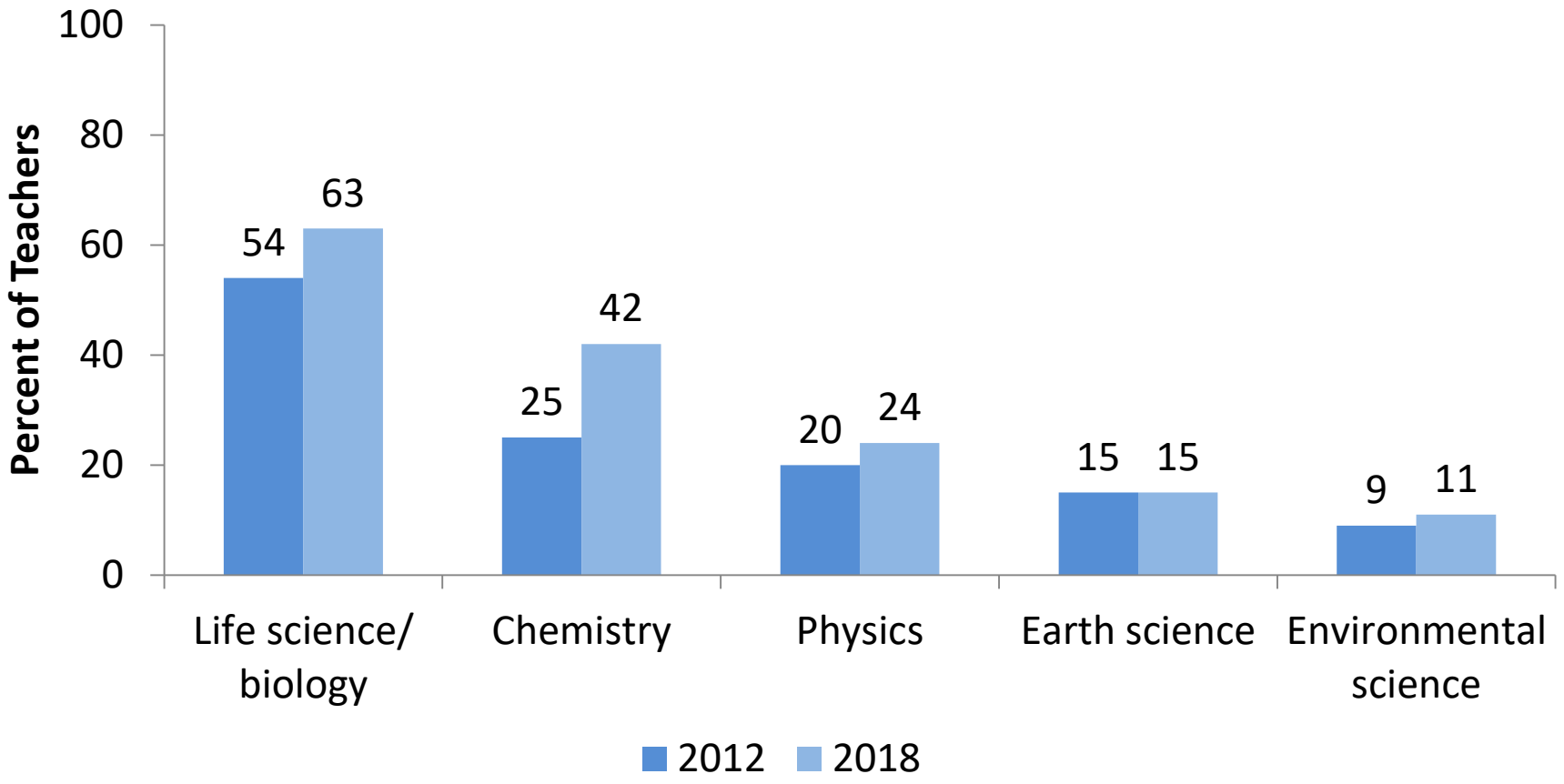
Equity Analyses: Teacher Perceptions of Preparedness



