

NSSME

THE NATIONAL SURVEY OF
SCIENCE & MATHEMATICS EDUCATION

Obstacles to and Progress Toward the Vision of the NGSS

NARST
APRIL 2, 2019

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Brief History of the NGSS

- **July 2011—NRC publishes Framework for K-12 Science Education**
- **2011-13—Achieve coordinates development of the Next Generation Science Standards (NGSS), based on the Framework and led by 26 “lead state partners”**
- **April 2013—Achieve releases the NGSS for adoption**
- **State adoption***
 - 2013–14: 15 states and DC (early adopters)
 - 2015–17: 24 states (late adopters)
 - 11 states had not adopted as of August 2018

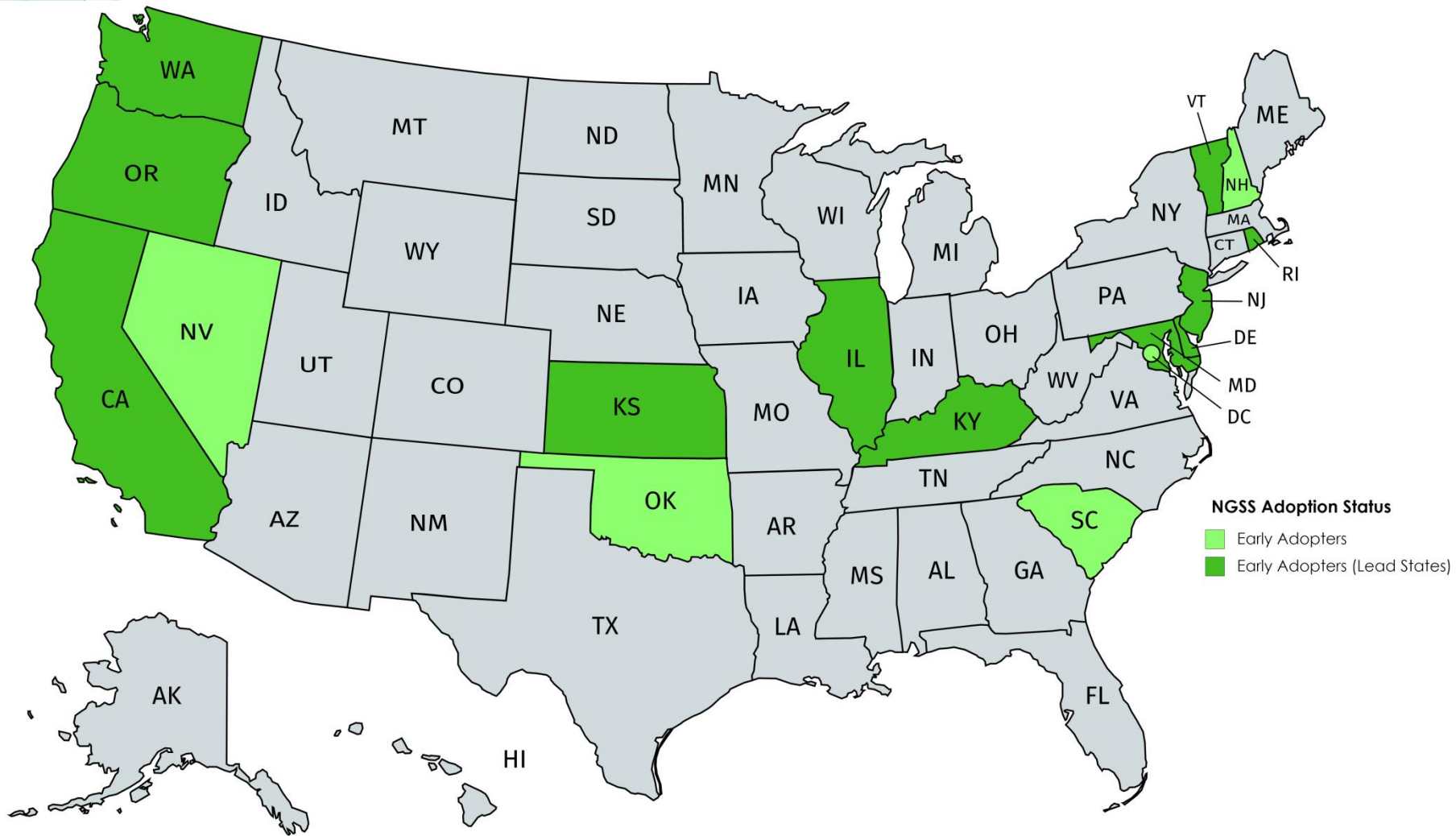


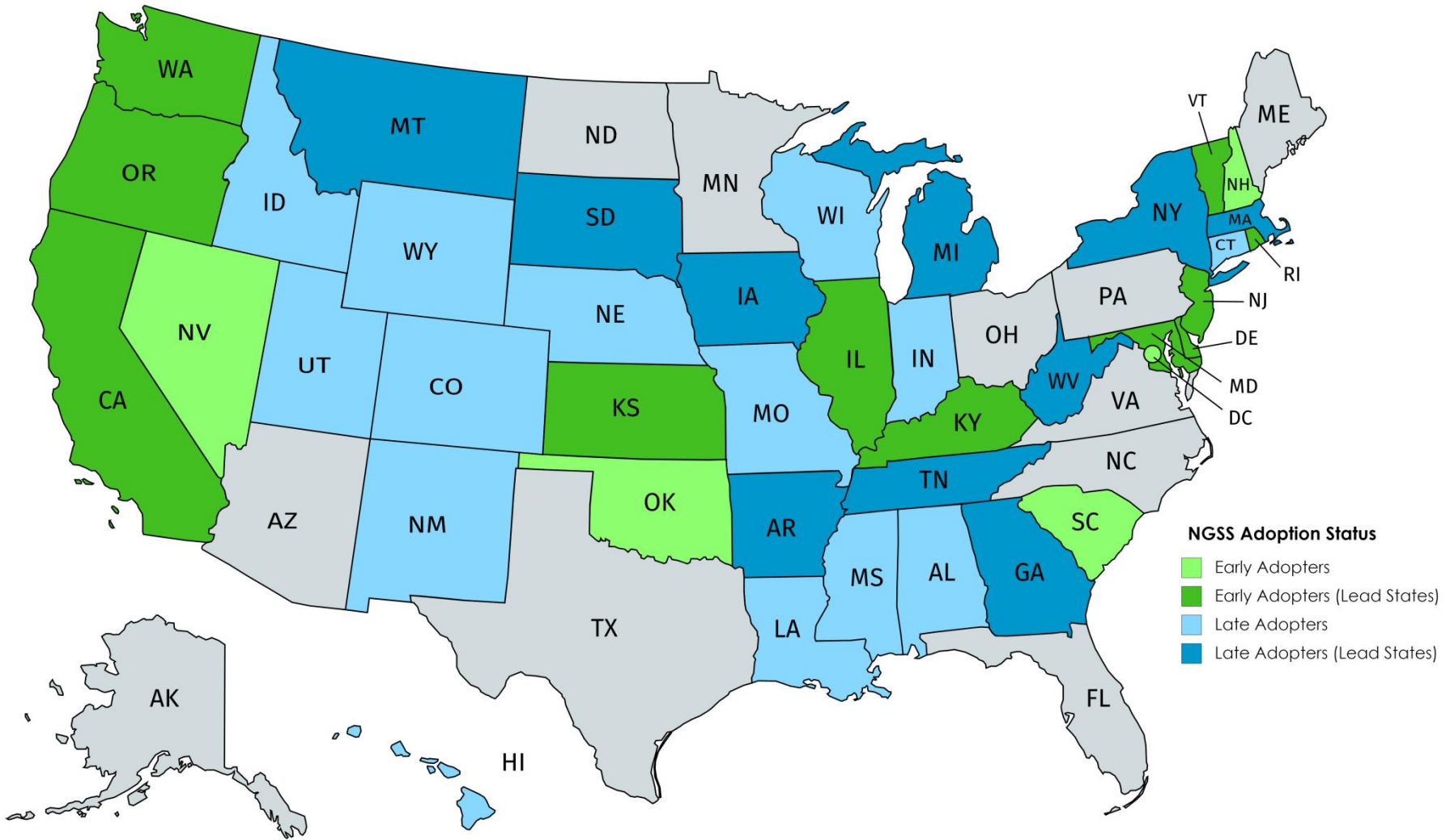
Geography of Adoption

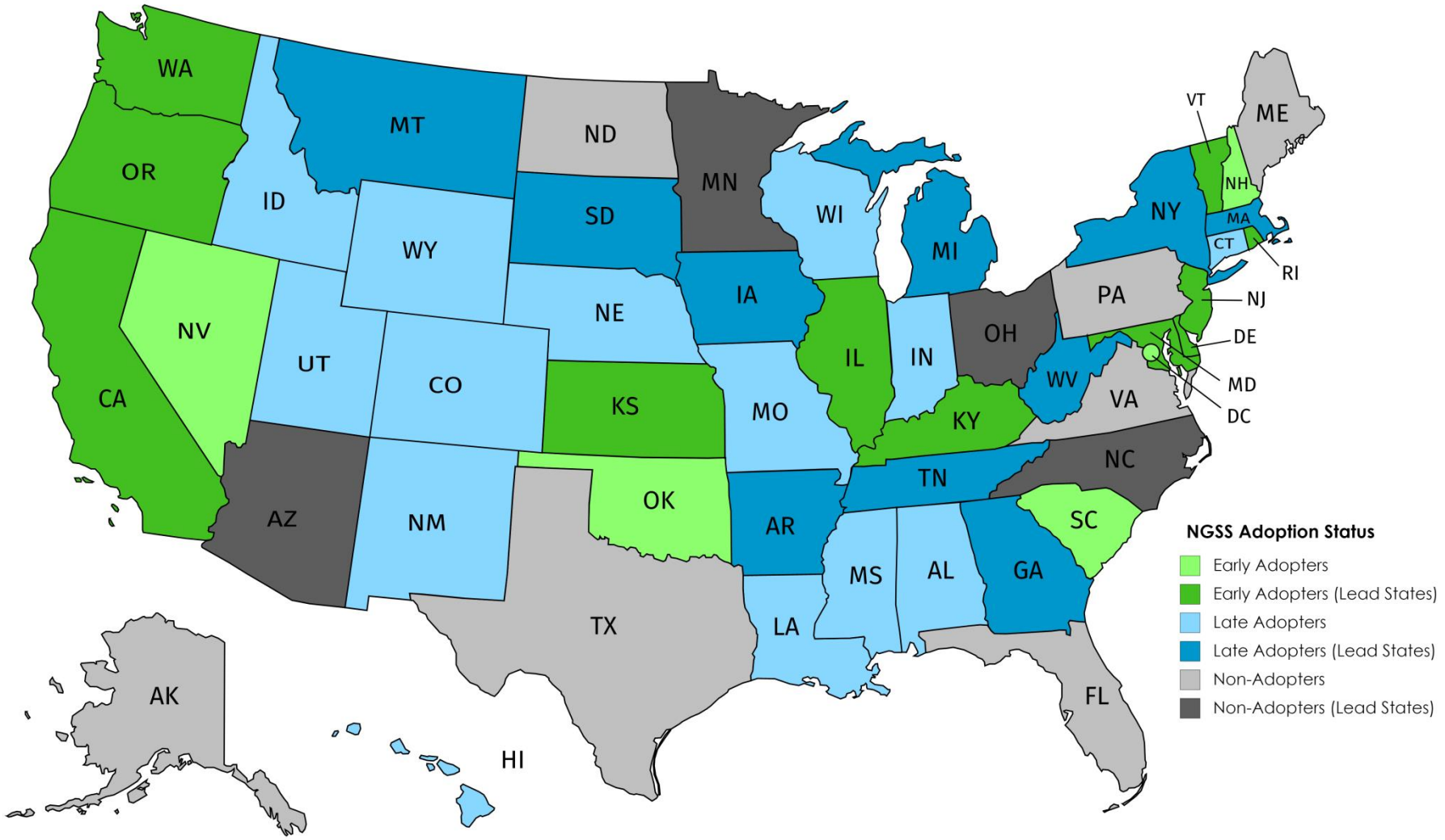
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- NGSS Adoption Status**
- Early Adopters
 - Early Adopters (Lead States)
 - Late Adopters
 - Late Adopters (Lead States)
 - Non-Adopters
 - Non-Adopters (Lead States)



NGSS and the NSSME





About the 2018 NSSME+

- The 2018 NSSME+ is the sixth in a series of surveys dating back to 1977.
- It is the only survey specific to STEM education that provides nationally representative results.



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.



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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
- How instructional resources are distributed



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.

Why should you care?

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



Looking for Obstacles and Progress

To fully realize the type of instruction envisioned by the NGSS requires alignment of many aspects of the education system:

- Teacher preparation (pre-service and in-service)
- Teacher knowledge, skills, and beliefs
- Classroom Resources
- Other policies