Degree in Science/Engineering/ Science Education



High School Science Teachers With Degree in Subject

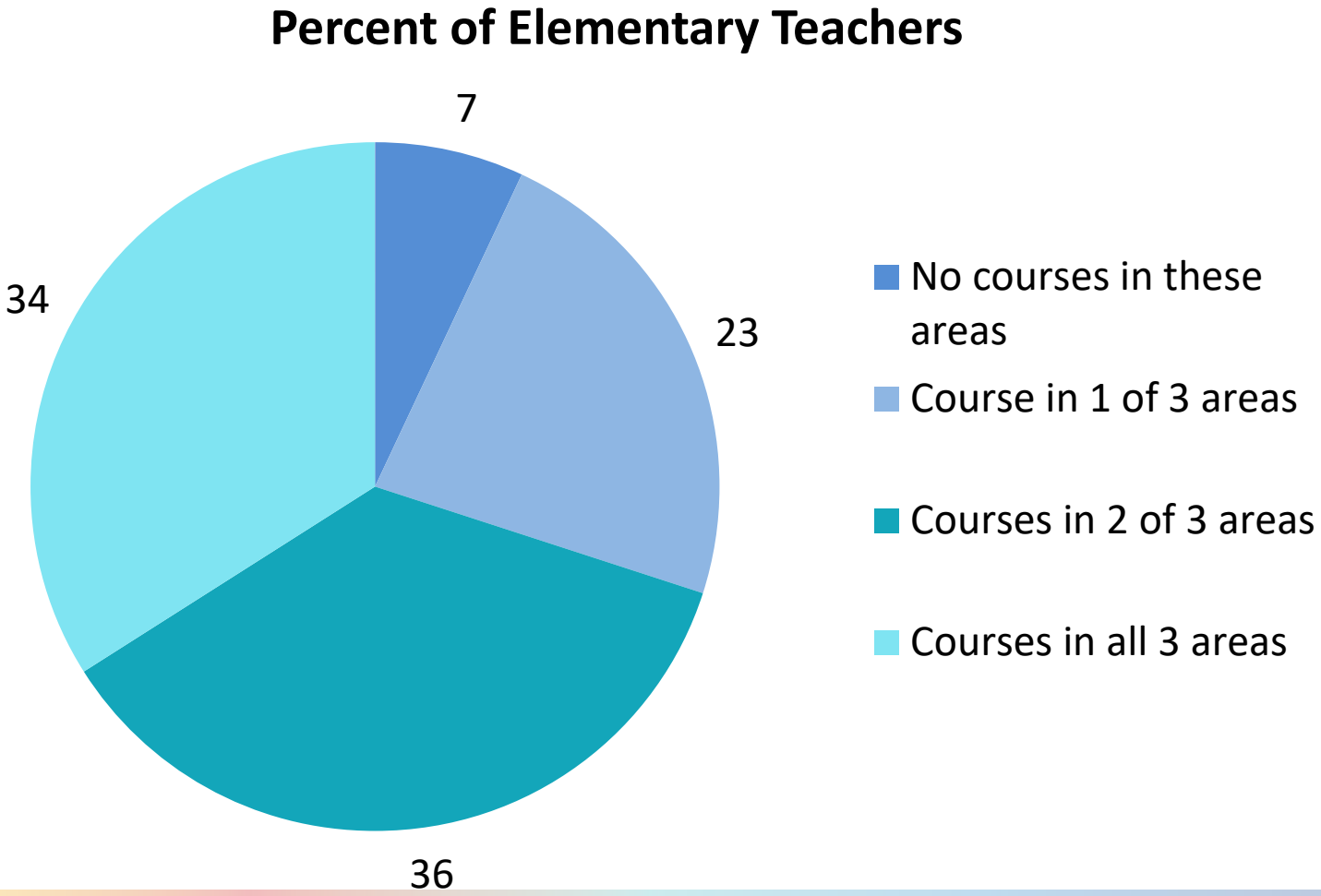


Elementary Teachers' College Coursework

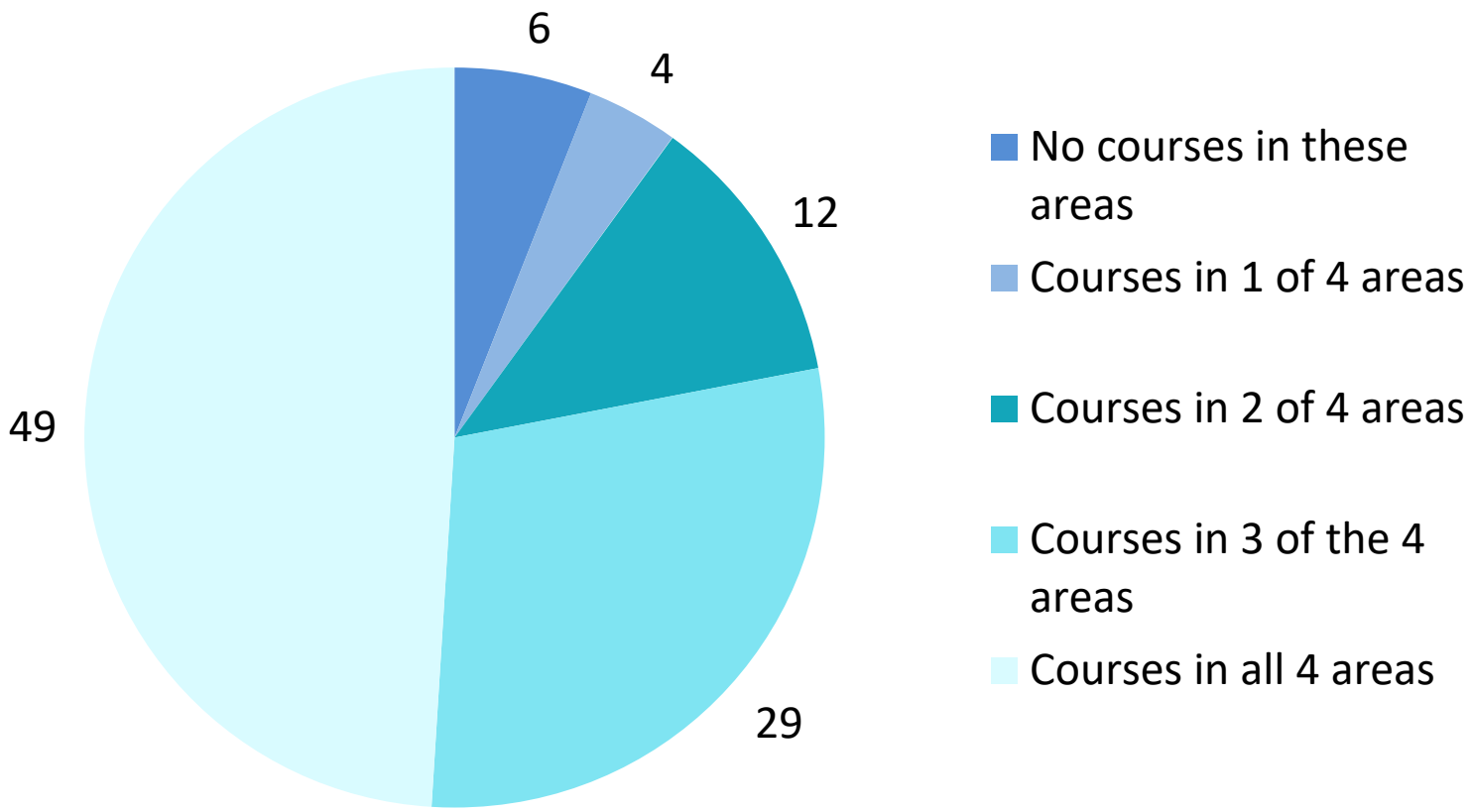
About what percentage of elementary science teachers have had at least one college course each in Earth, life, and physical science?

A. 20%
B. 30%
C. 40%
D. 50%

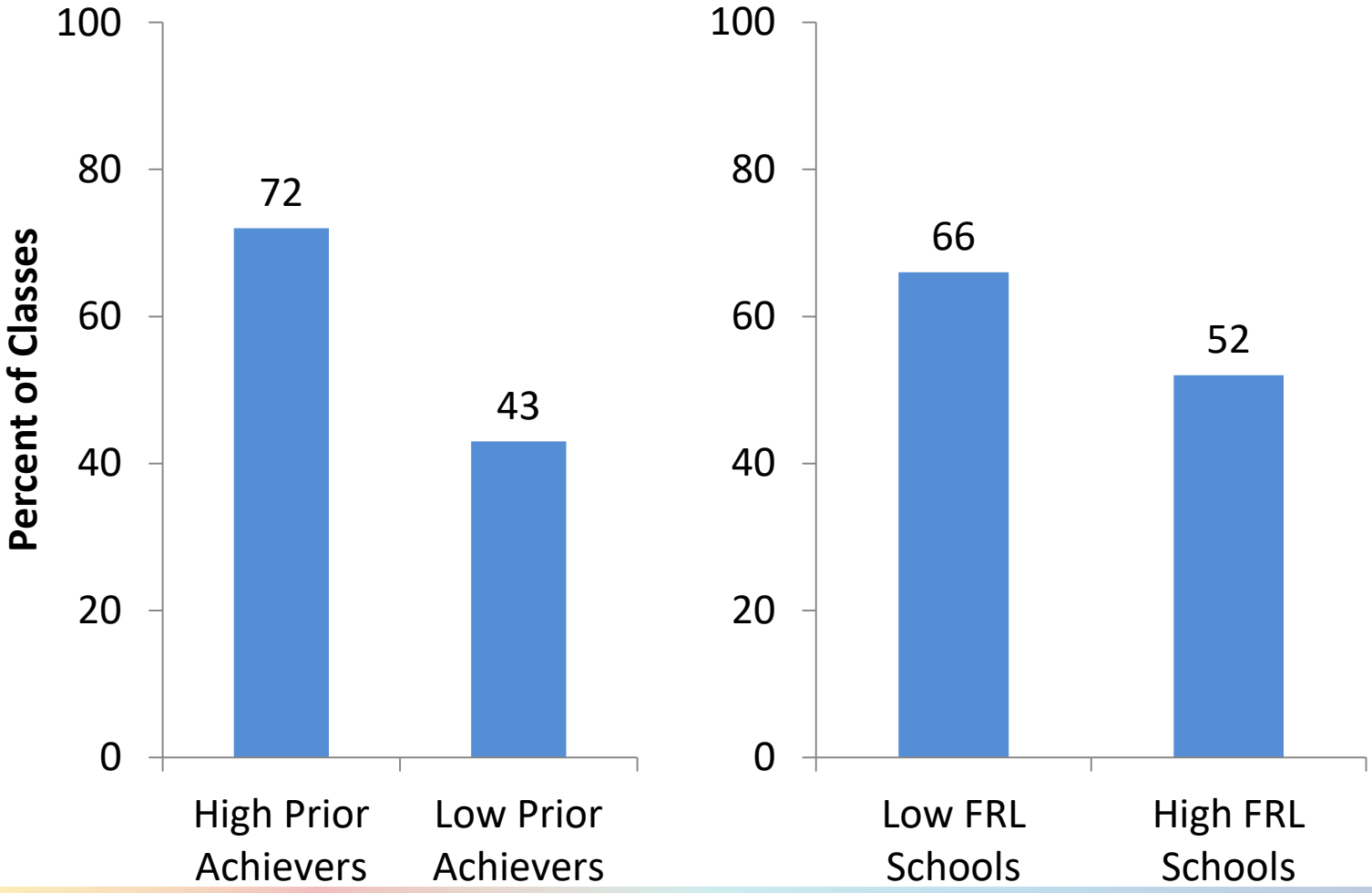
Elementary Teachers' College Coursework: Earth, Life, Physical Sciences



Middle School Teachers' College Coursework: Chemistry, Earth Science, Life Science, Physics



Equity Analyses: Secondary Classes Taught by Teacher With Degree/3+ Advanced Courses



Science Teachers Takeaways

Teachers' beliefs about teaching and learning only partially align with what is known about how students learn science.