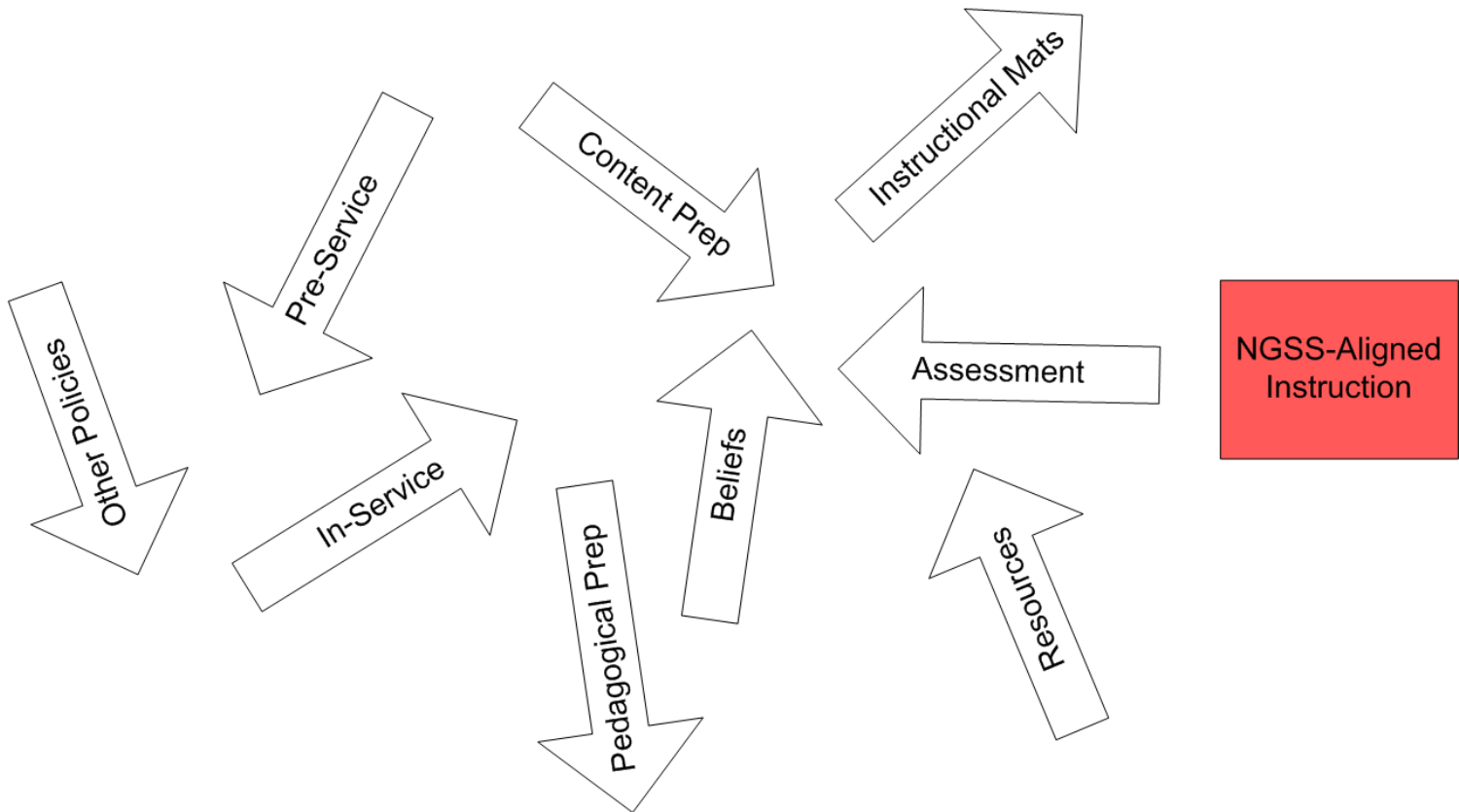


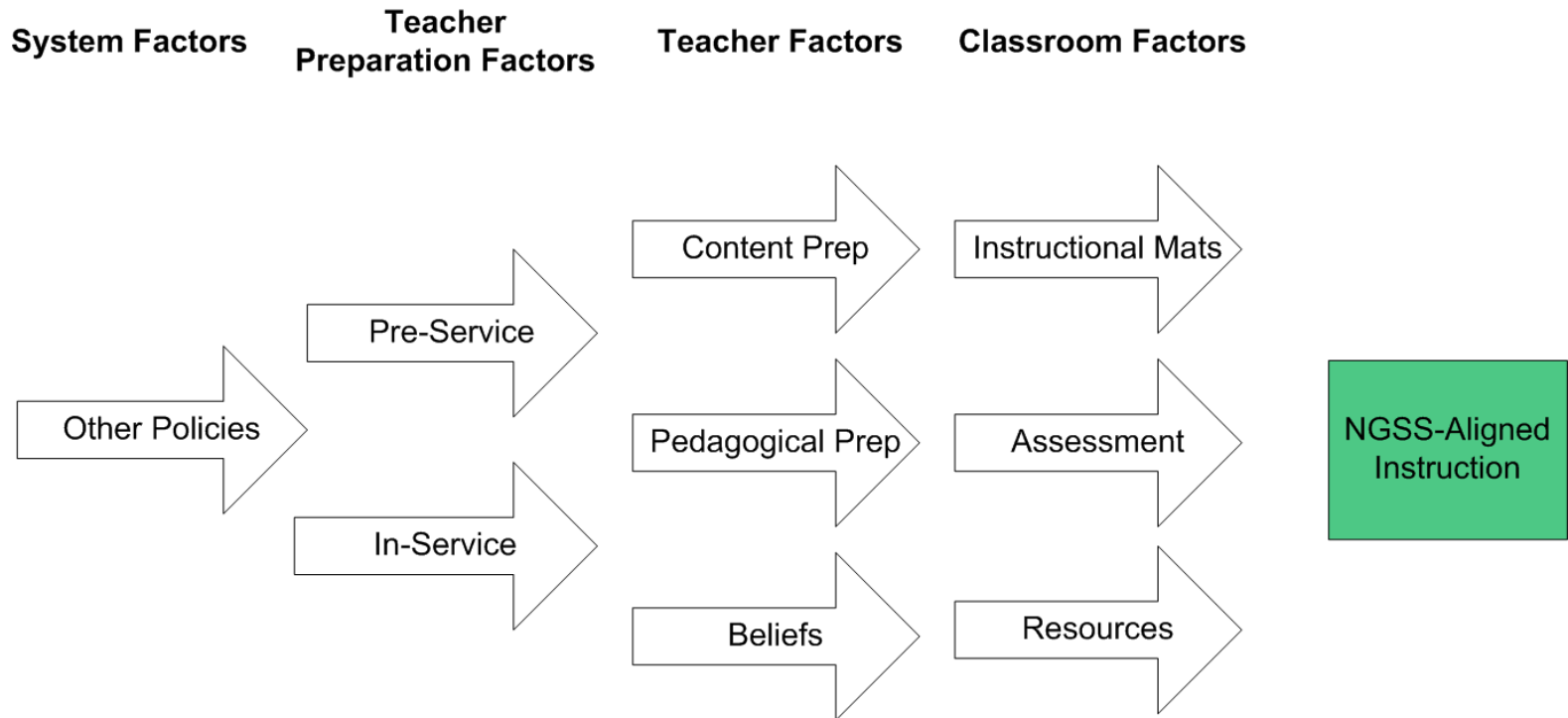
System Factors

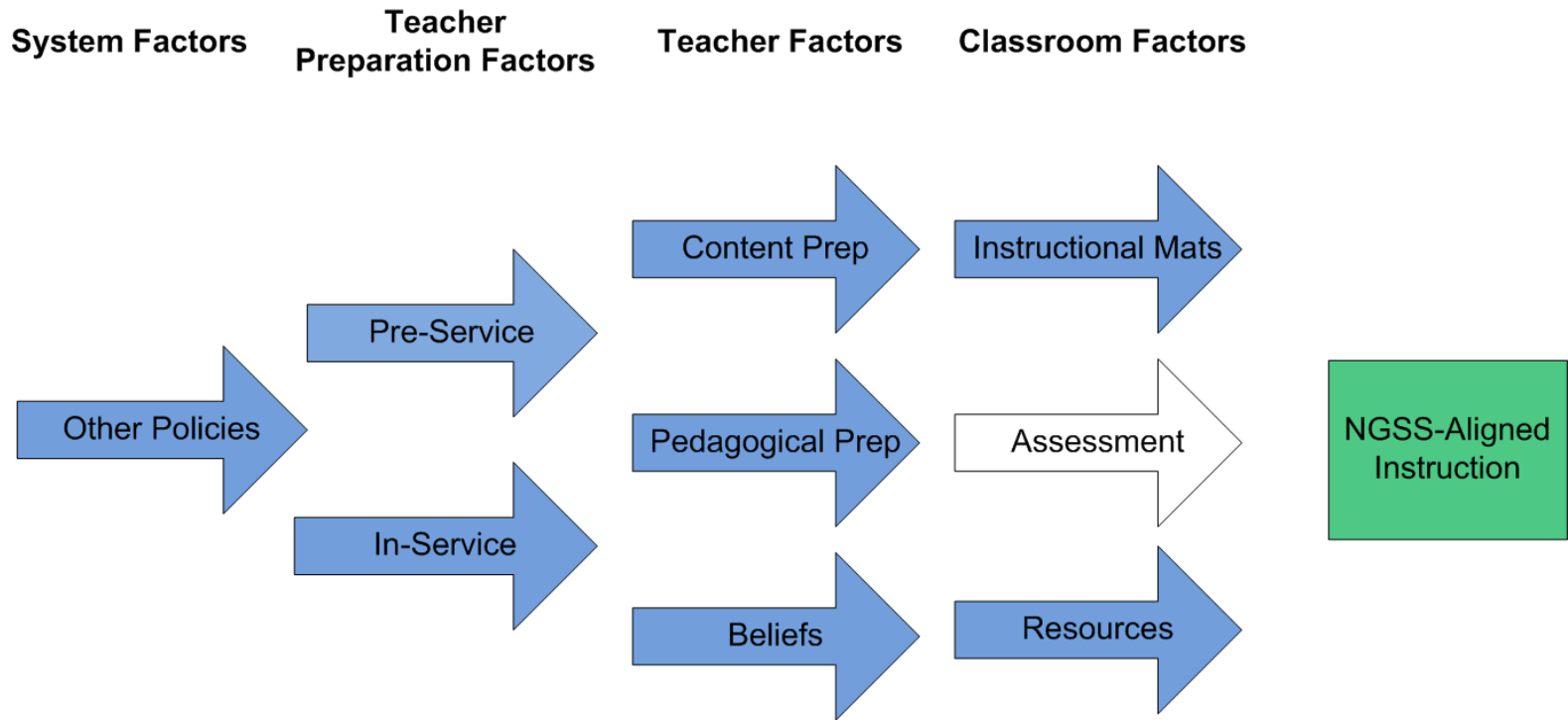
Teacher Preparation Factors

Teacher Factors

Classroom Factors









Session Overview

Share data related to NGSS implementation:

- Nature of science instruction
- Science teachers' background and beliefs
- Professional development experiences
- Resources for science instruction

As appropriate, data are disaggregated by:

- Year (2012 vs. 2018)
- Grade range
- Adoption status (non, late, early)

Time for Q&A after each section

Heidi Schweingruber will offer her perspective on the findings at the end of the session.



Science Instruction*

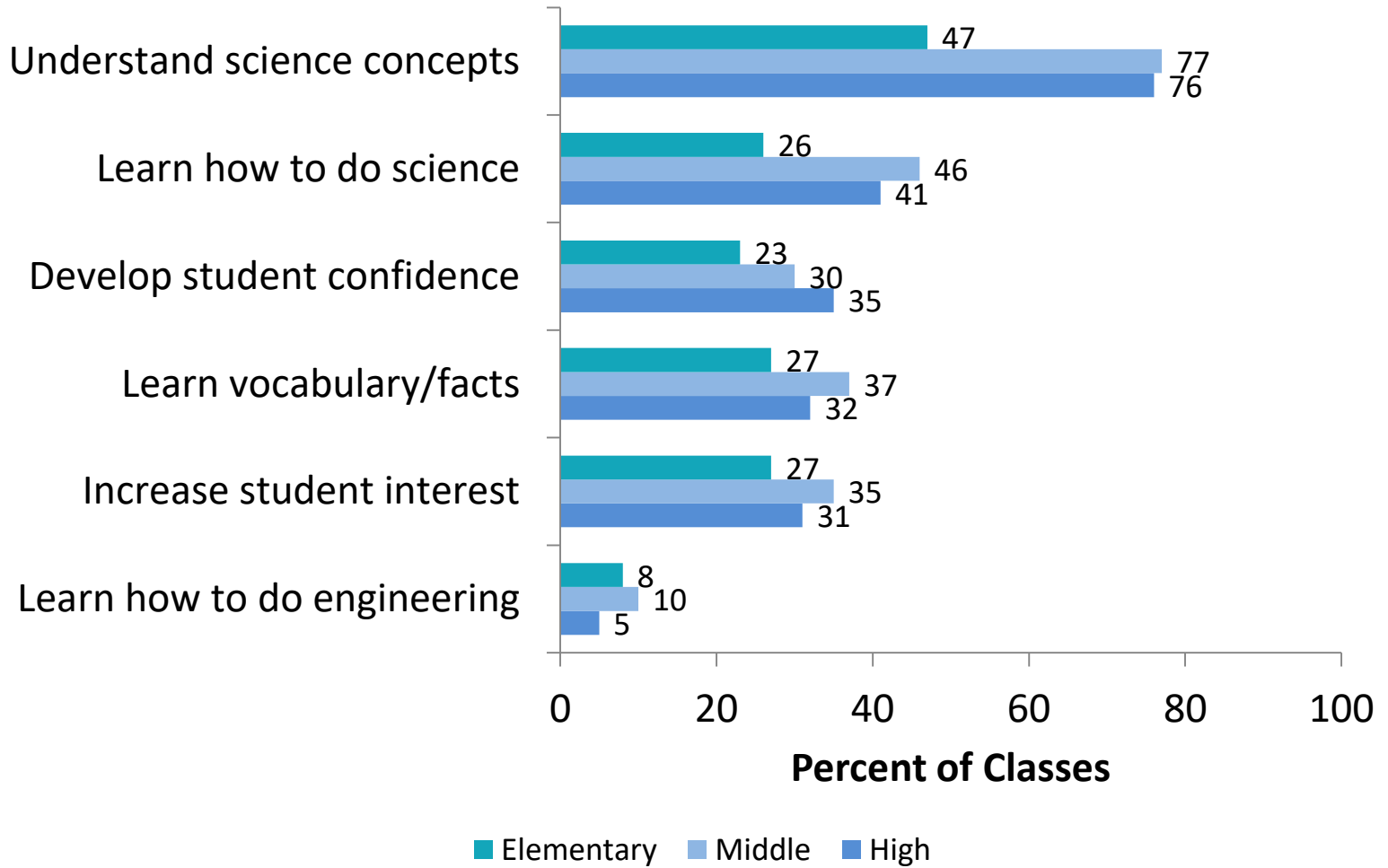
Are students experiencing the kind of science instruction as envisioned in the NGSS?

The 2018 NSSME+ collected data on:

- Instructional objectives
- Classroom practices
- Engagement of students with science practices