Elementary teachers do not feel nearly as well prepared to teach science as do secondary teachers, which is not surprising given they have taken relatively few college courses in science.

Low prior-achieving students and those in schools with large proportions of FRL-eligible students are less likely to have a well-prepared teacher.

Inservice Support

The 2018 NSSME+ asked about:

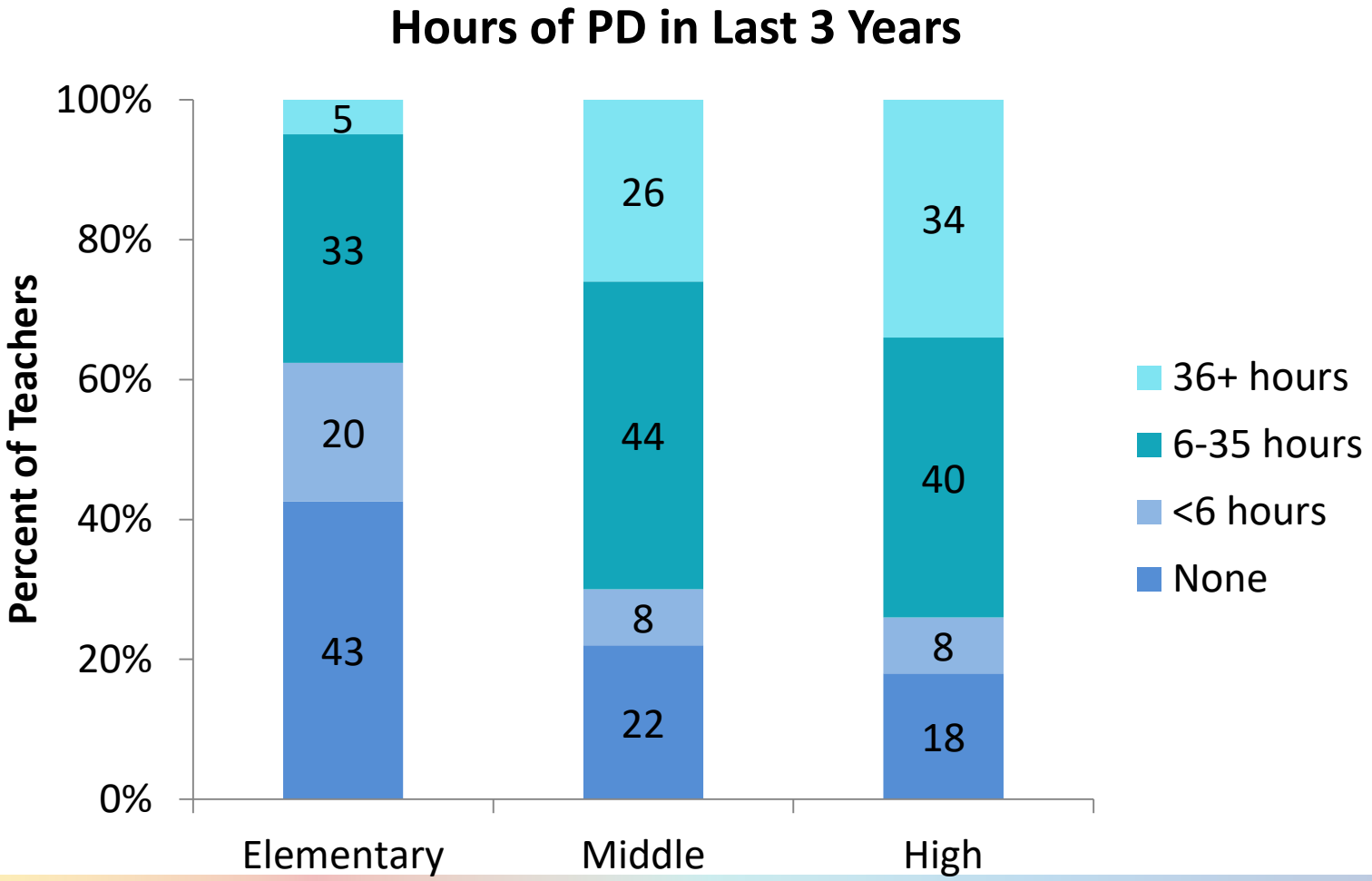
- School/district-offered professional development (workshops, study groups/PLCs, coaching)
- Teacher PD experiences

Professional Development

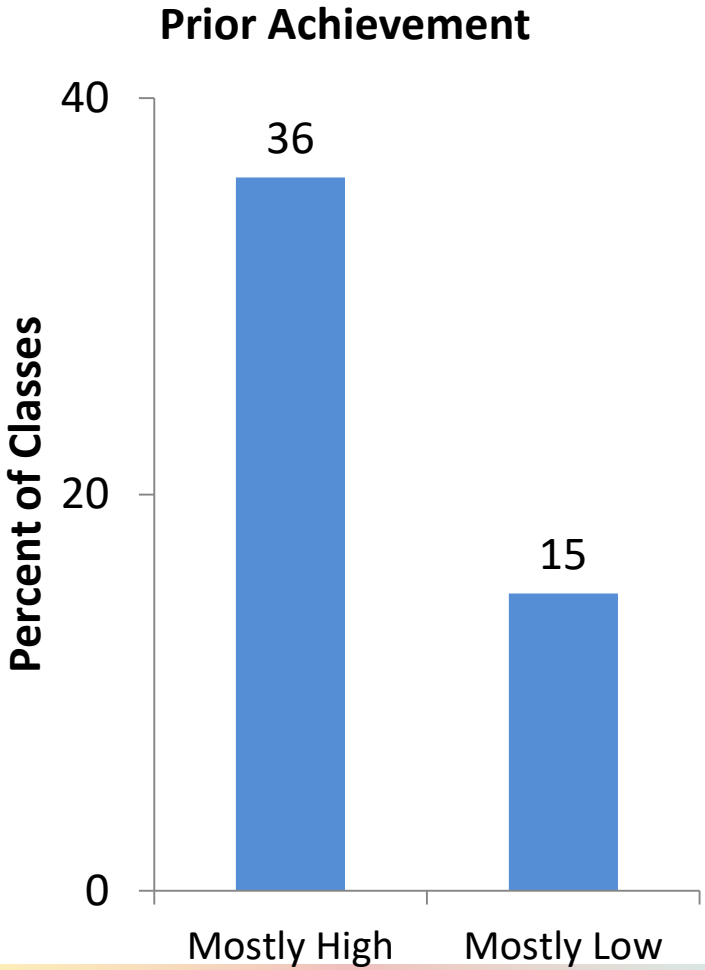
About what percentage of high school science teachers have had more than 35 hours of PD in the last three years?