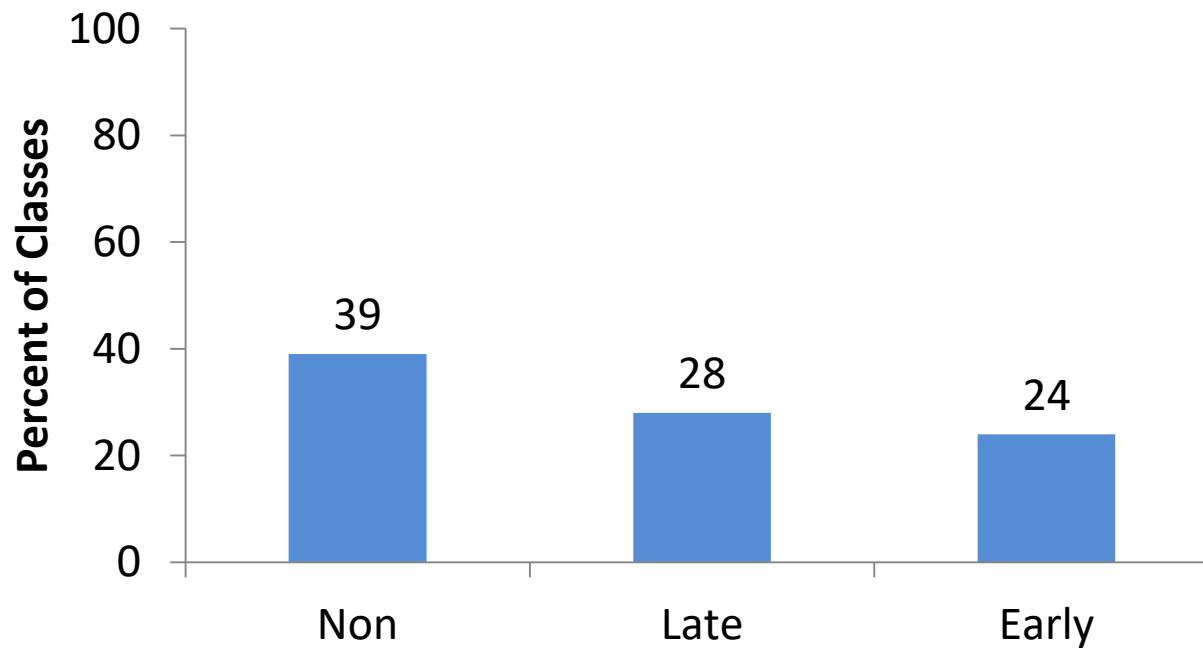


Objectives Receiving a Heavy Emphasis



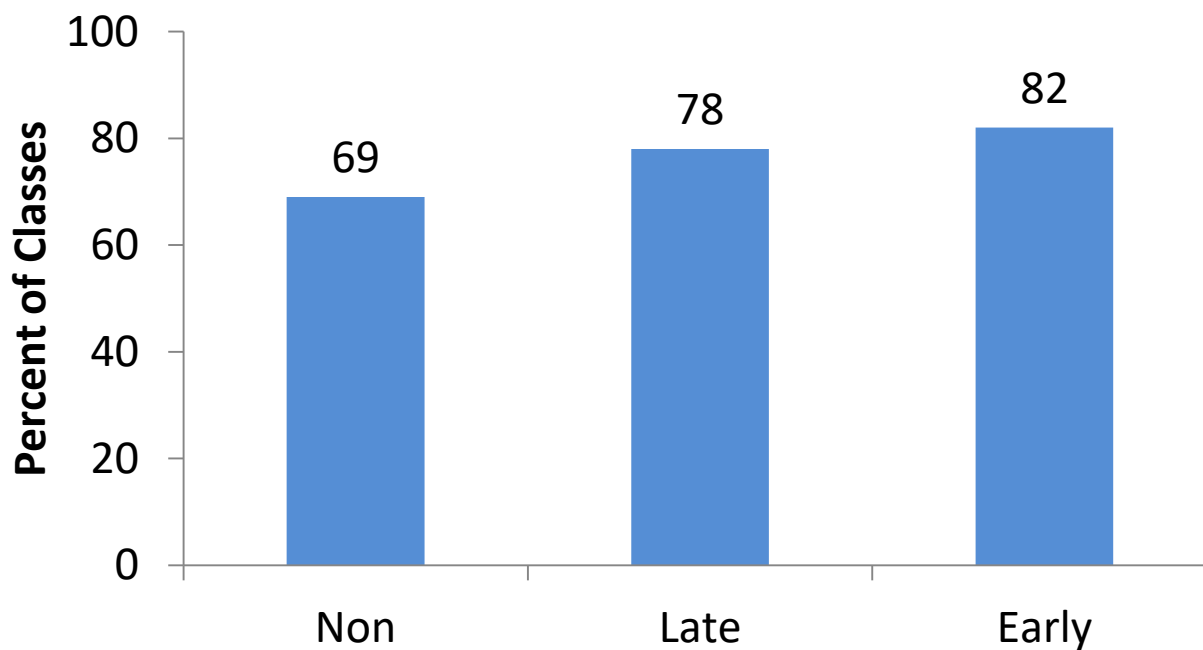


Heavy Emphasis on Learning Science Vocabulary/Facts



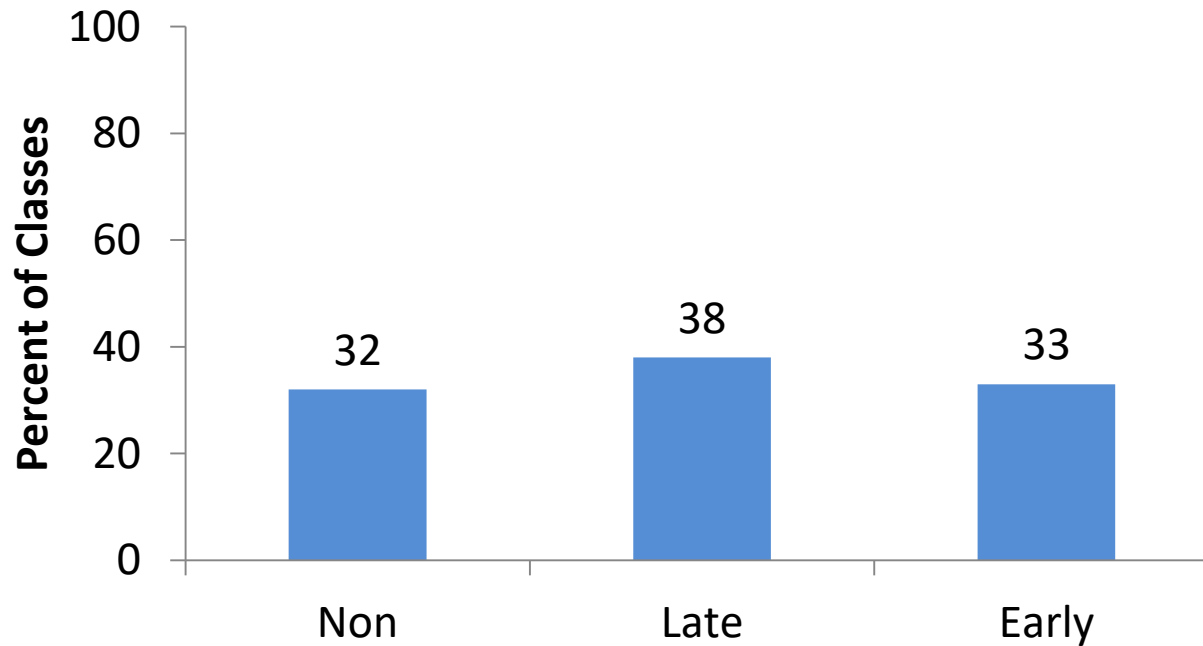


Science Classes With Any Emphasis on Learning How To Do Engineering



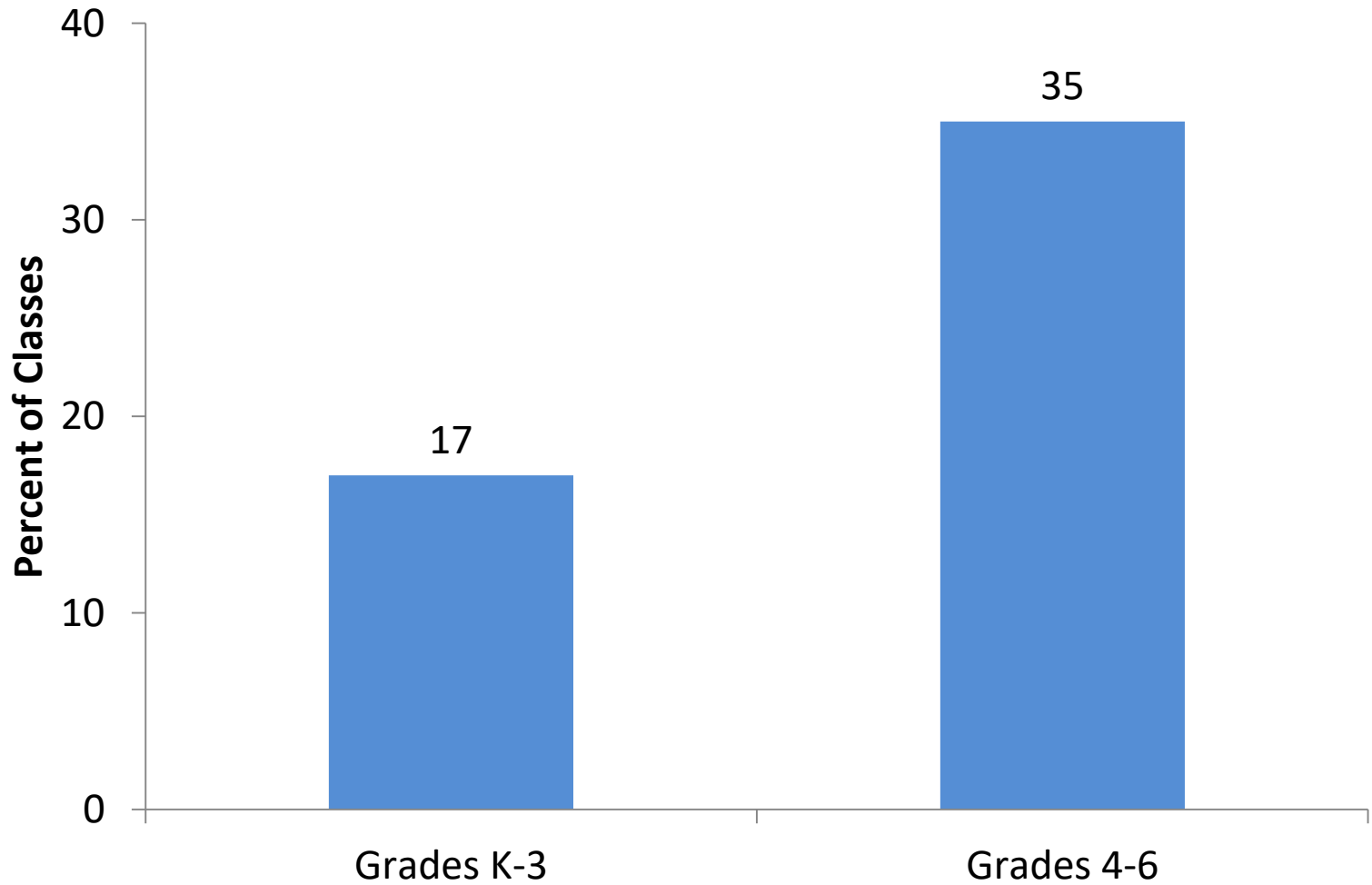


Heavy Emphasis on Learning How To Do Science



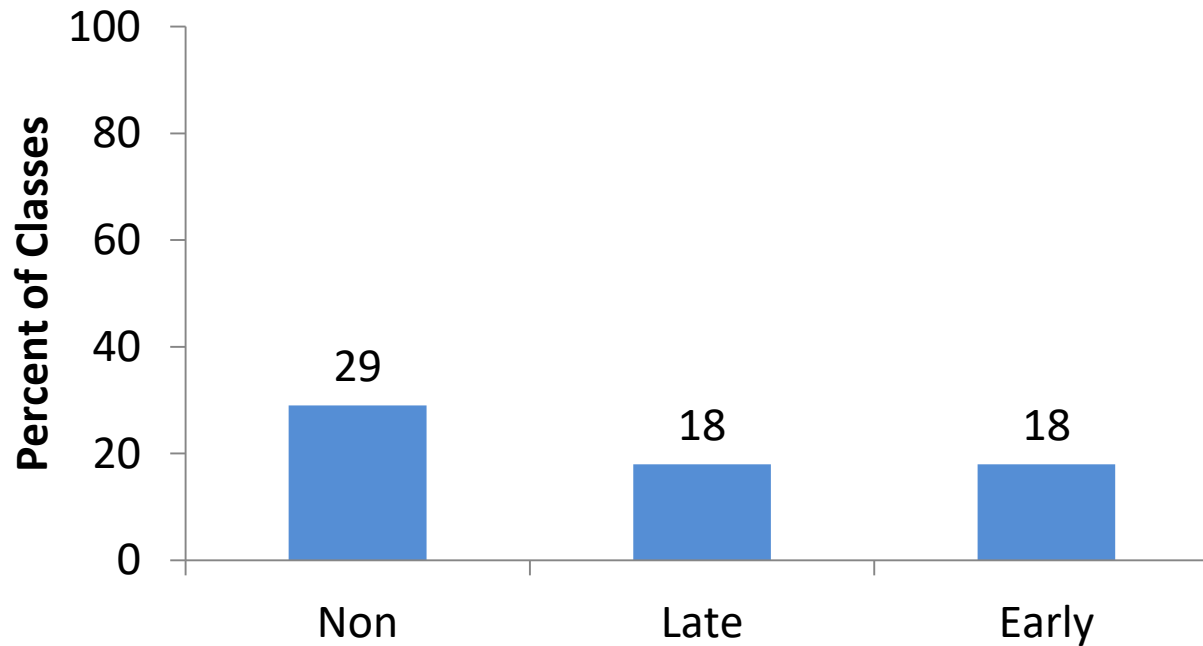


Elementary Classes Receiving Science Instruction All/Most Days



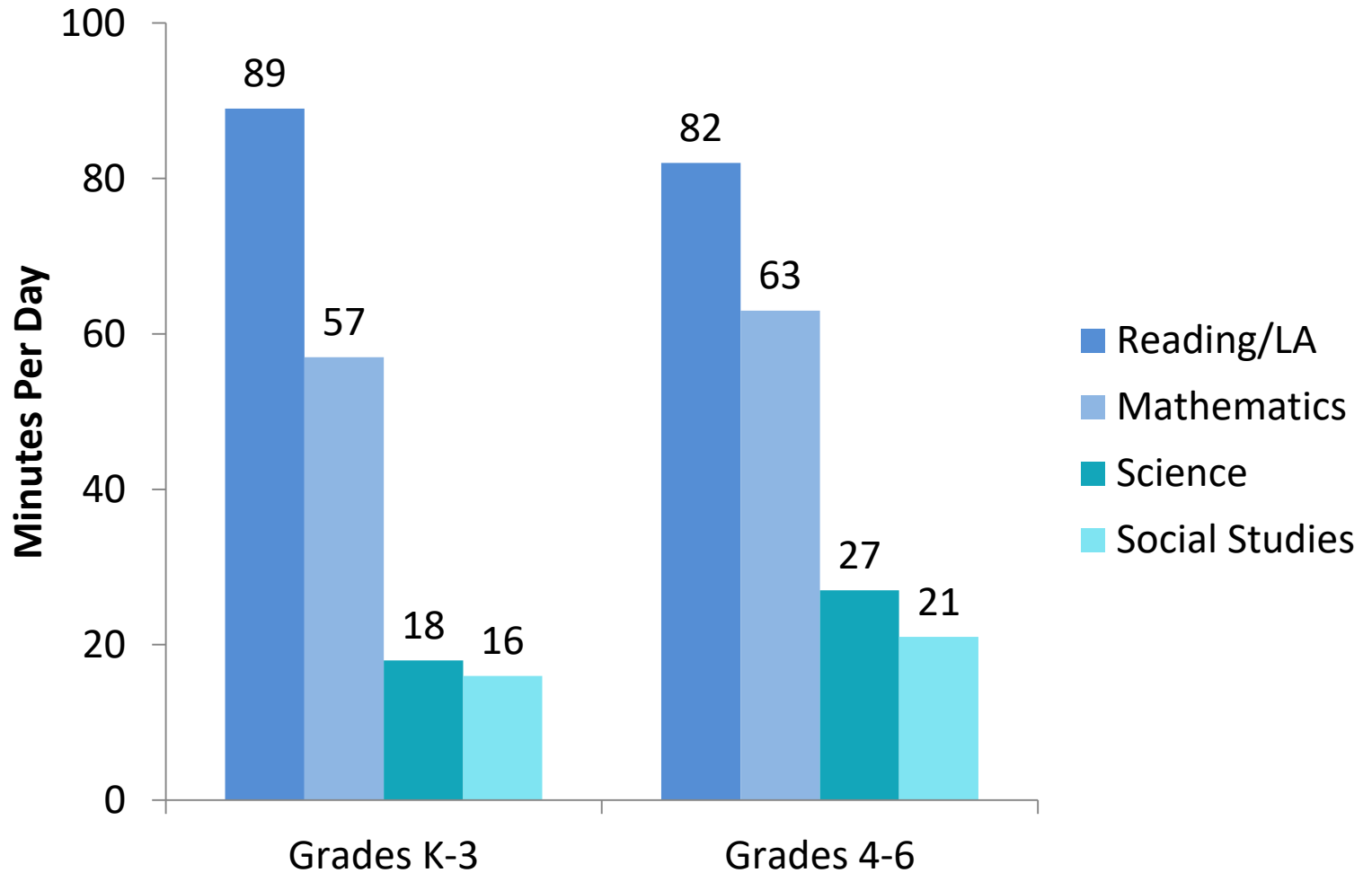


Elementary Classes Receiving Science Instruction All/Most Days



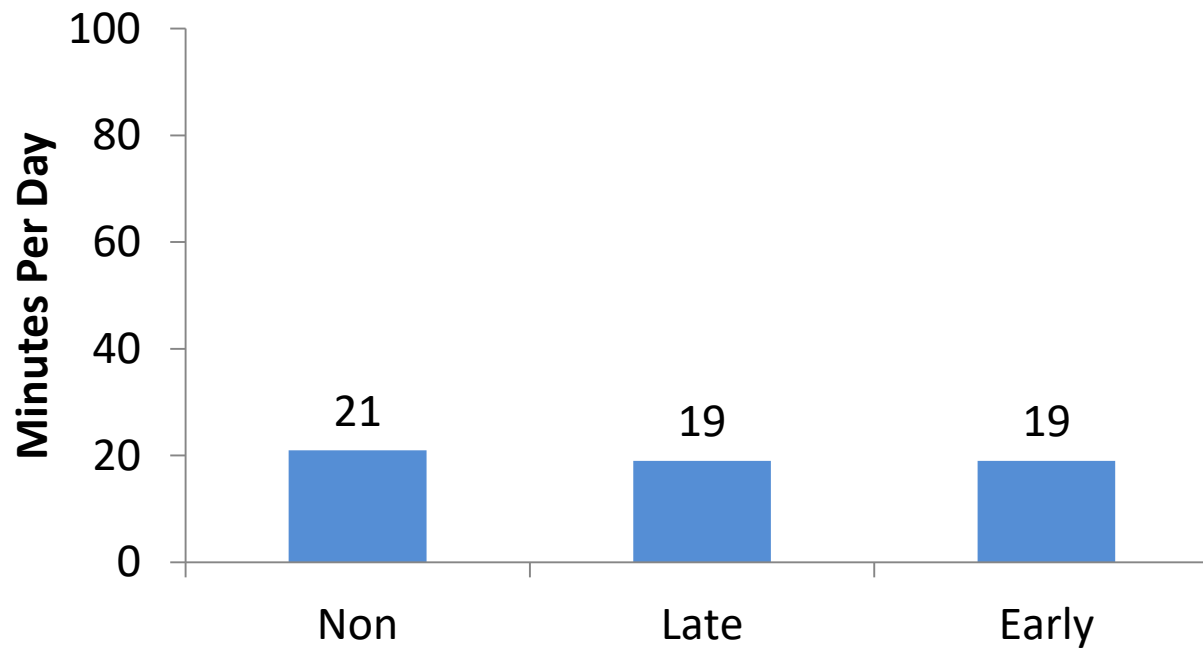


Instructional Time: Elementary



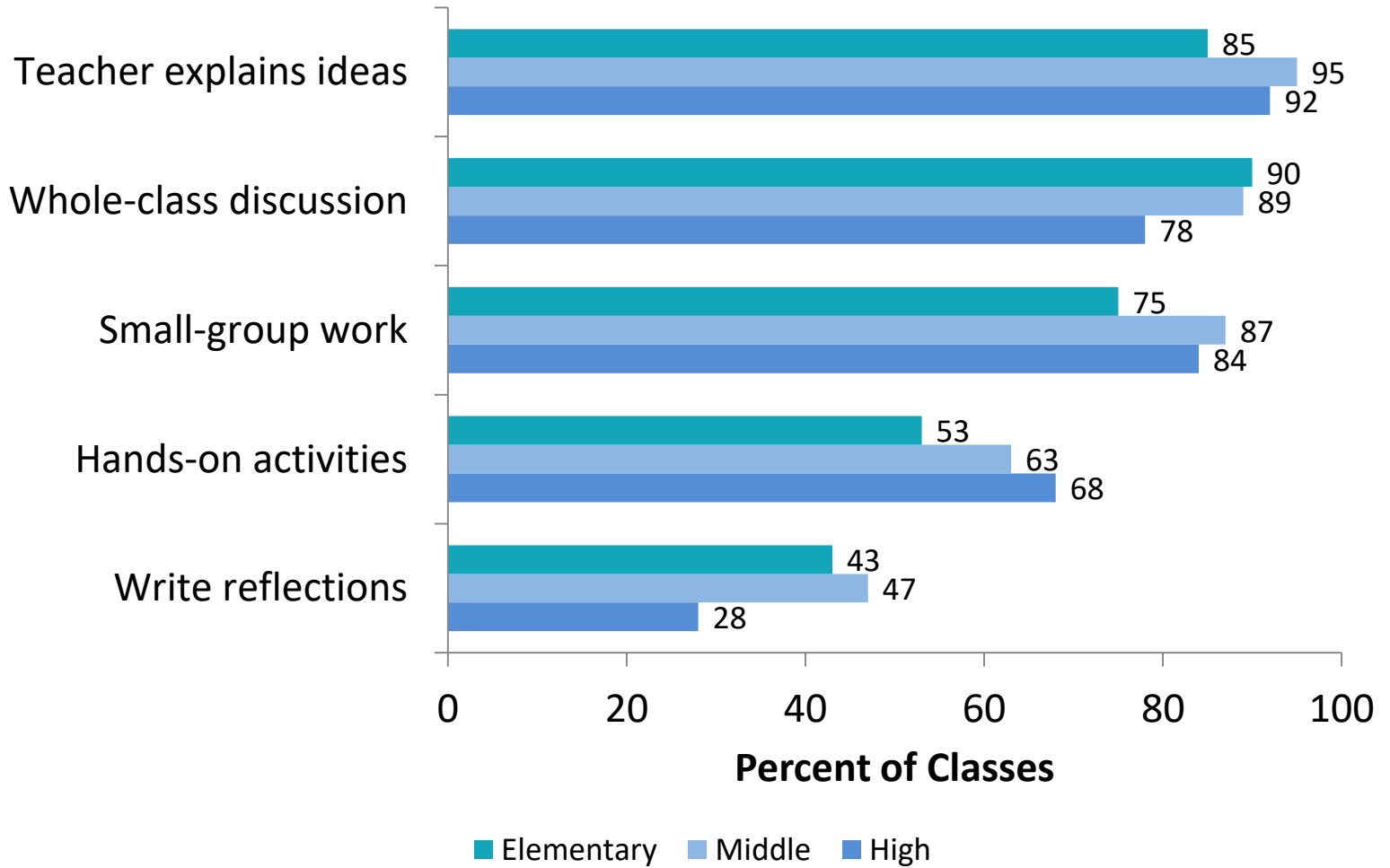


Minutes Per day on Science: Elementary



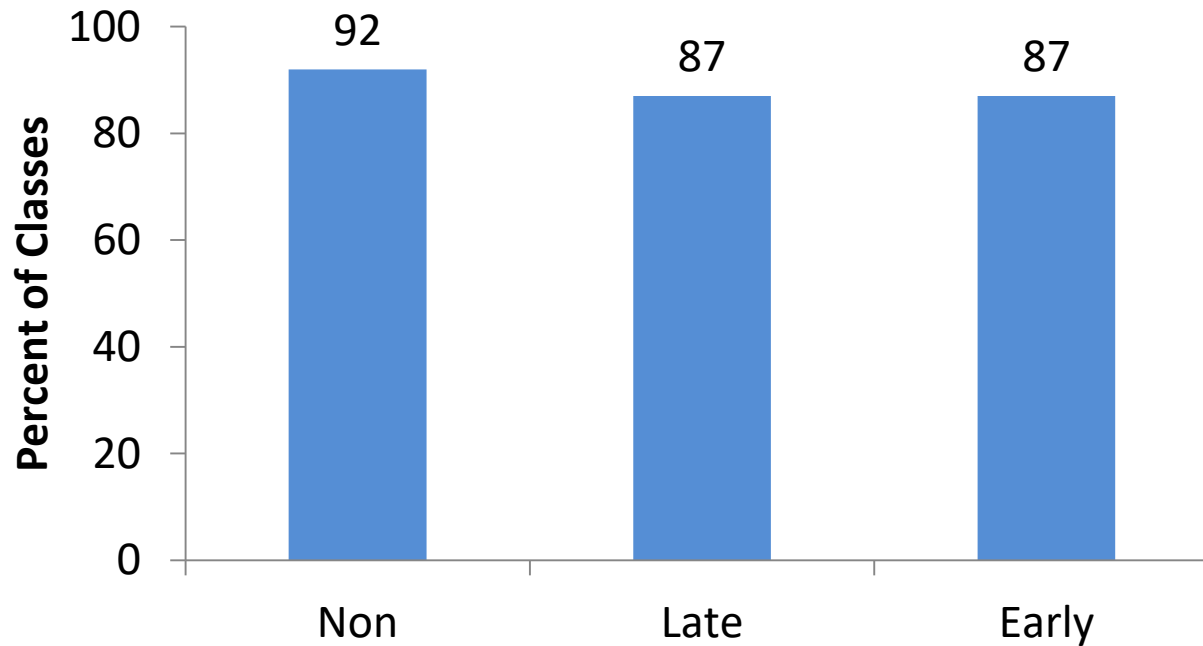


Instructional Activities (Weekly)



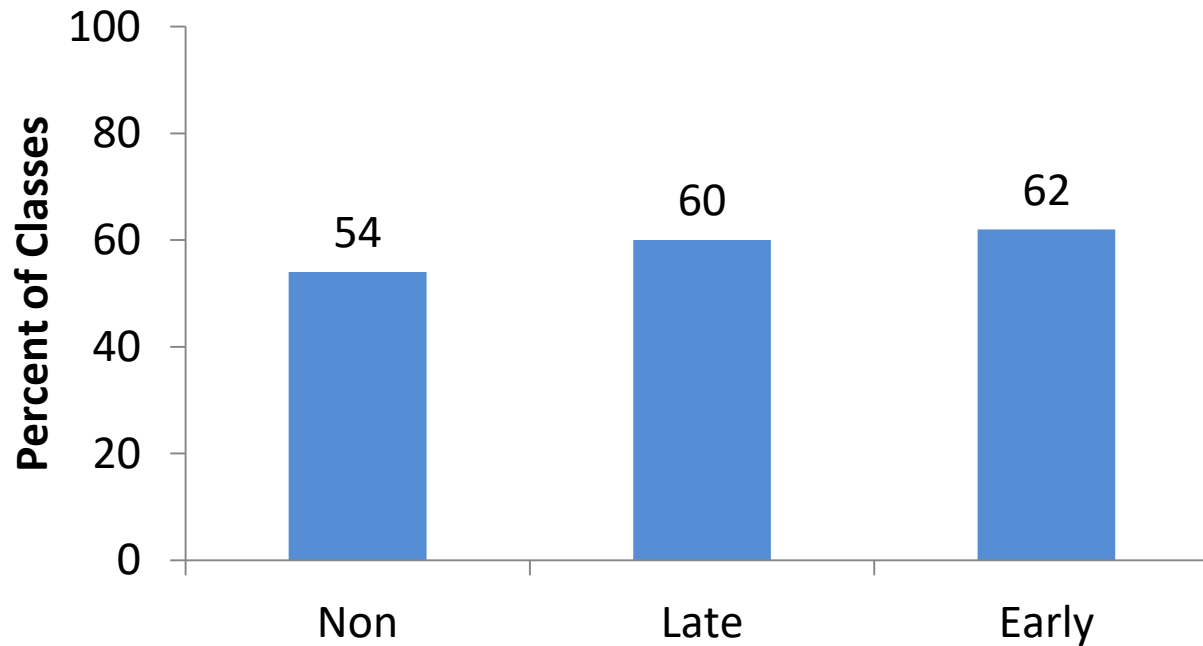


Teacher Explains Ideas (Weekly)



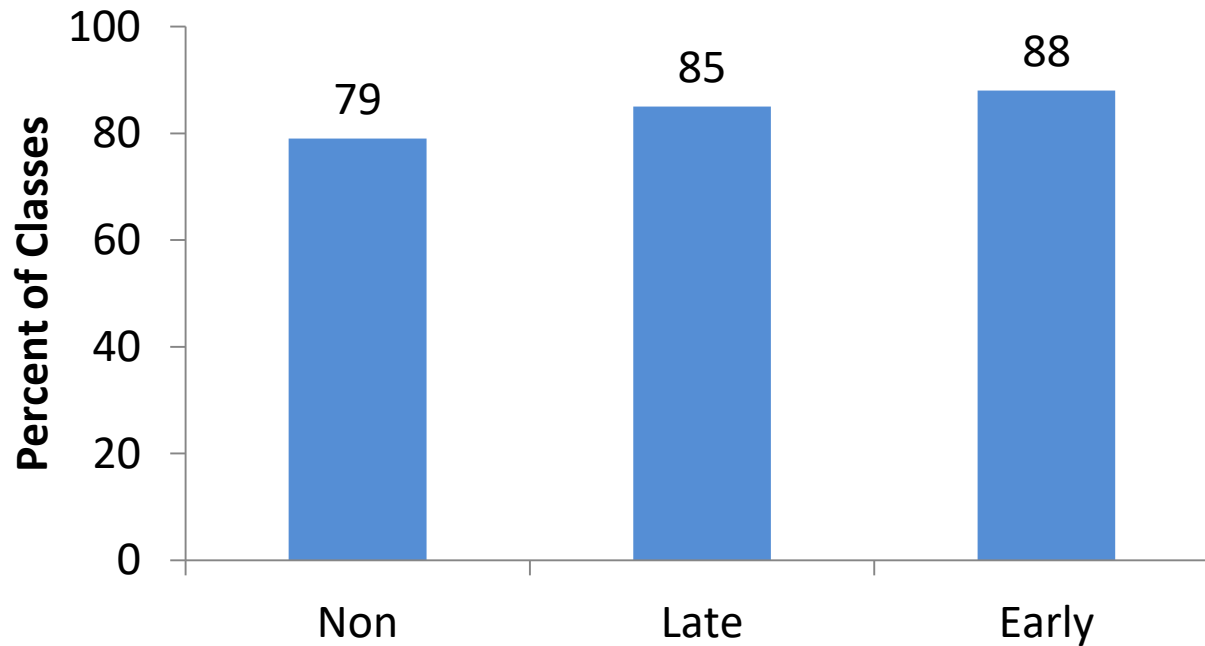


Hands-On Activities (Weekly)





Science Classes in Which Teachers Report Incorporating Engineering Into Science Instruction “At All”