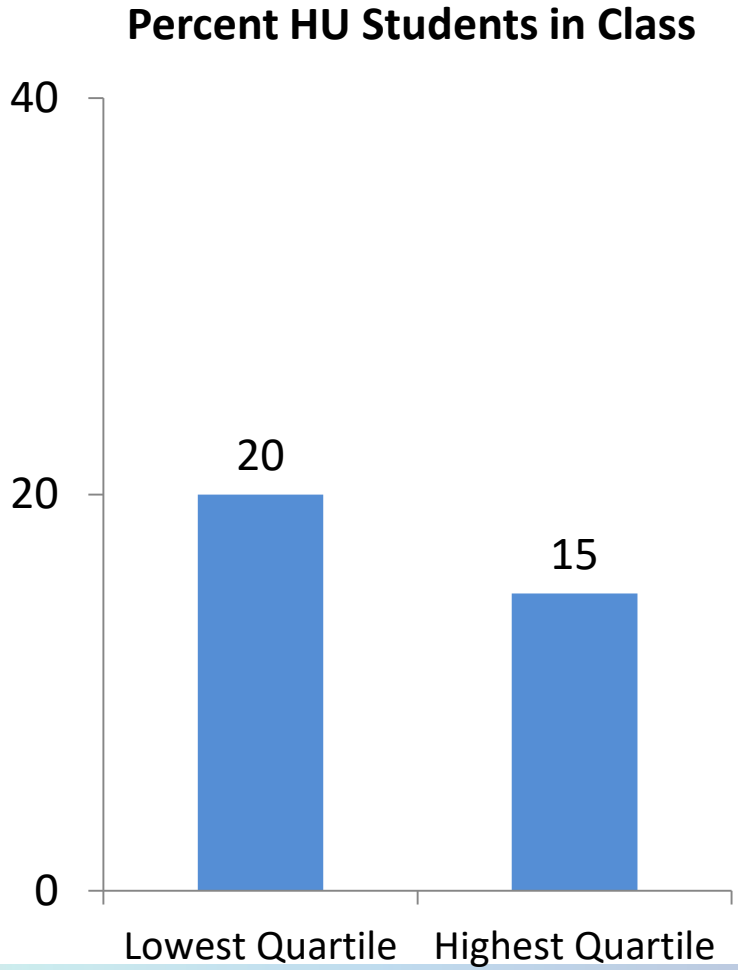
A. 30%
B. 40%
C. 50%
D. 60%

Professional Development

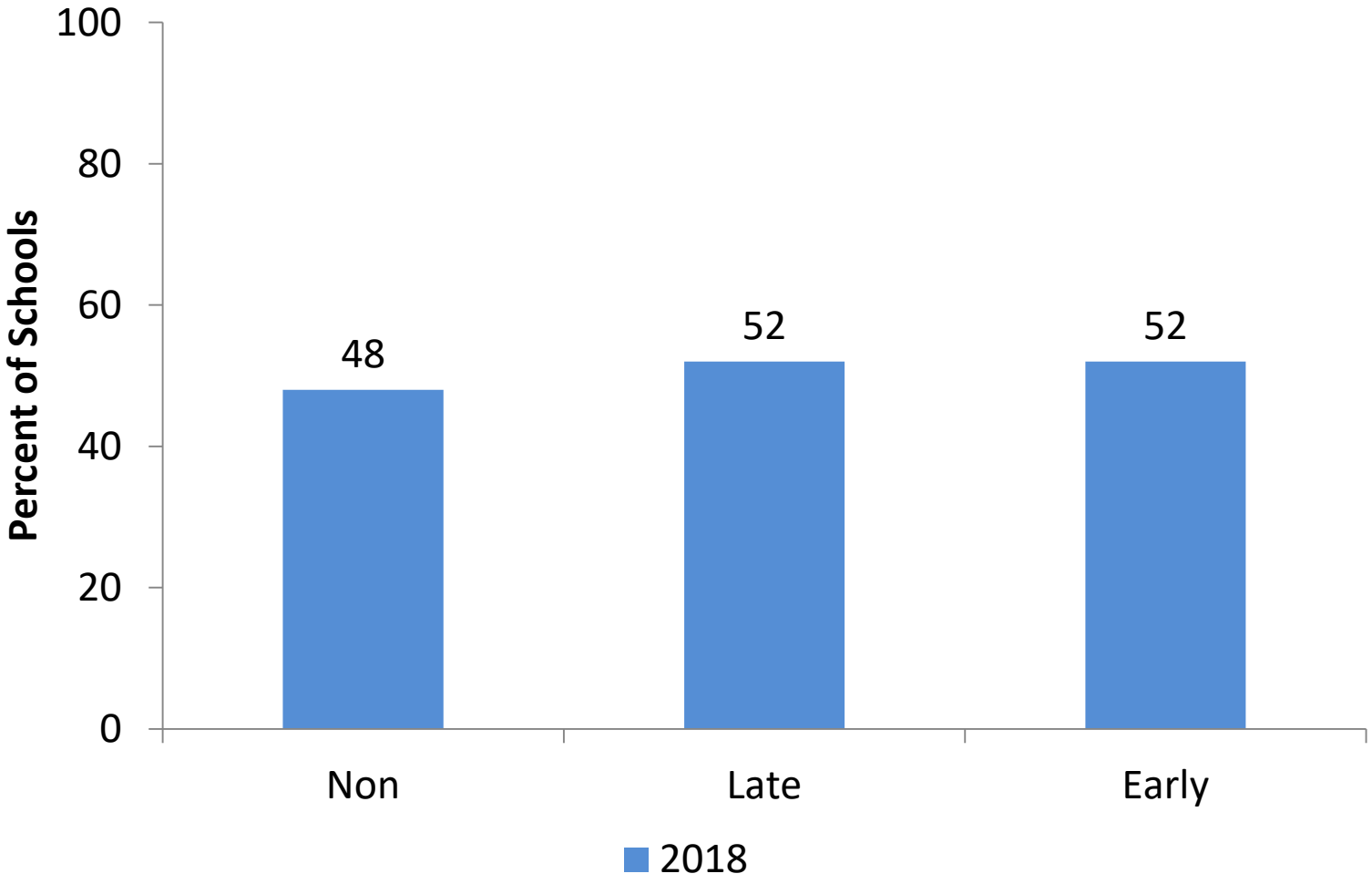


Equity Analyses: Teachers with 36+ Hours of PD in Last 3 Years

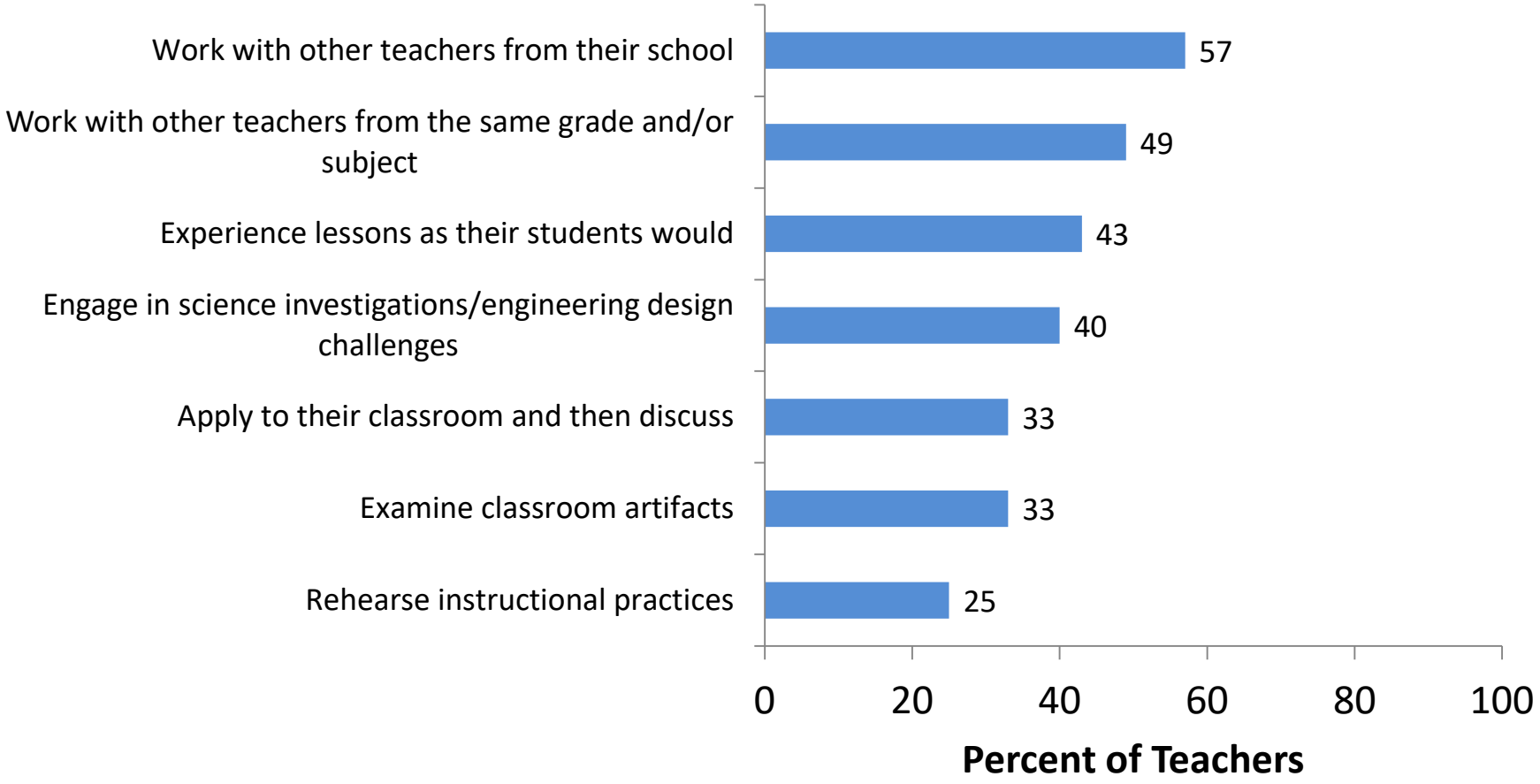




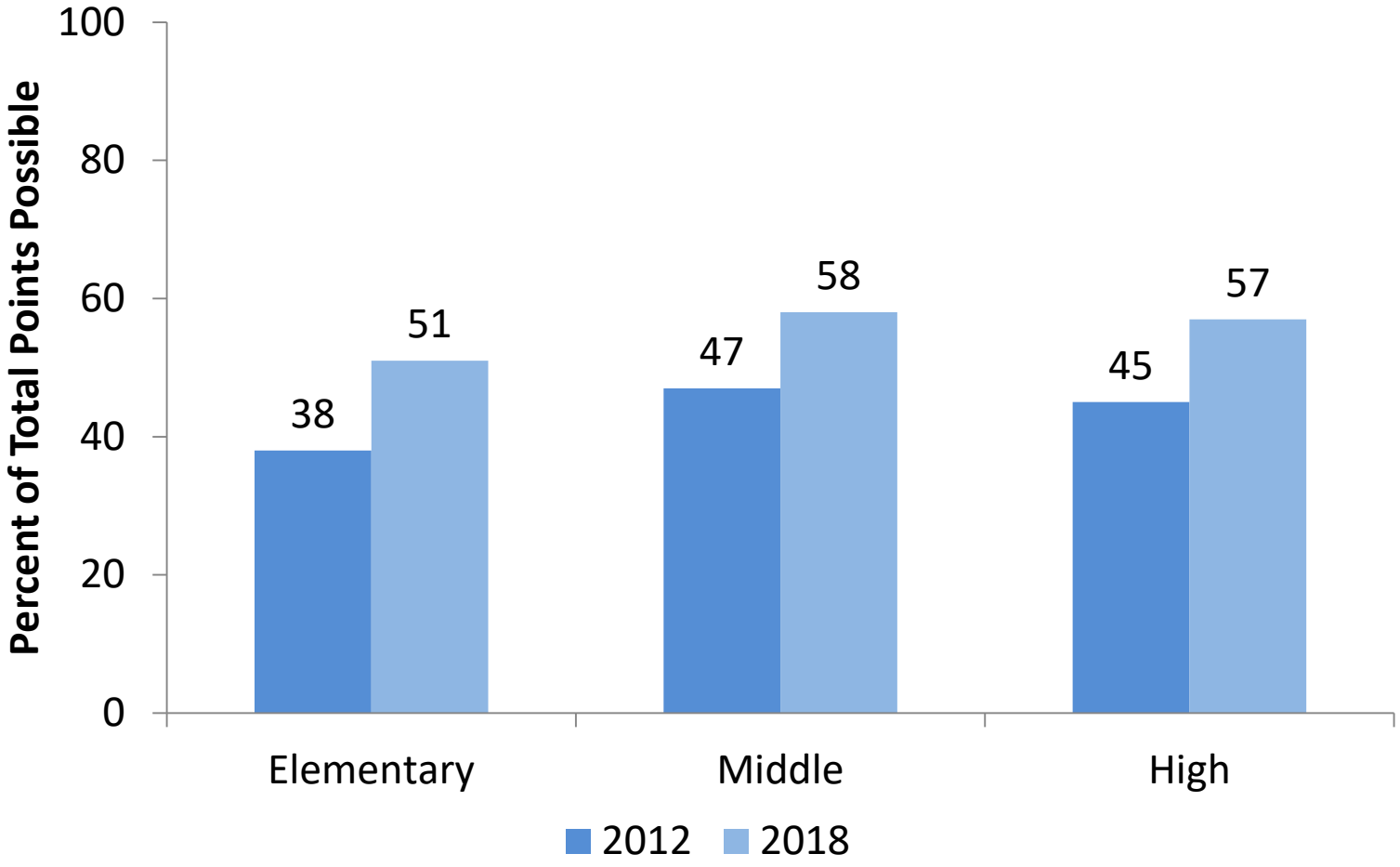
Science Workshops Offered Locally in Last Three Years