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

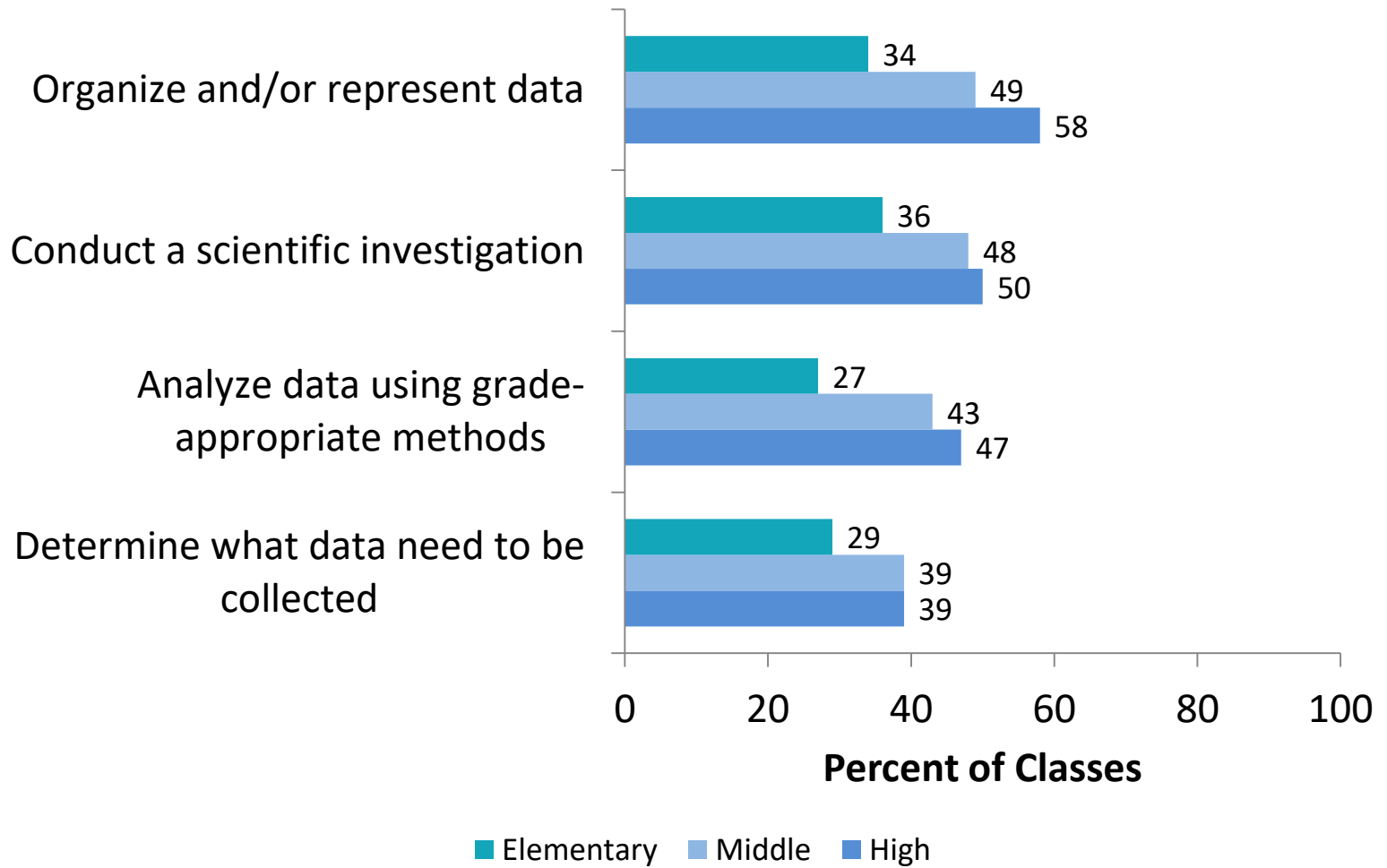


Engagement in Science Practices

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



Conducting Investigations and Analyzing Data (Weekly)





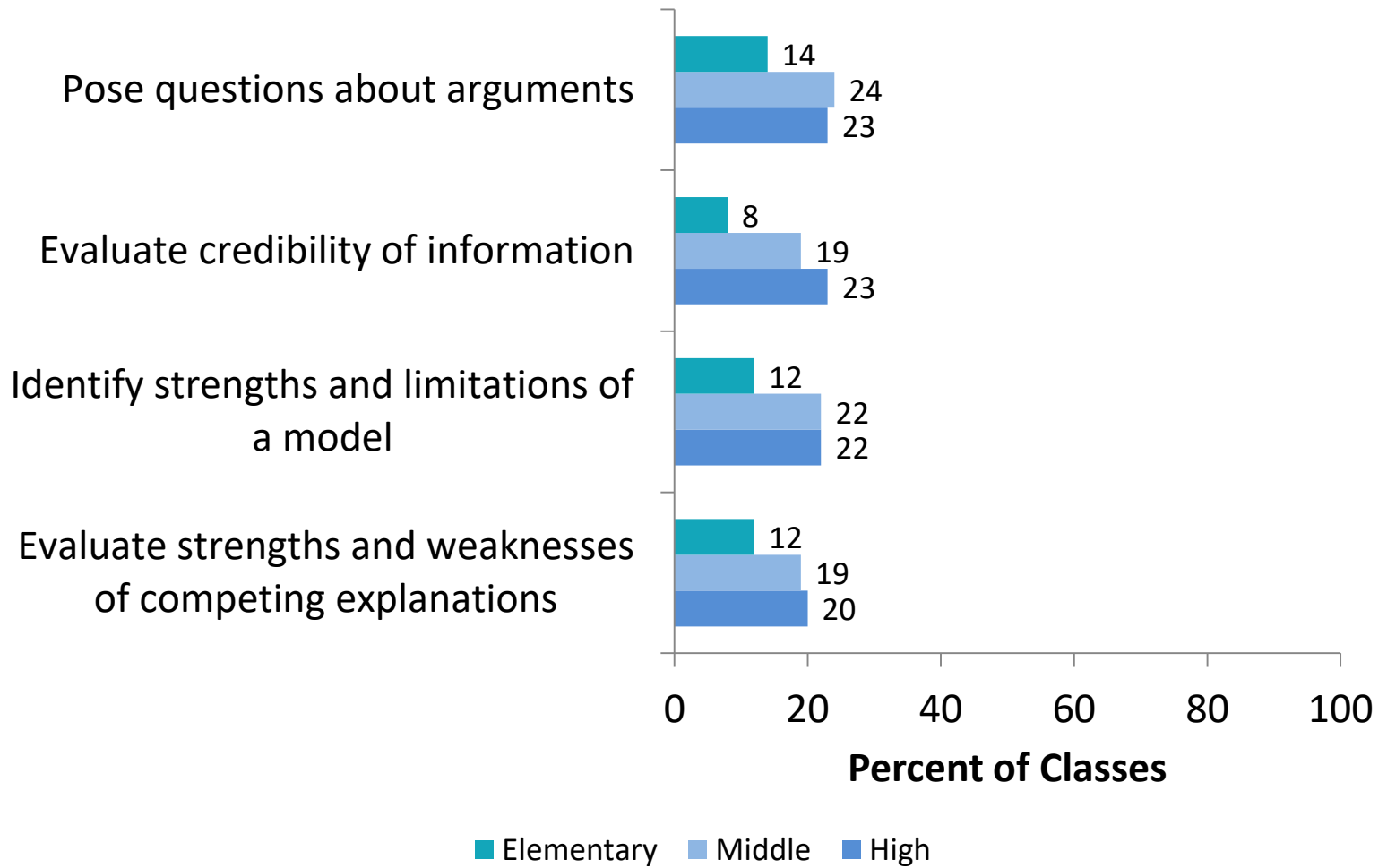
Engagement in Science Practices

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

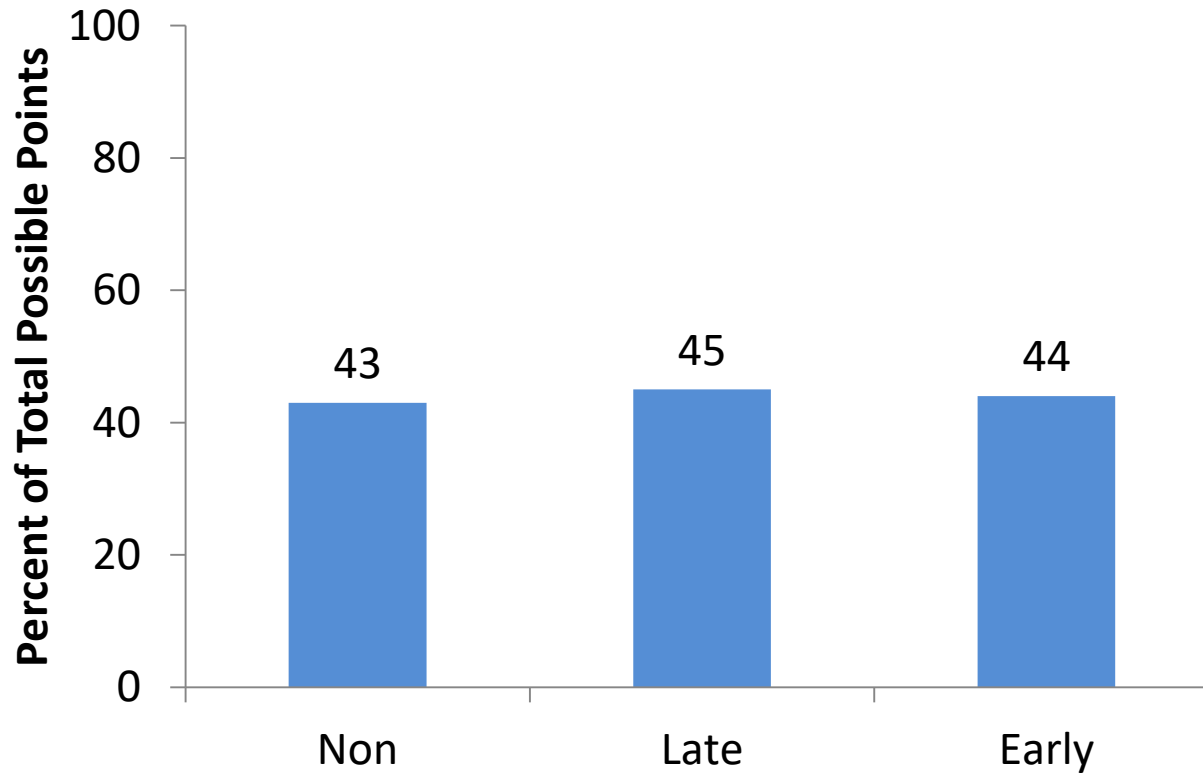


Evaluating Evidence and Arguing (Weekly)





Engaging Students in the Practices of Science Composite





Instruction Takeaways

Instructional time for science at the elementary is 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

Only a few differences by adoption status

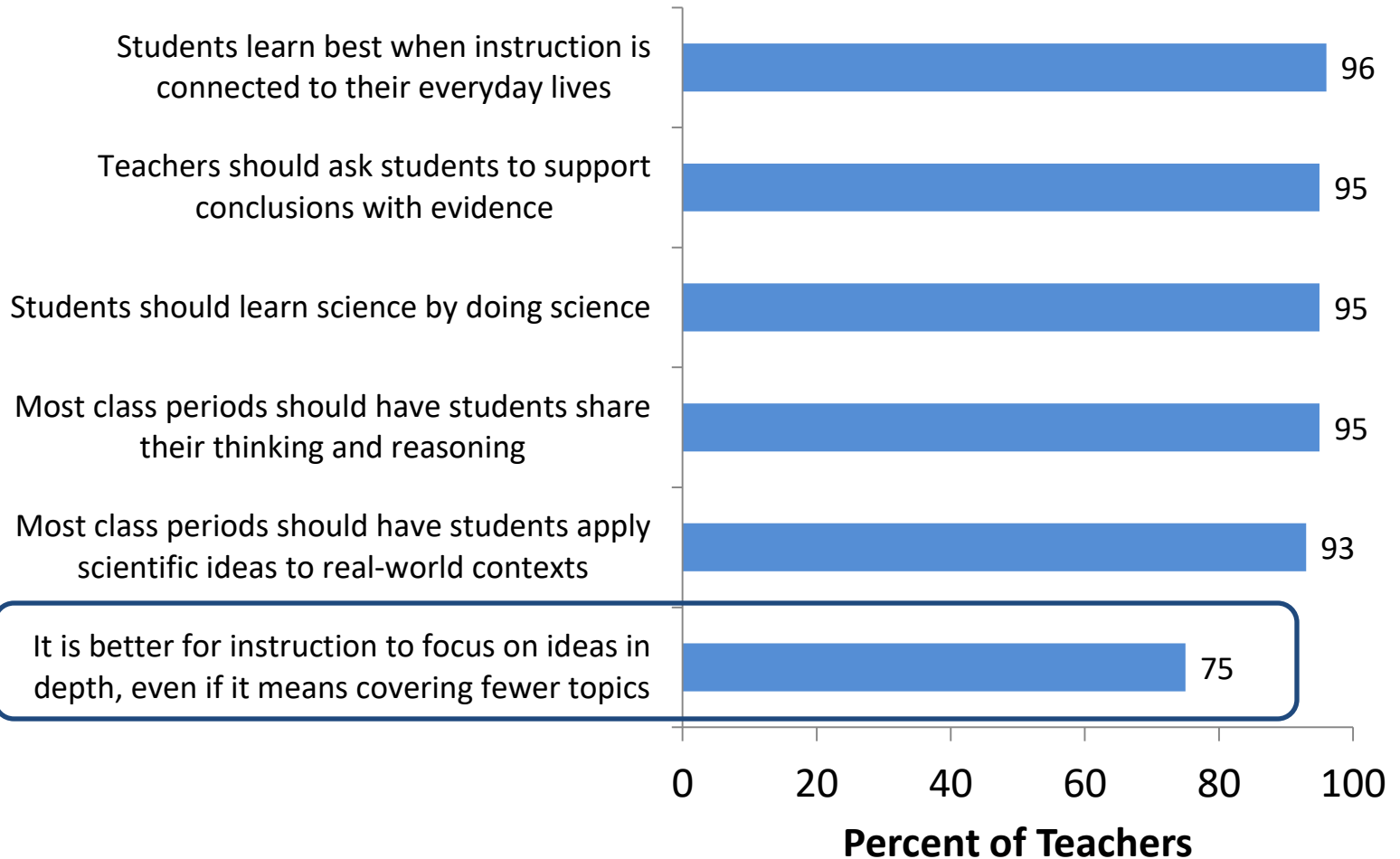


Characteristics of the Science Teaching Force

- **Teacher beliefs about effective science instruction**
- **Teacher background (degrees & coursework)**
- **Perceptions of preparedness**

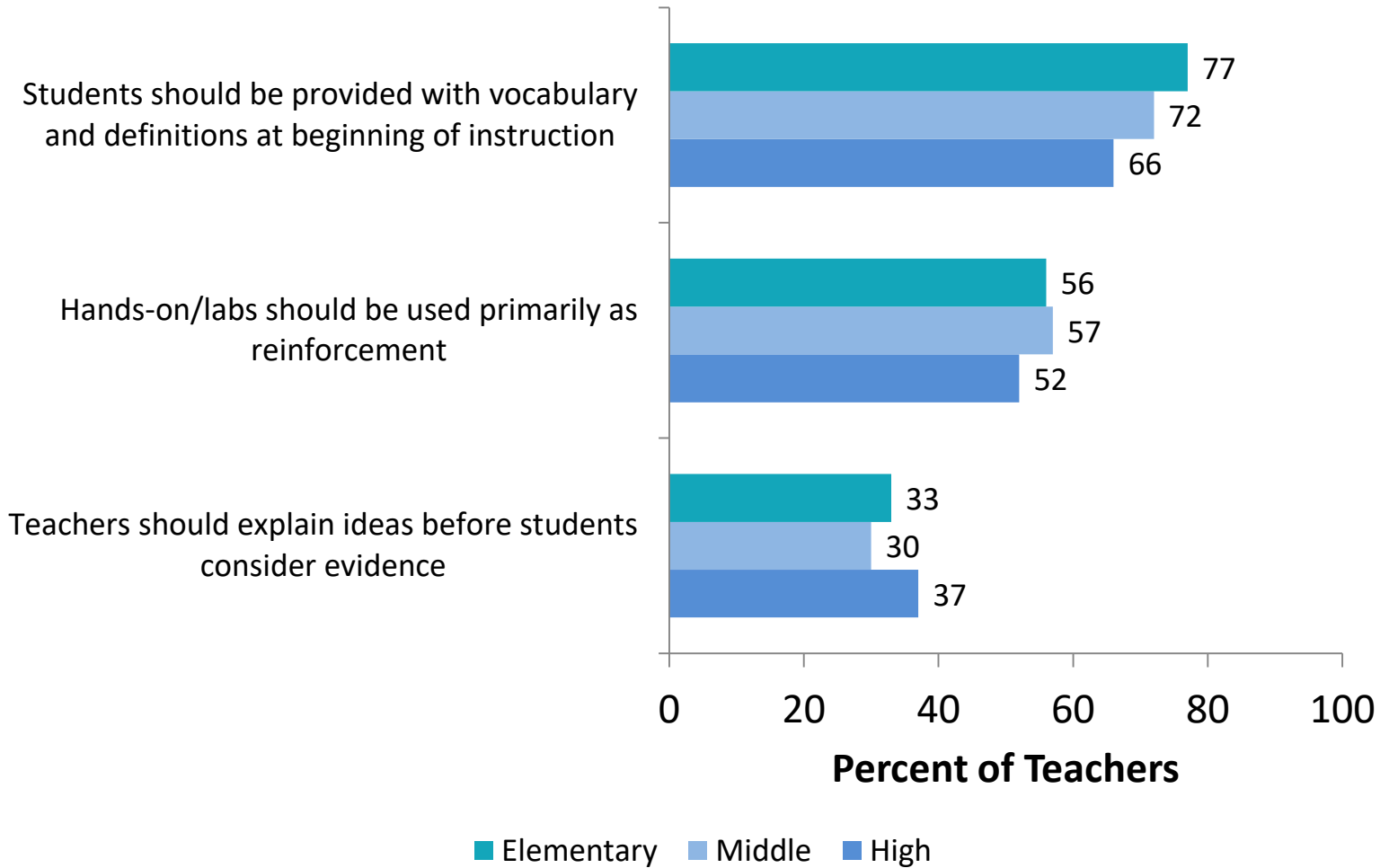


Teachers Agreeing With Reform-Oriented Beliefs About Instruction





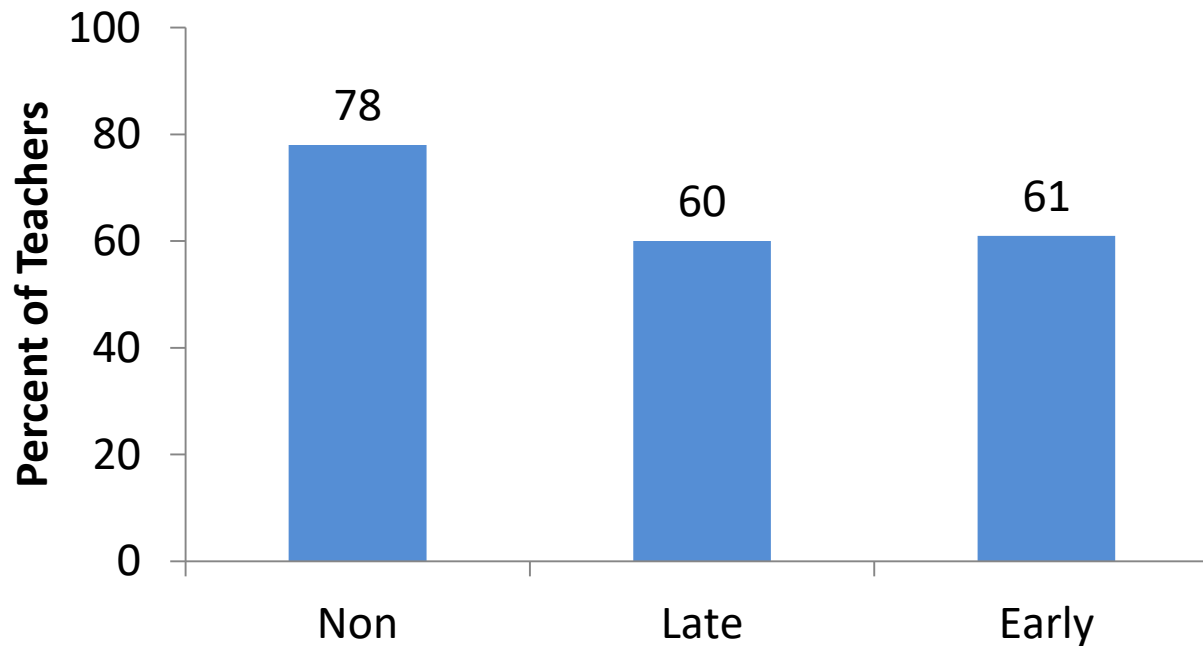
Teachers Agreeing With Traditional Beliefs About Instruction