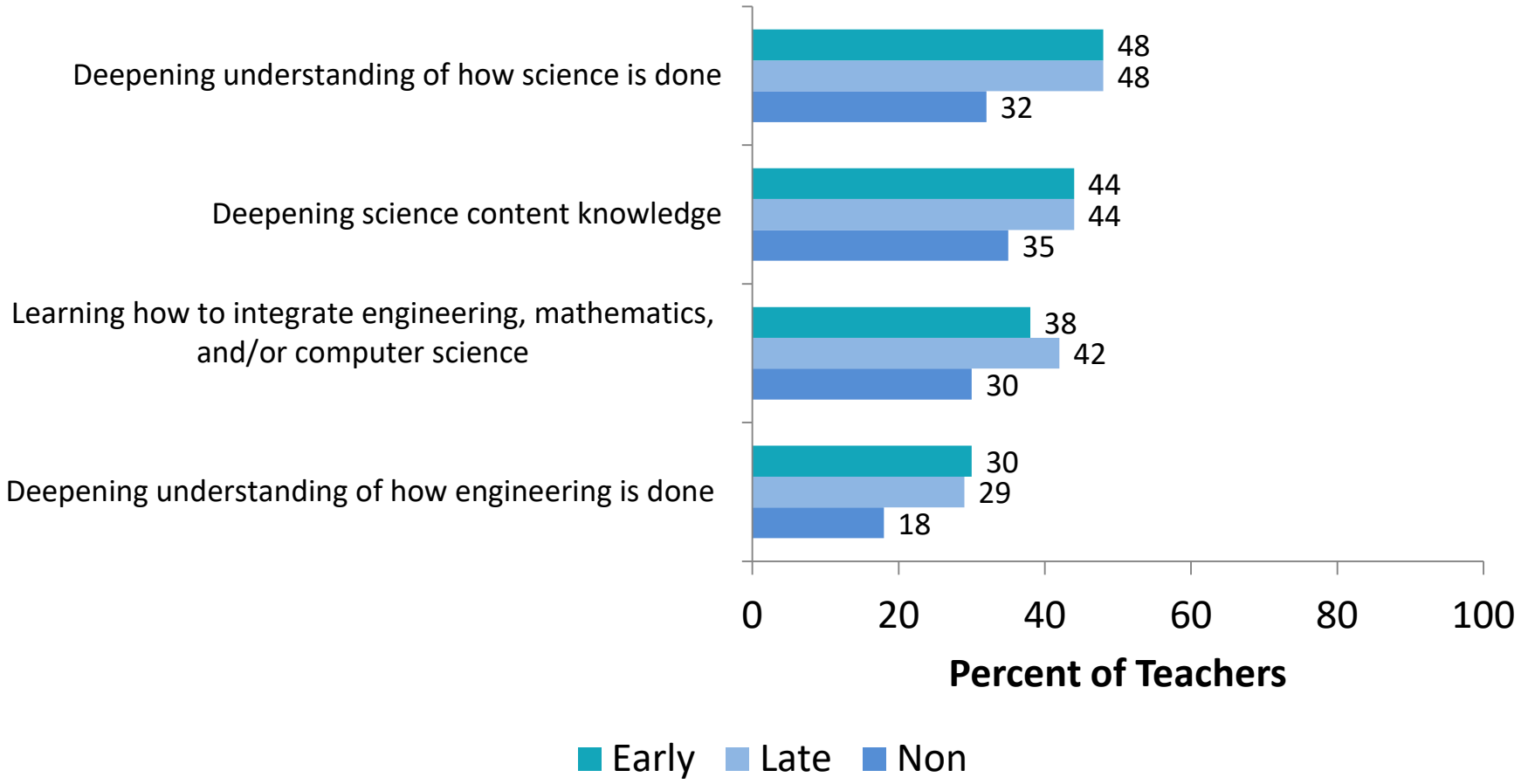
Characteristics of Effective PD in Last Three Years



Alignment With Elements of Effective PD



Heavy Emphasis of PD in Last Three Years



Inservice Support Takeaways

Participation in science-focused PD is quite low, especially among elementary teachers.

PD offerings are not frequent, but they often have characteristics identified as high quality.