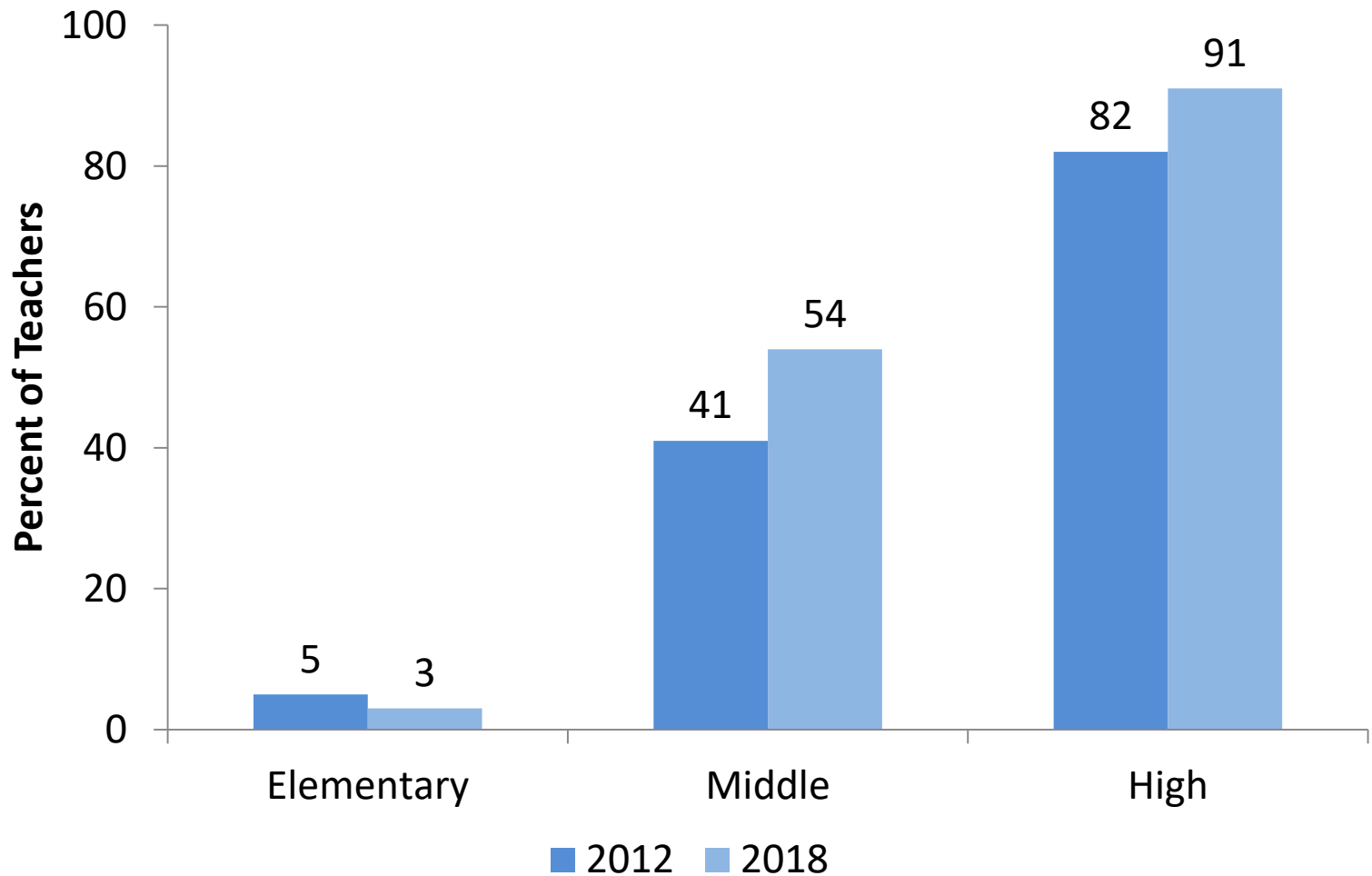
High School Teachers

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





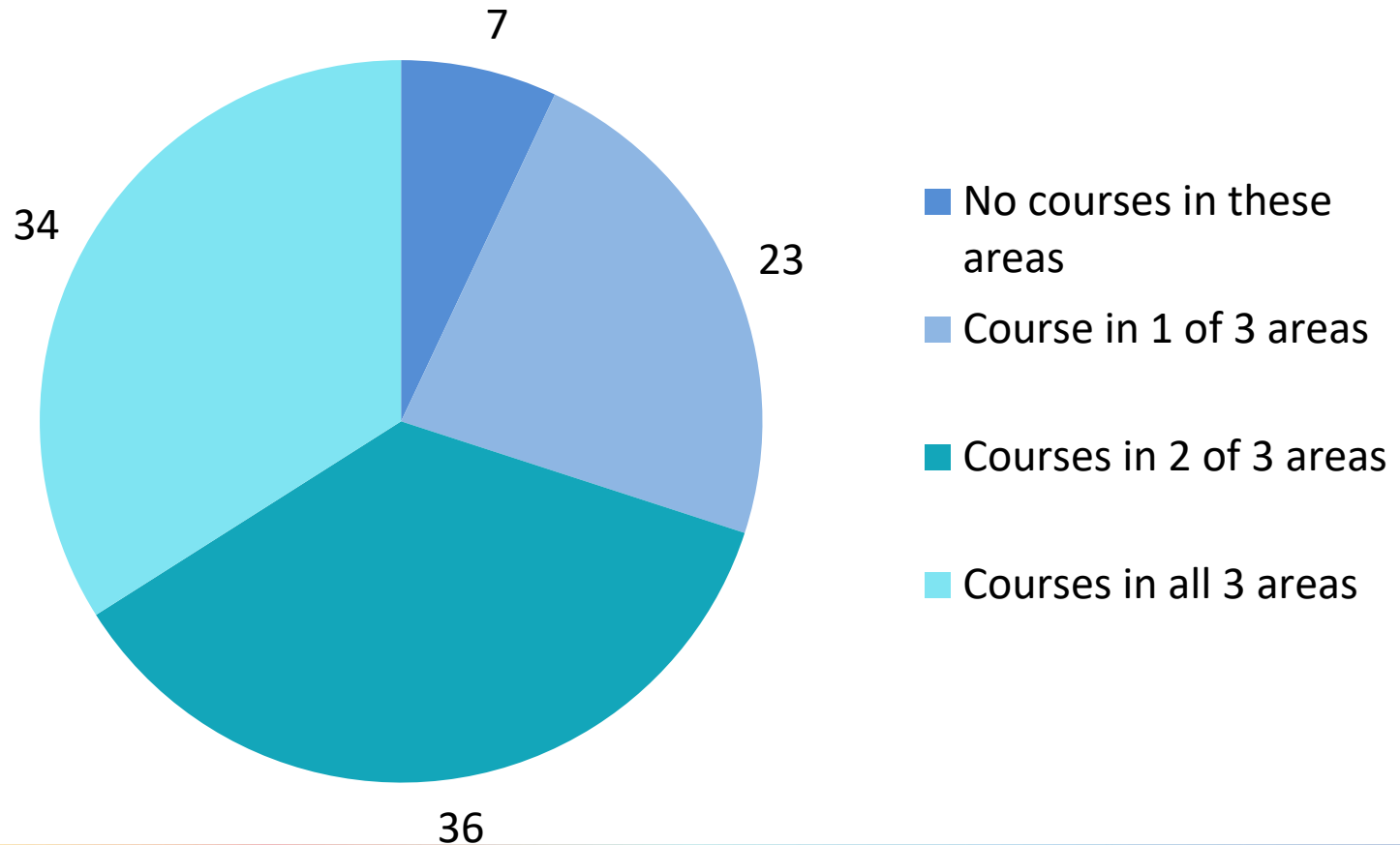
Degree in Science/Engineering/ Science Education





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

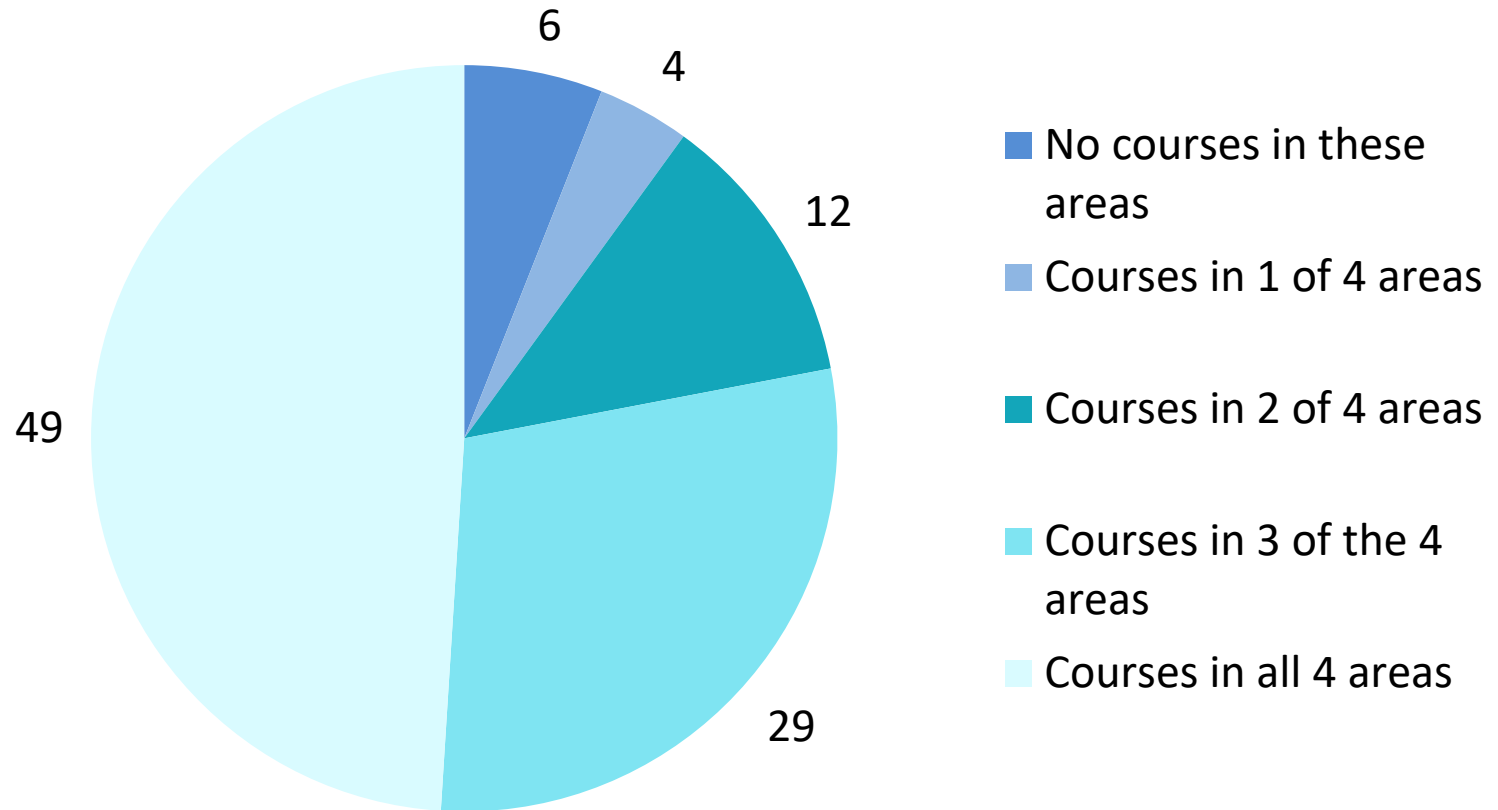
Percent of Elementary Teachers





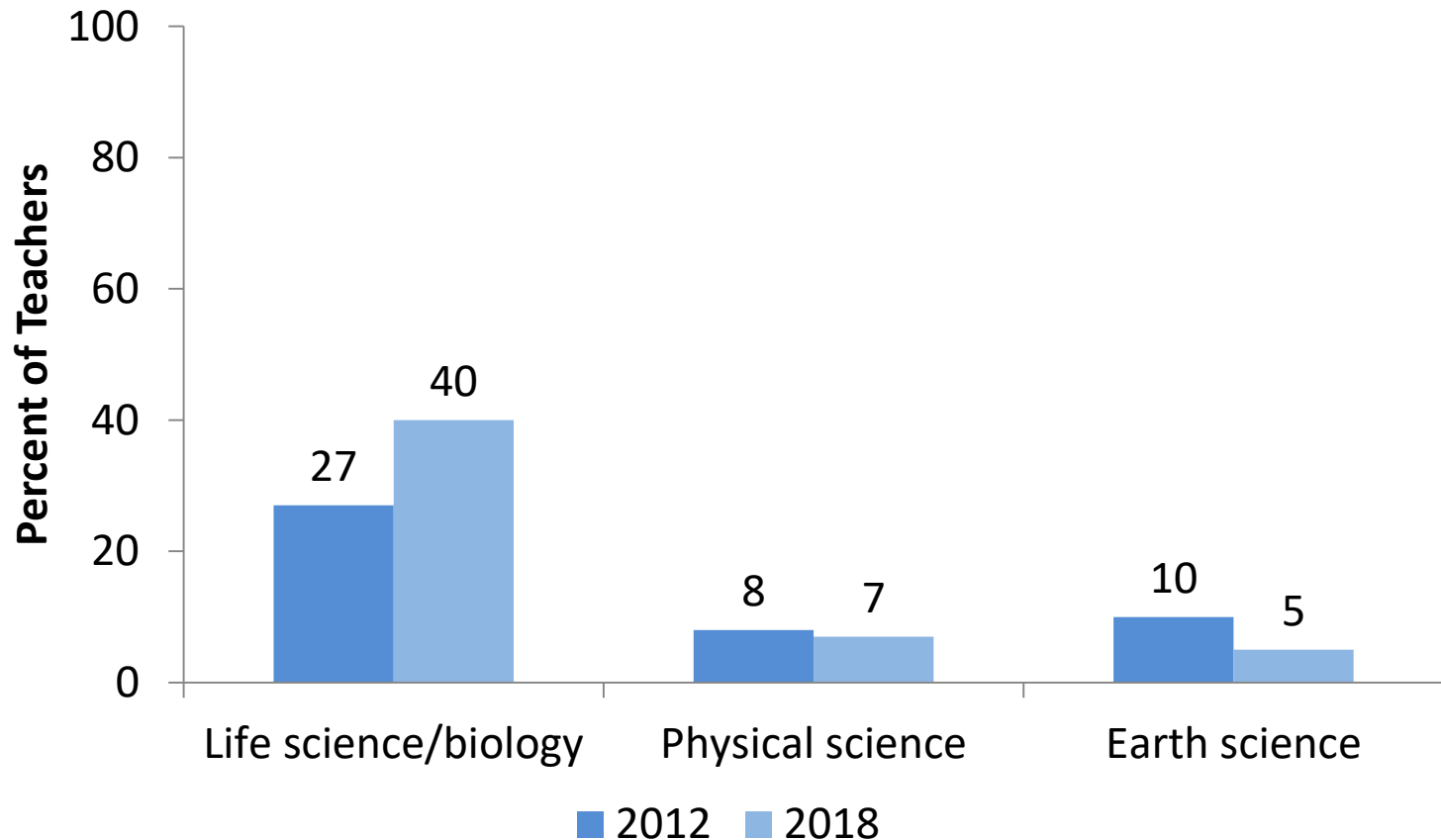
Middle School Teachers' College Coursework: Chemistry, Earth Science, Life Science, Physics

Percent of Middle Grades Teachers



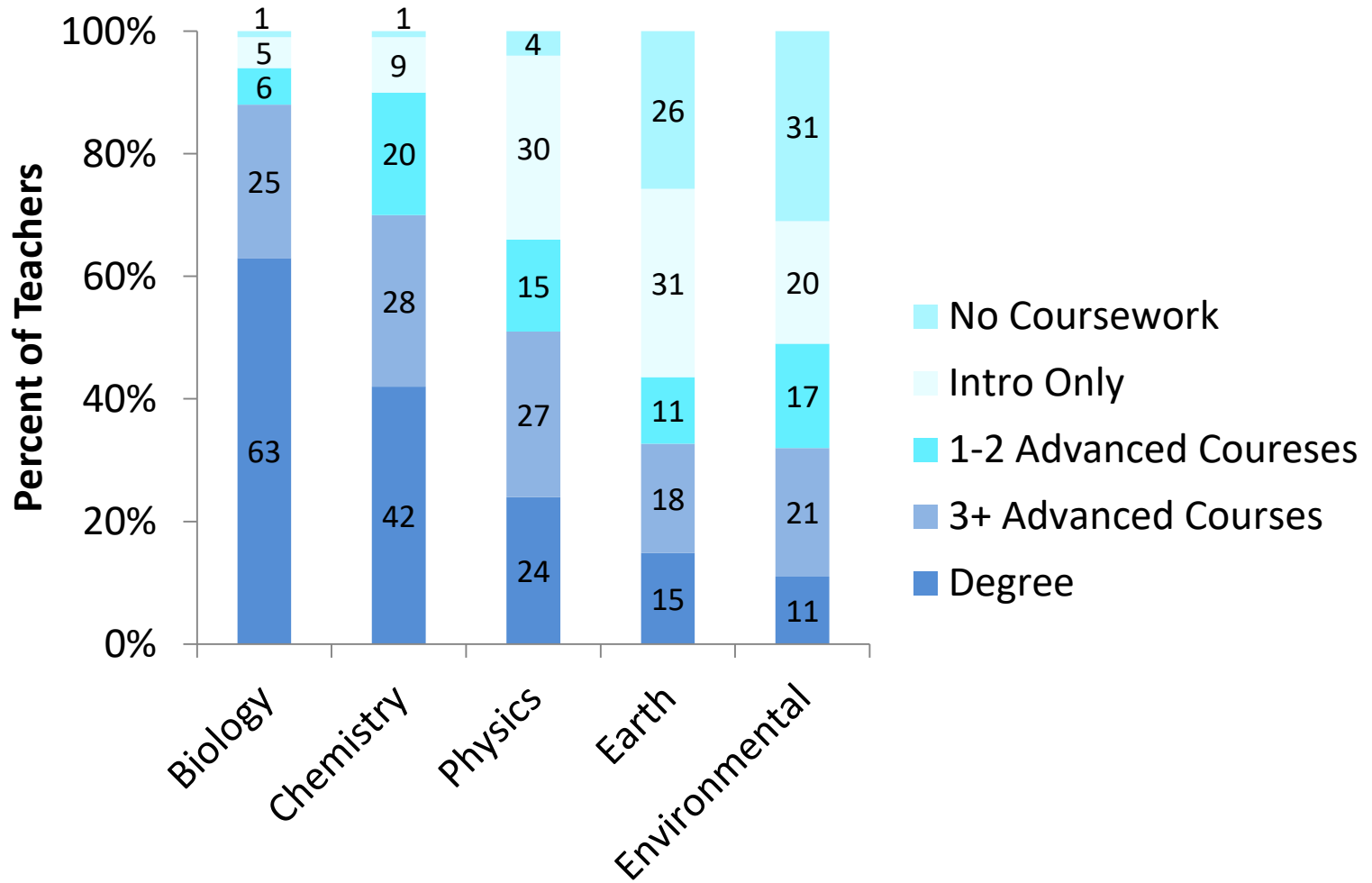


Middle School Science Teachers' Degrees, by Course Taught



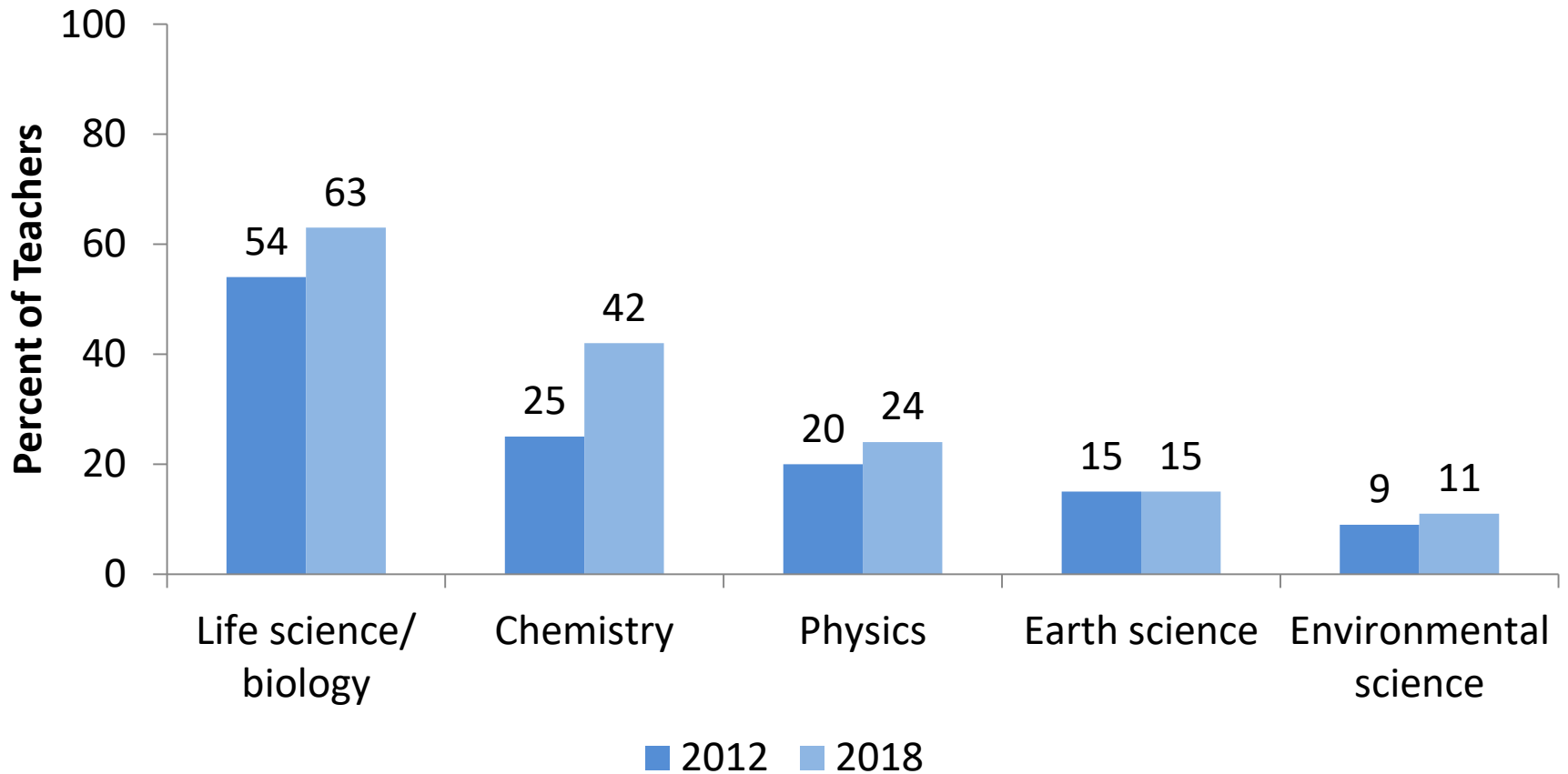


High School Teachers' College Coursework, by Course Taught



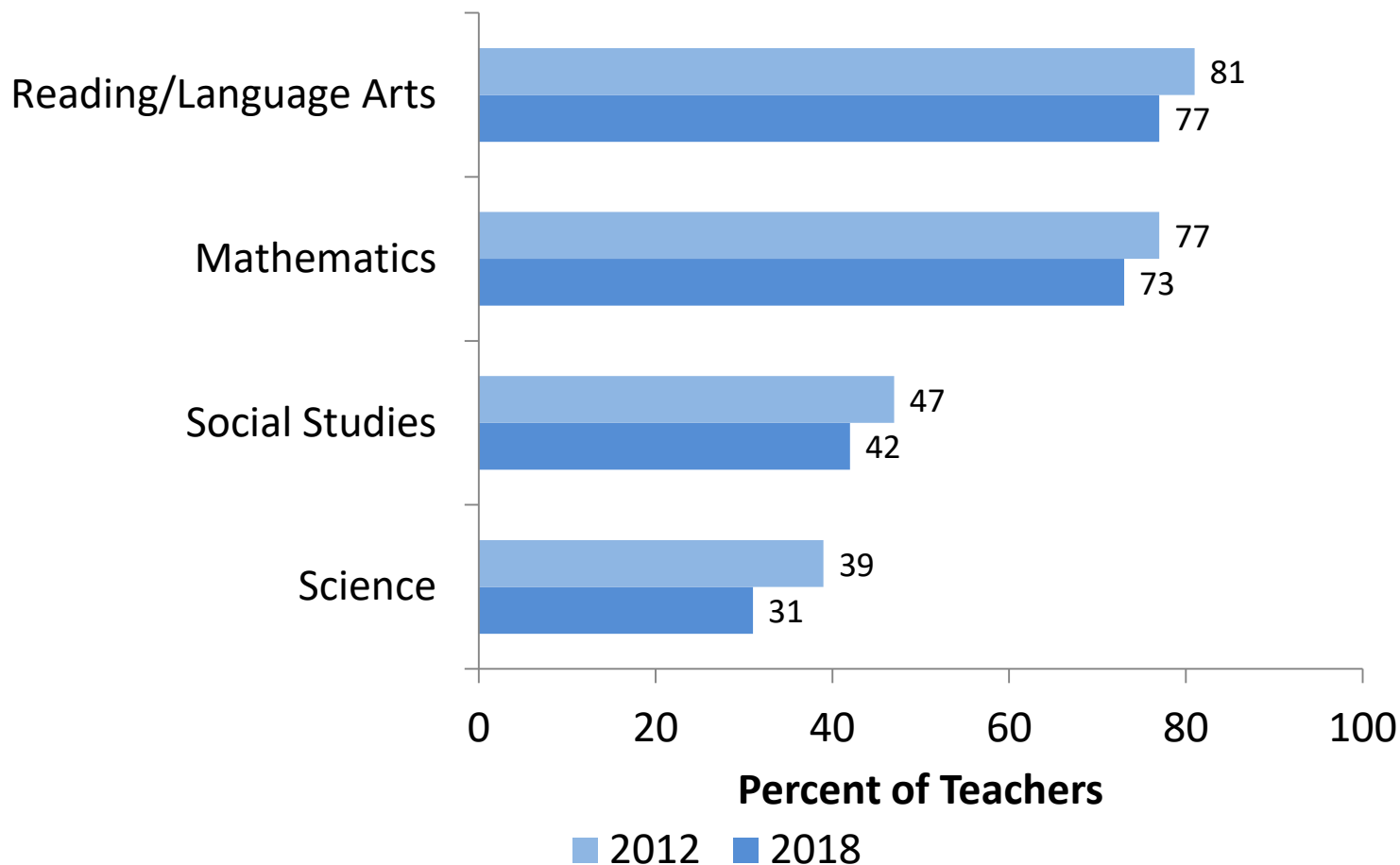


High School Science Teachers With Degree in Subject



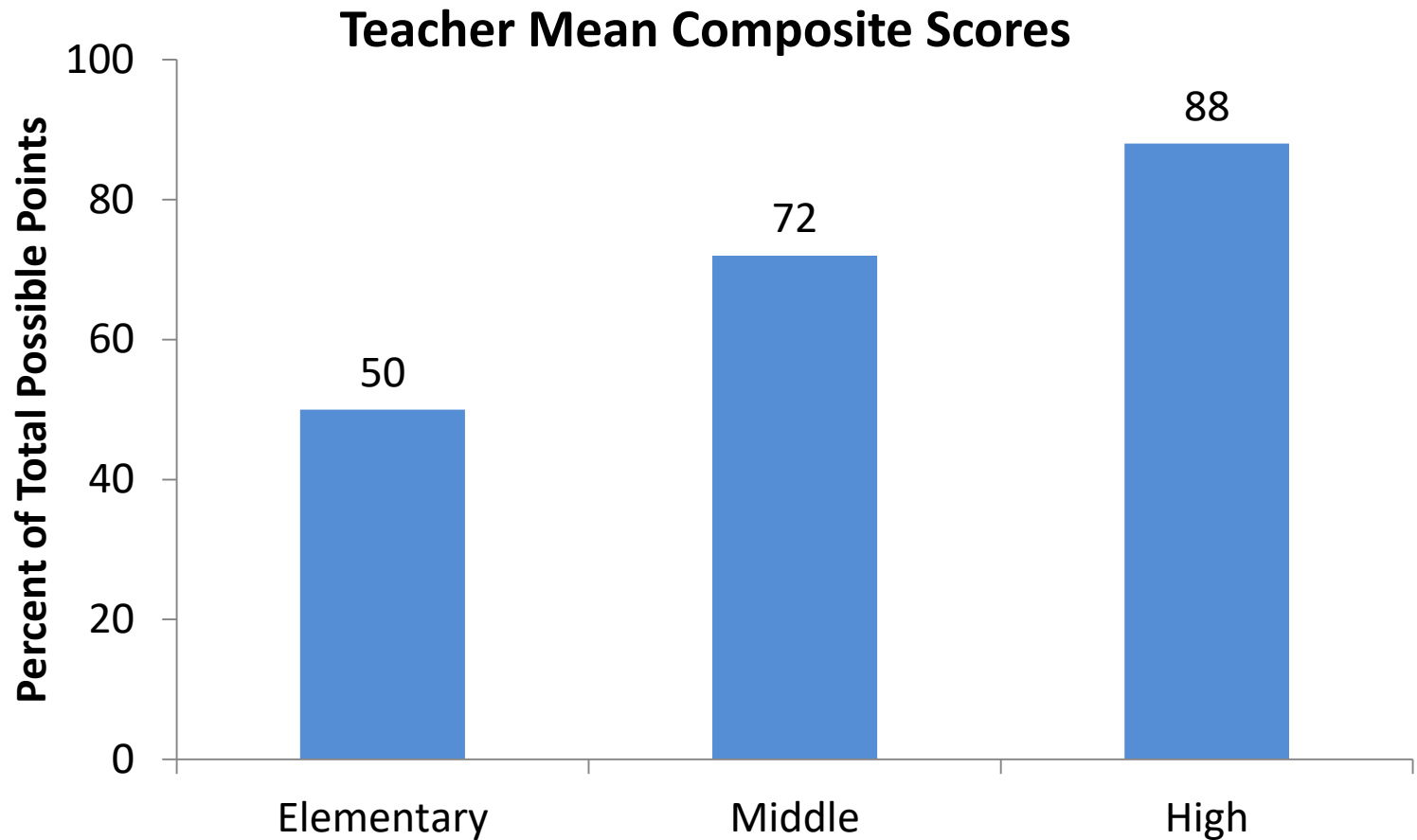


Elementary Teachers' Considering Themselves Very Well Prepared to Teach Each Subject



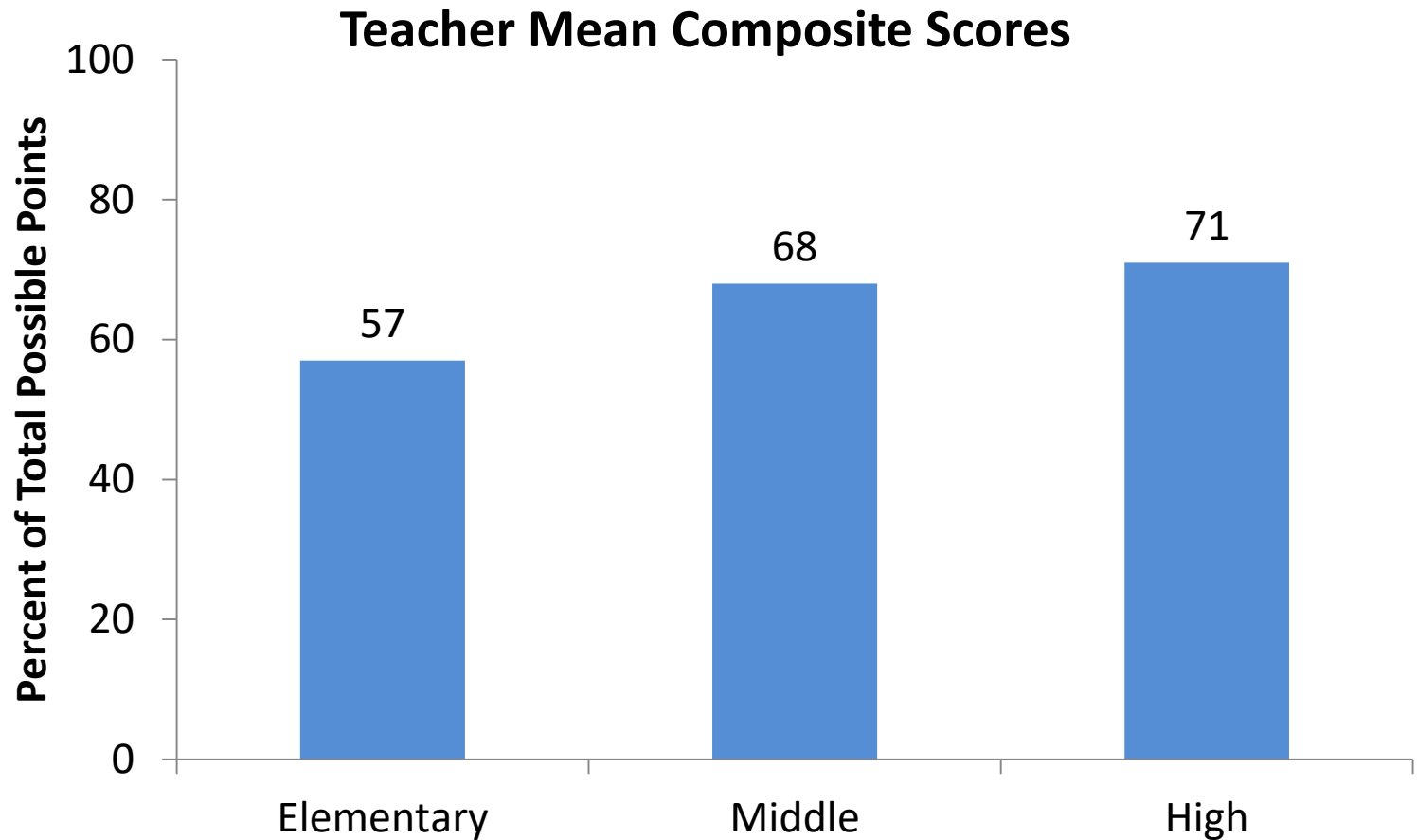


Teachers' Perceptions of Content Preparedness



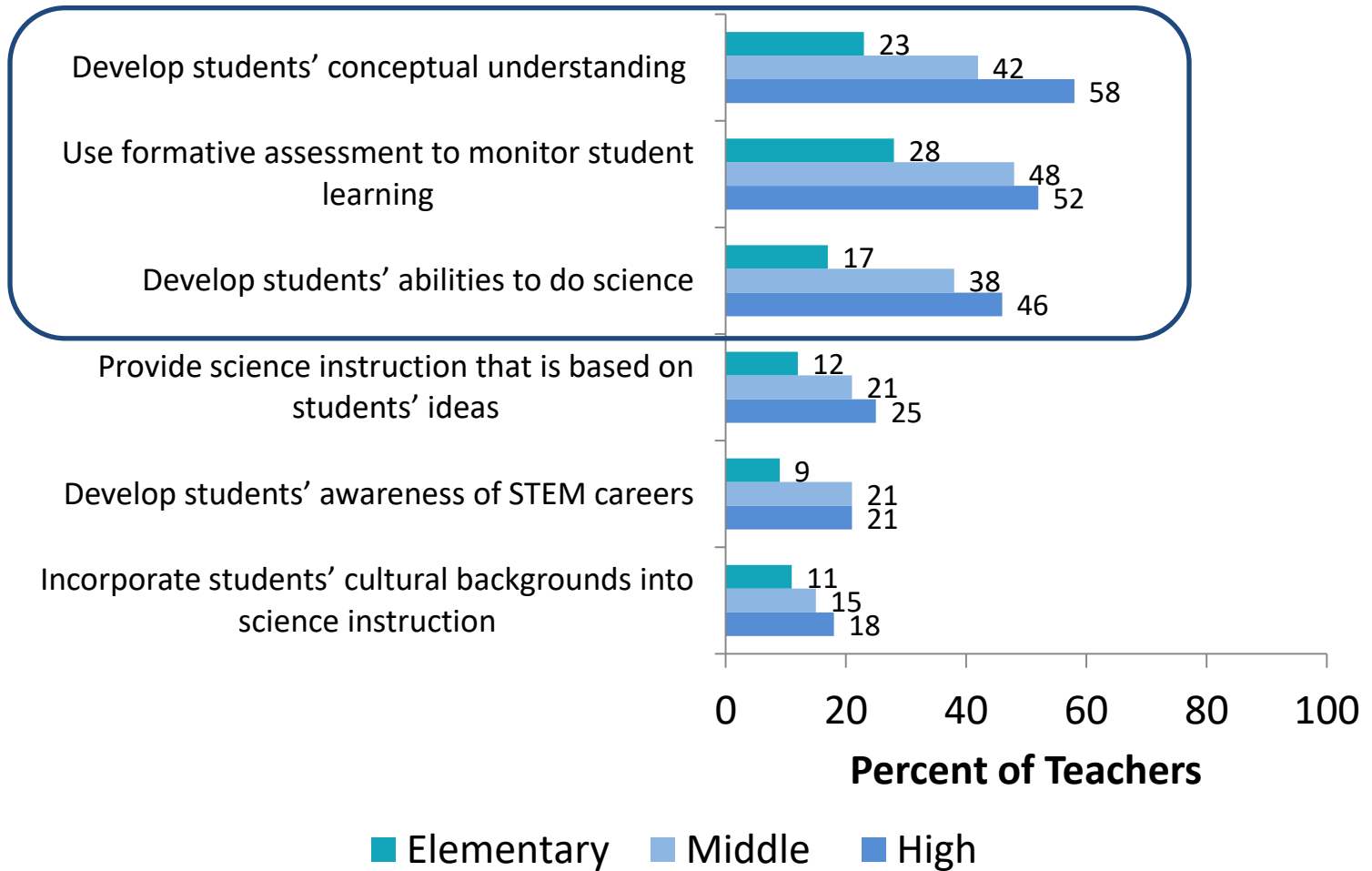


Teachers' Perceptions of Pedagogical Preparedness



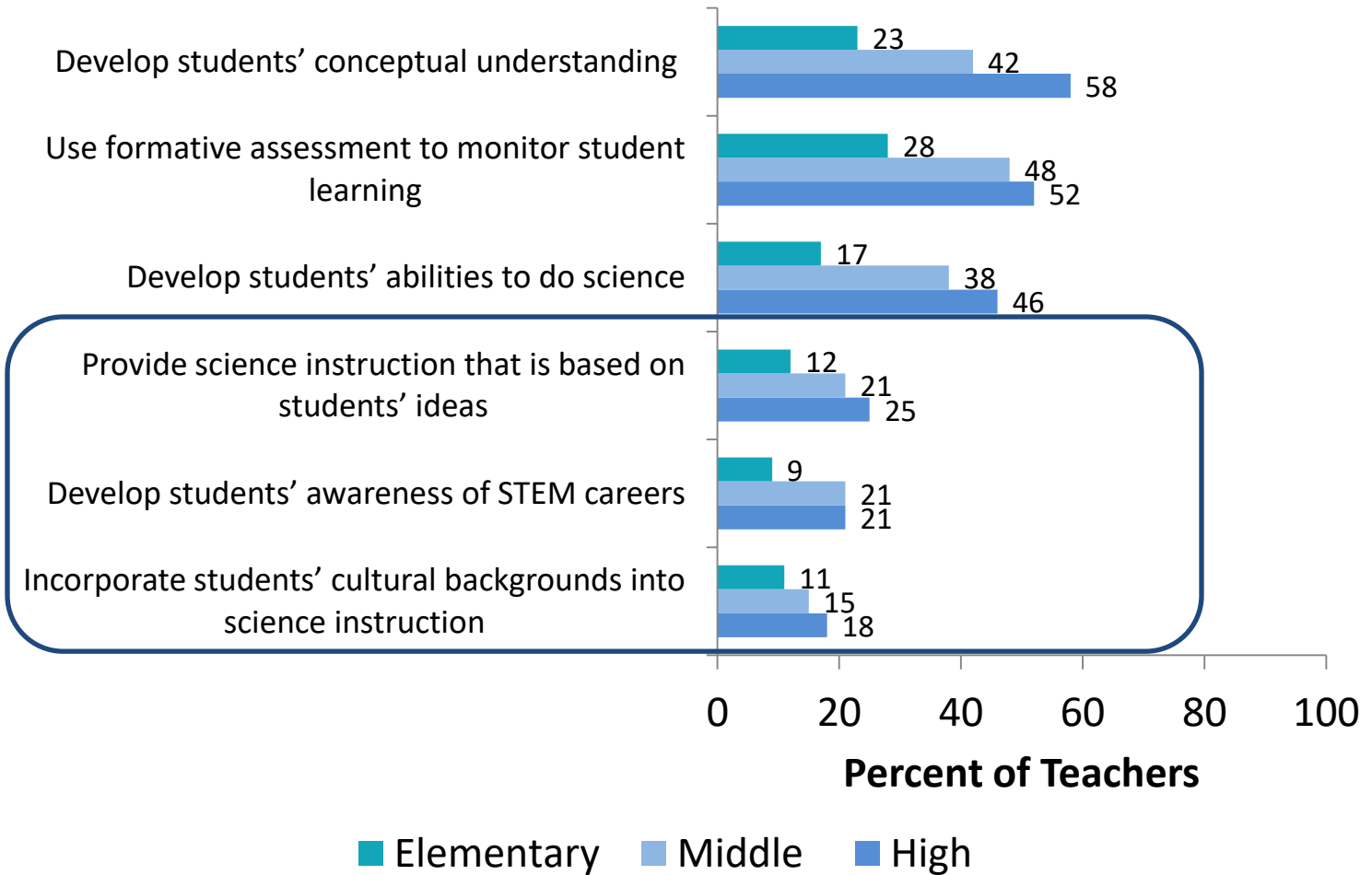


Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks



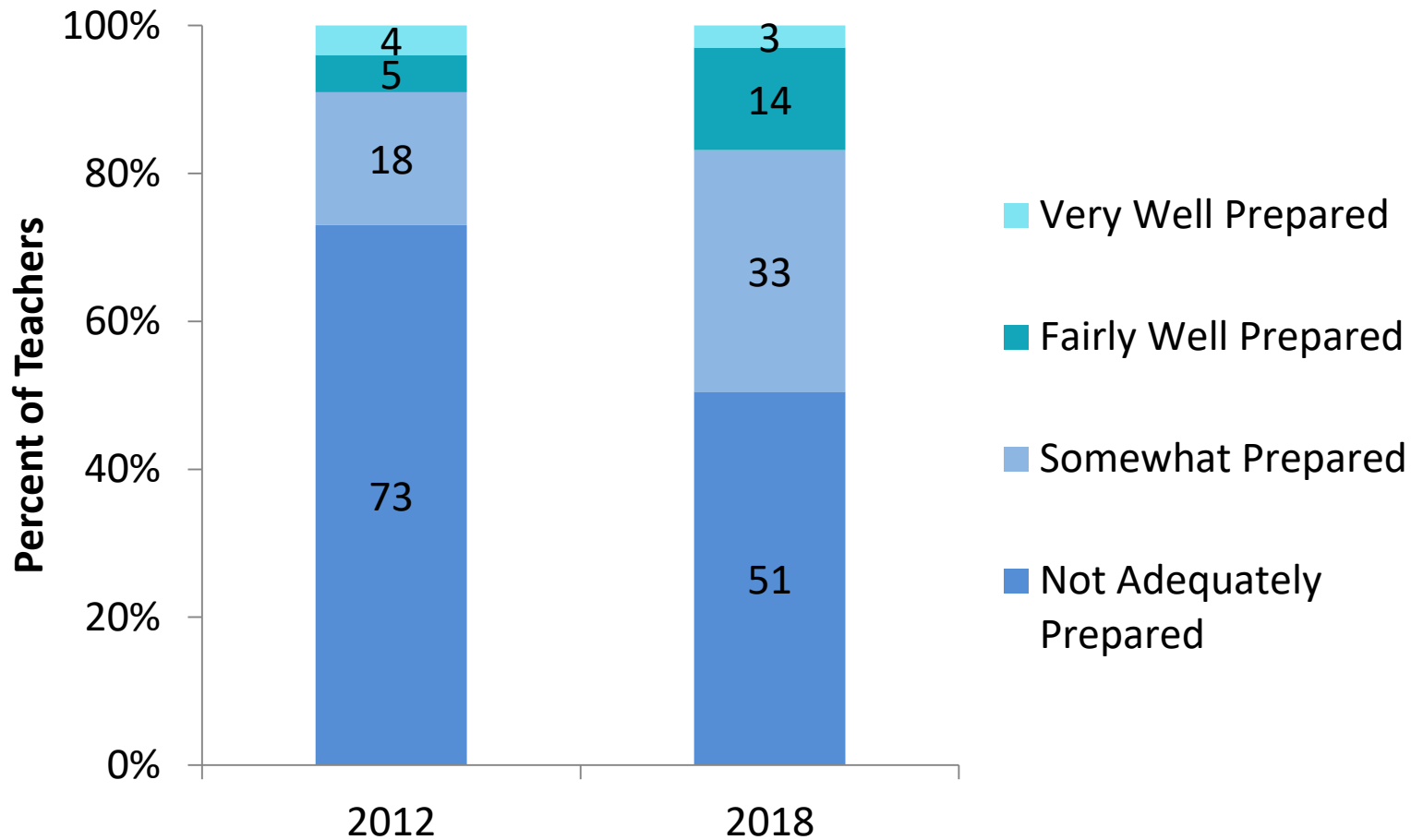


Science Teachers Considering Themselves Very Well Prepared for Each of a Number of Tasks





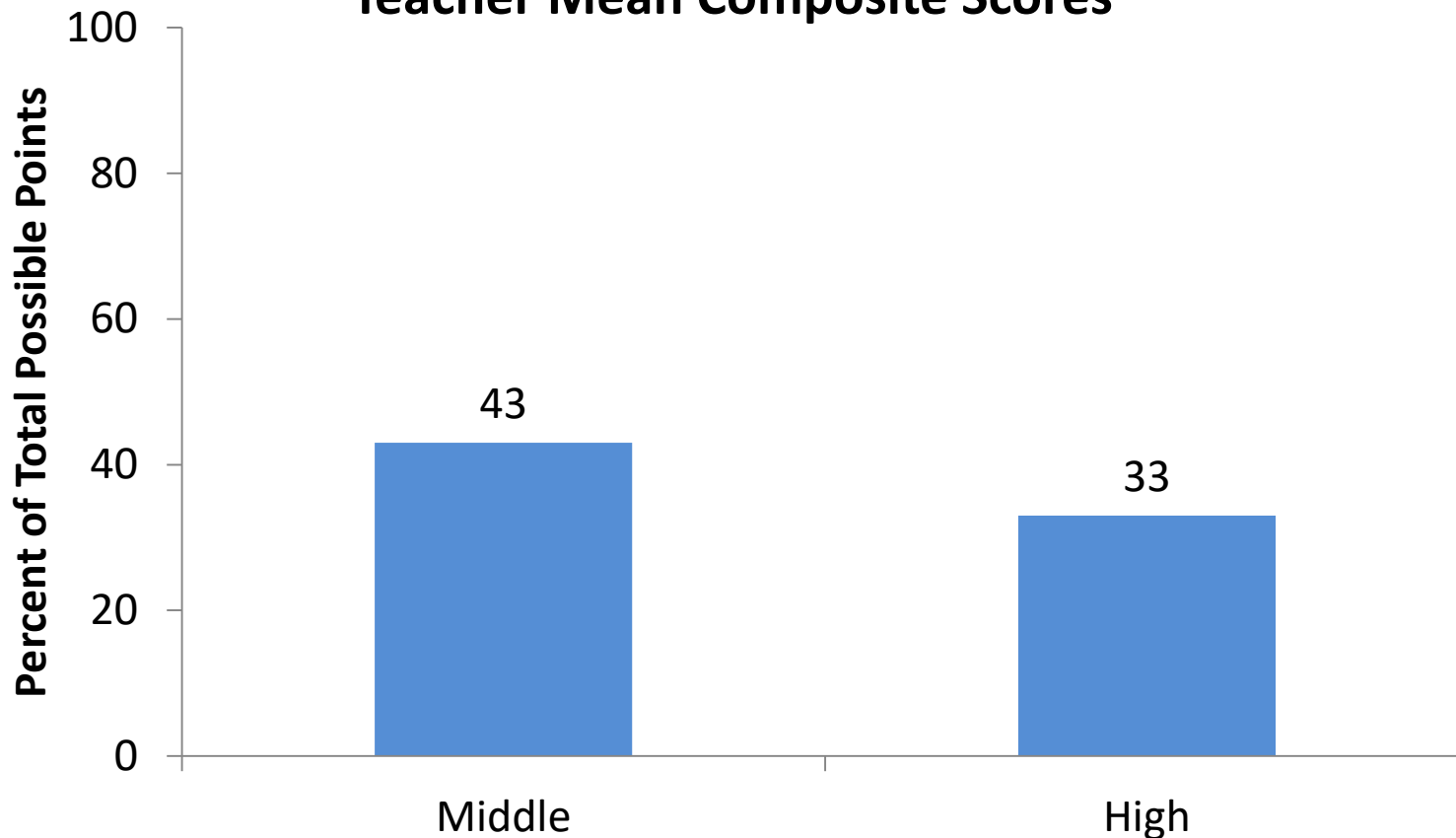
Elementary Teachers' Perceptions of Preparedness to Teach Engineering





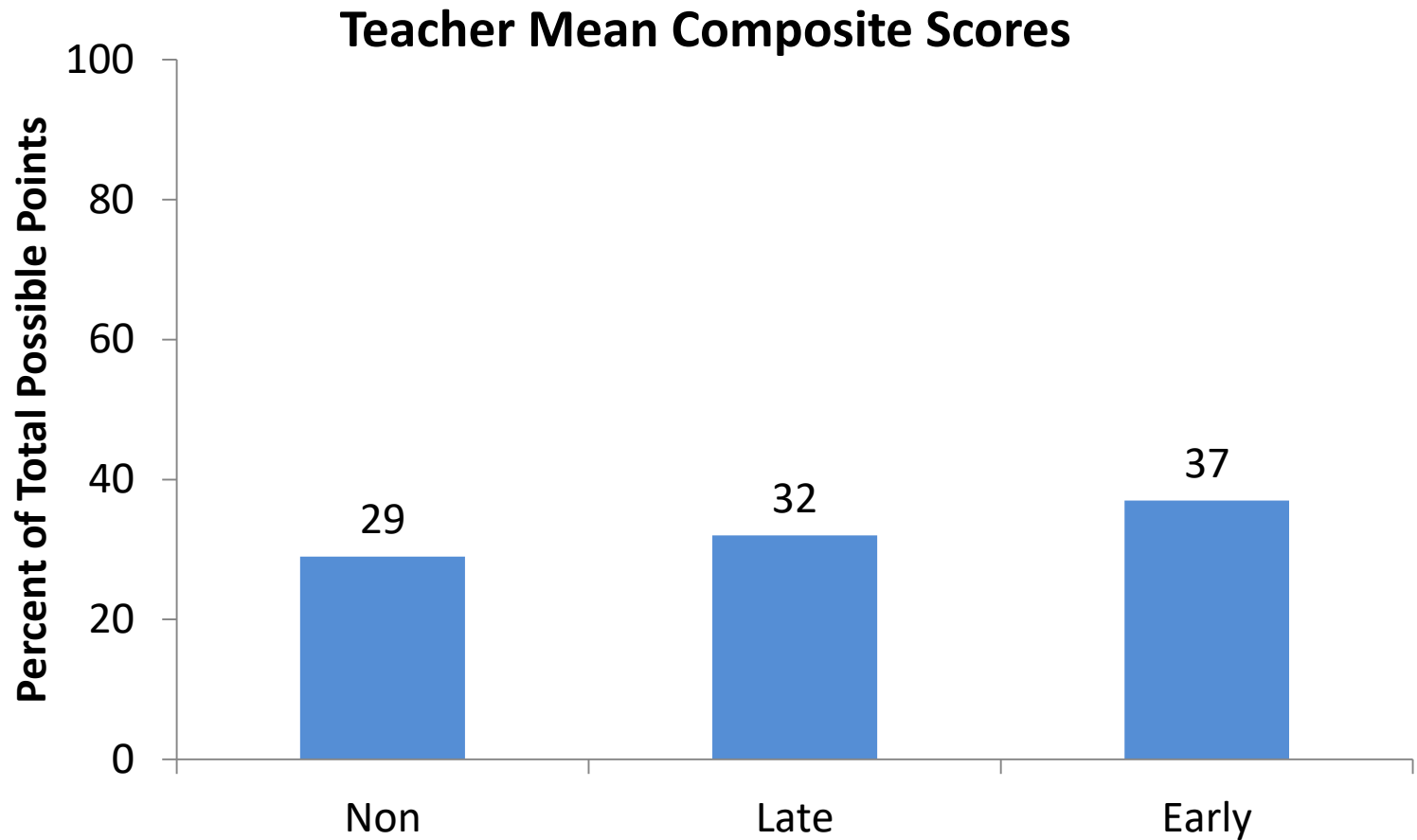
Secondary Science Teachers' Perceptions of Preparedness to Teach Engineering Composite

Teacher Mean Composite Scores





High School Science Teachers' Perceptions of Preparedness to Teach Engineering





Teaching Force Takeaways

- The majority of teachers hold many beliefs that are aligned with what is known about effective science instruction, though these beliefs may not always translate into practice.
- Many teachers have had limited coursework in the content they are expected to teach.
- Teachers' perceptions of preparedness tend to increase with increasing grade range.
- Some evidence of movement in the right direction since the adoption of NGSS, but many obstacles still remain.

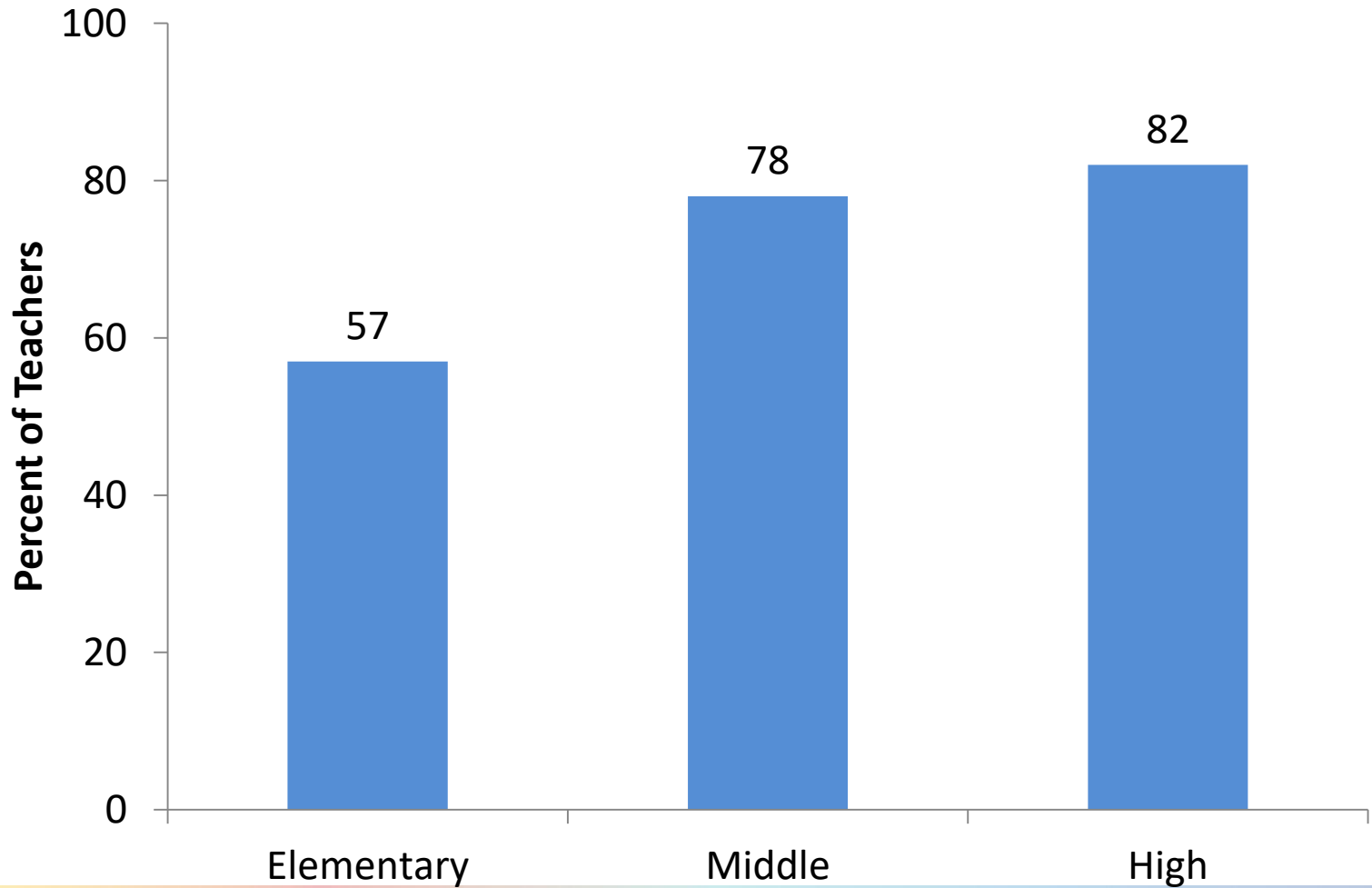


Professional Development

- Participation in science professional development in the last three years
- Characteristics of science professional development
- Emphasis of science professional development

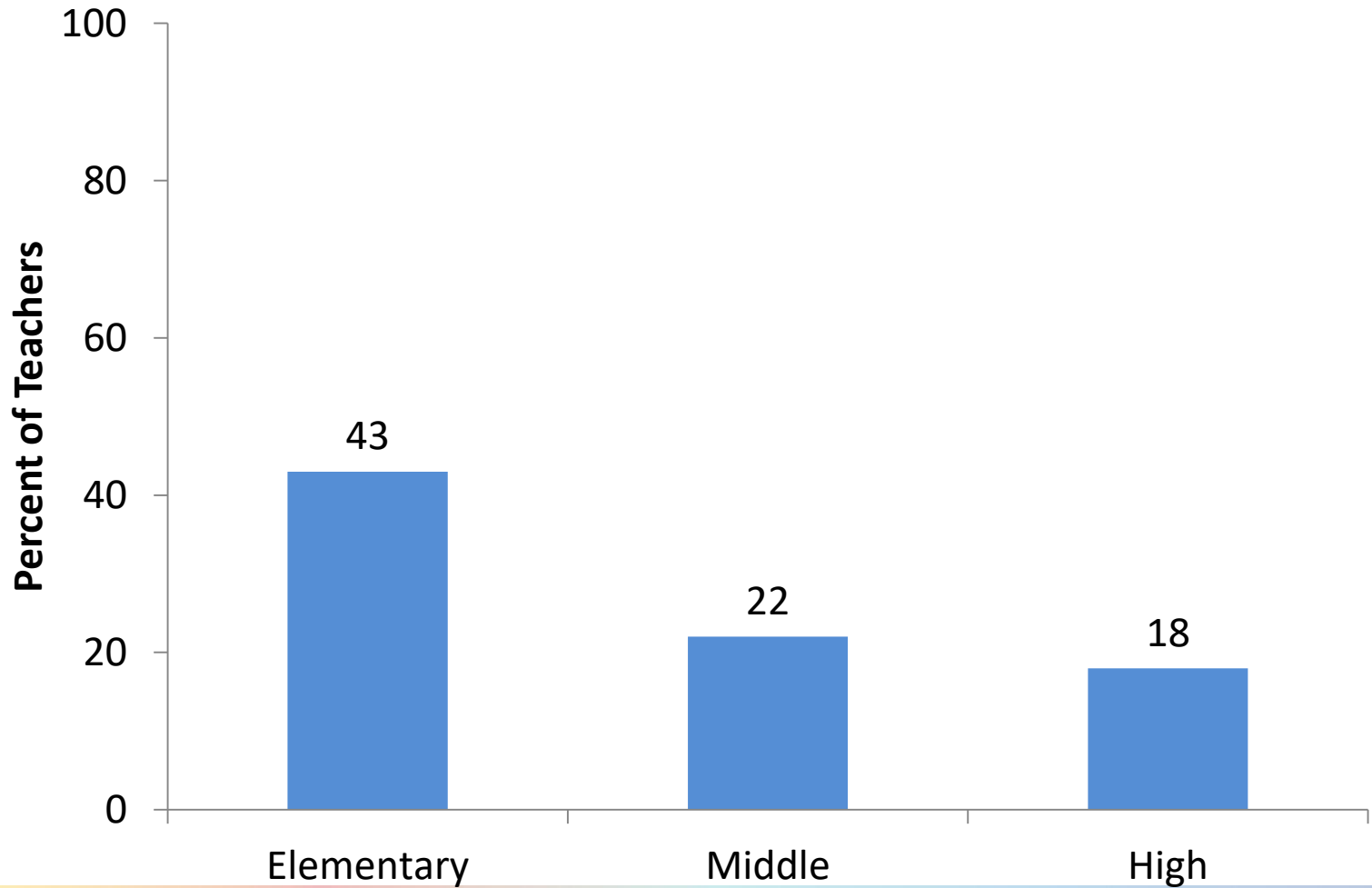


Participation in Science PD in Last Three Years



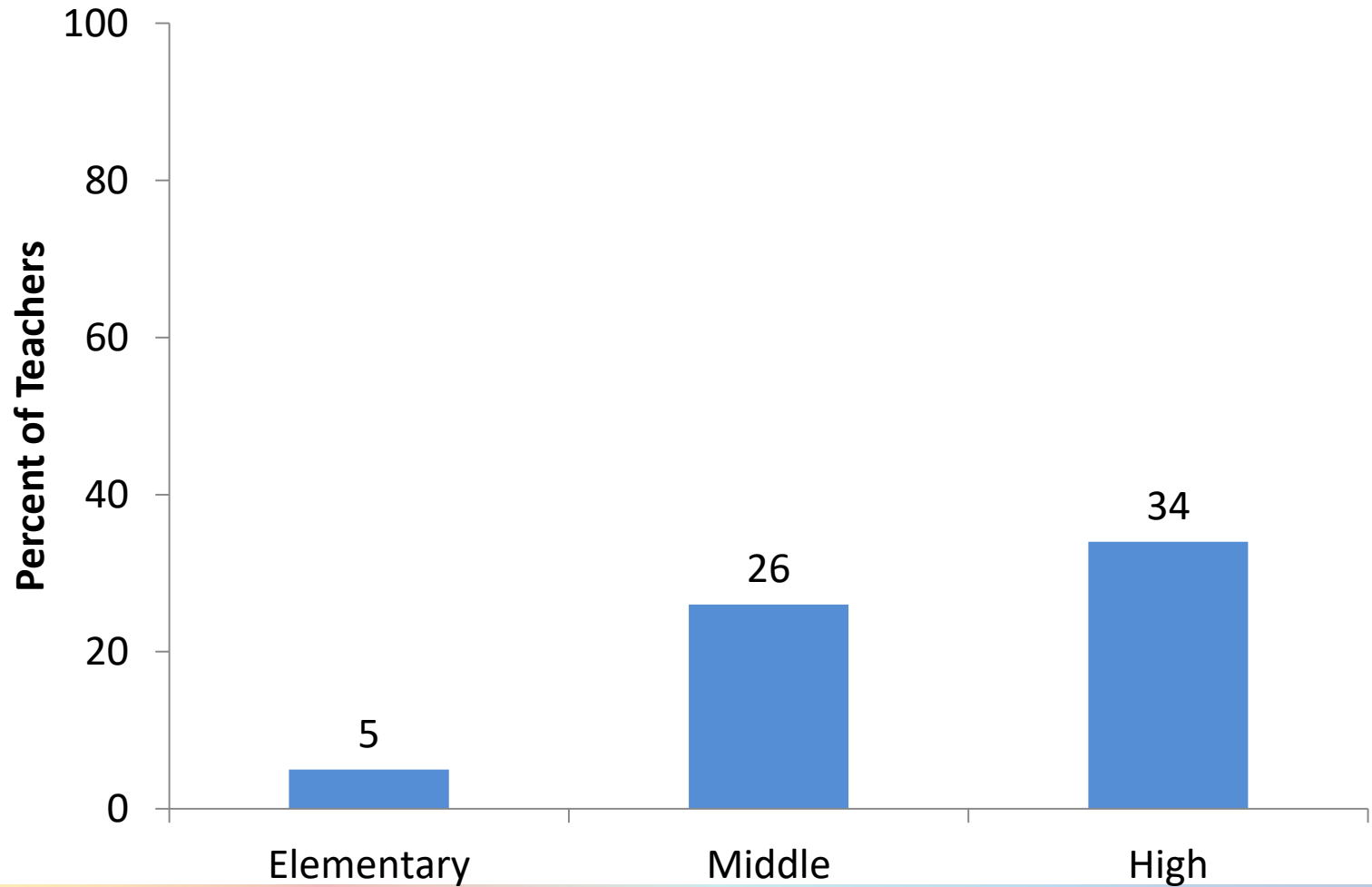


No Science PD in Last Three Years



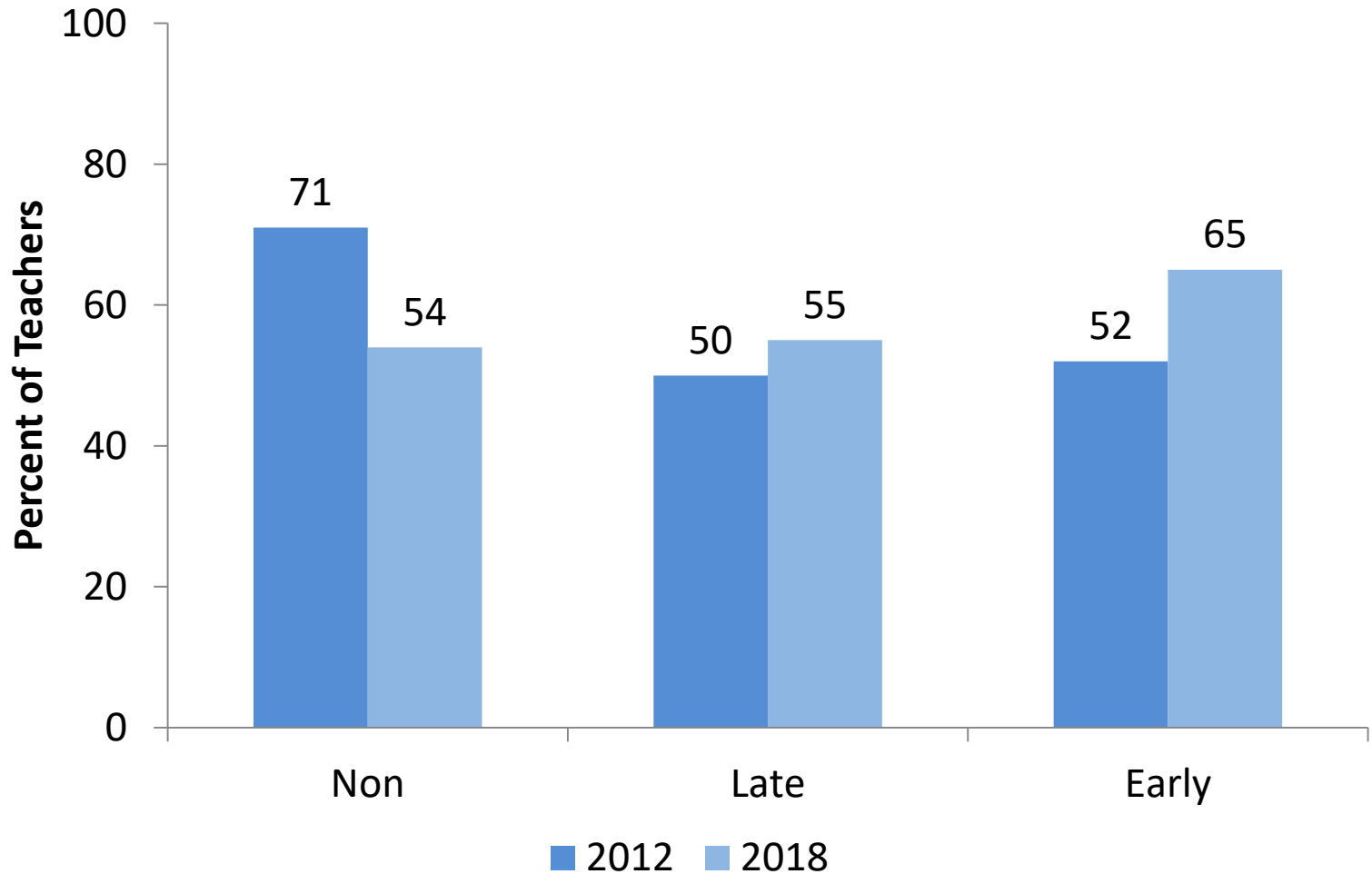


More Than 35 Hours of Science PD in Last Three Years



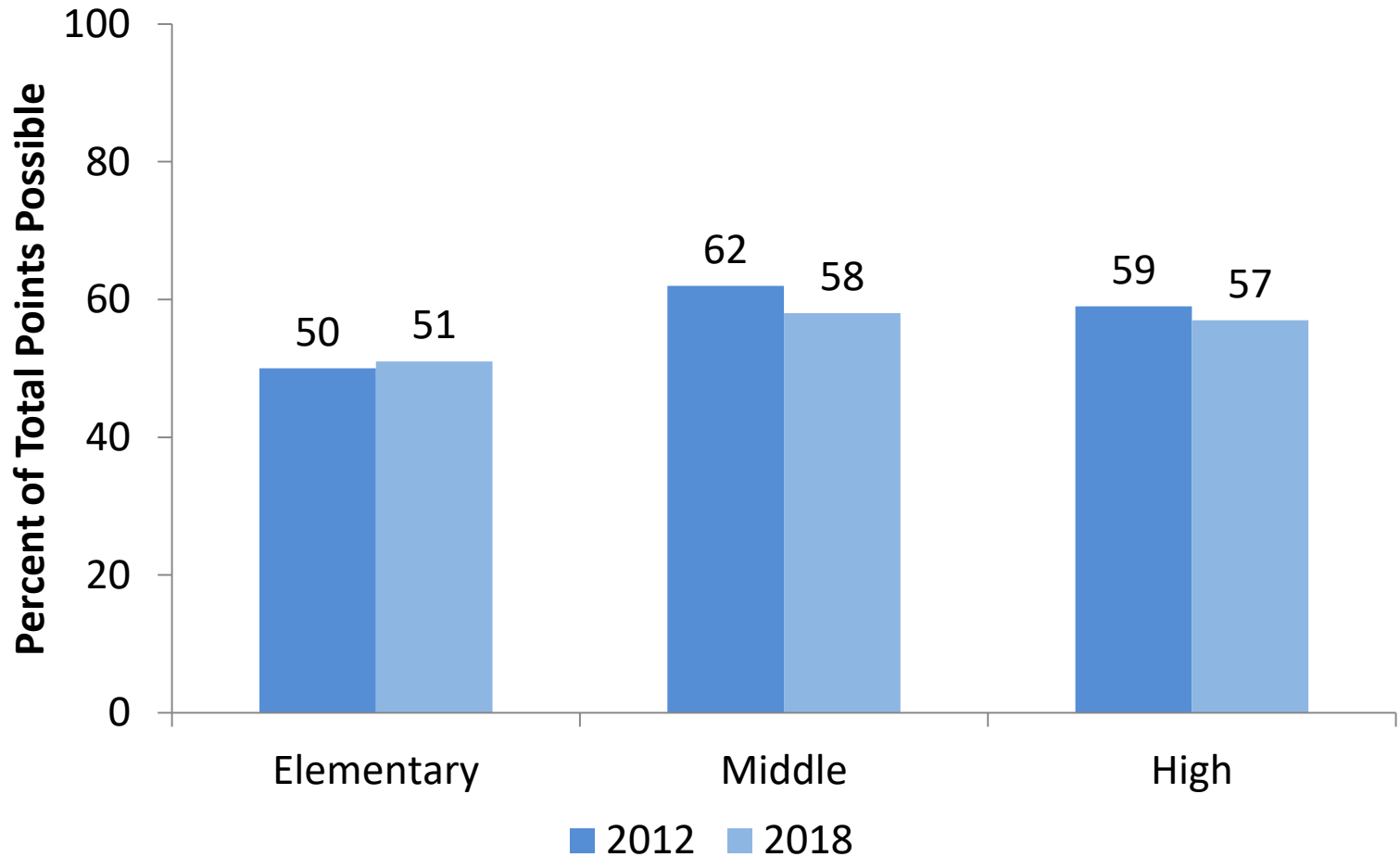


Participation in Science PD in Last Three Years - Elementary



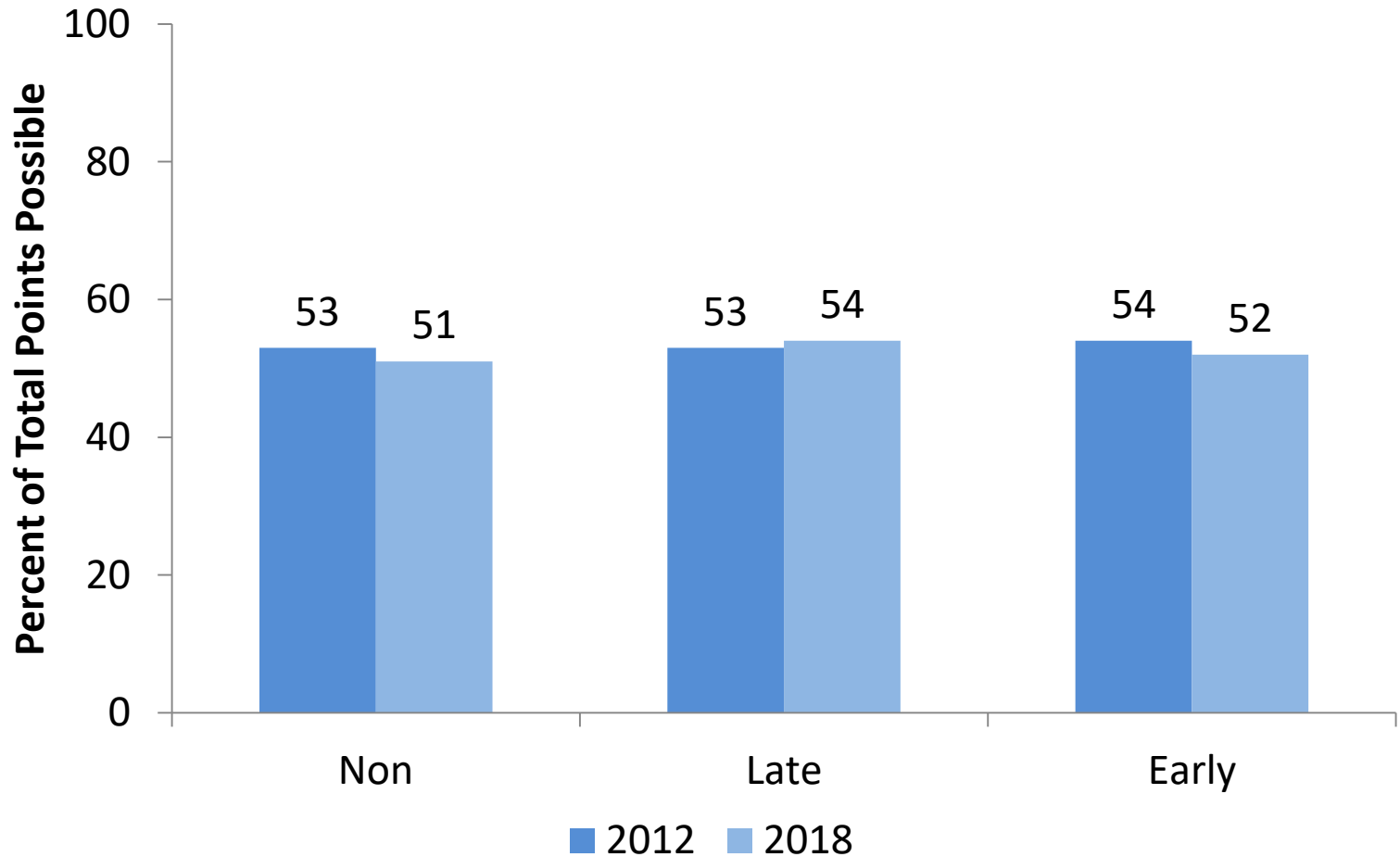


Alignment With Elements of Effective PD



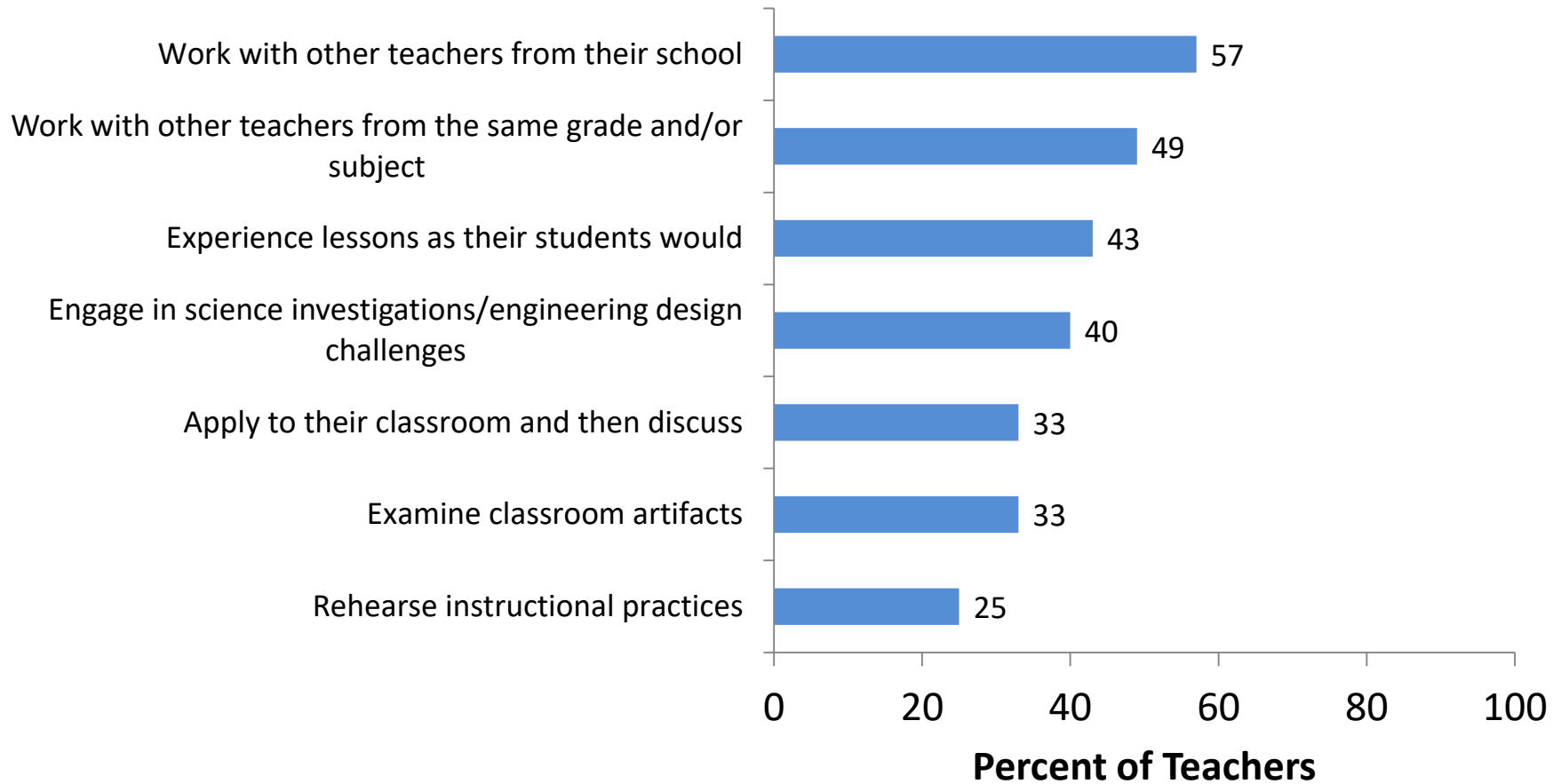


Alignment With Elements of Effective PD



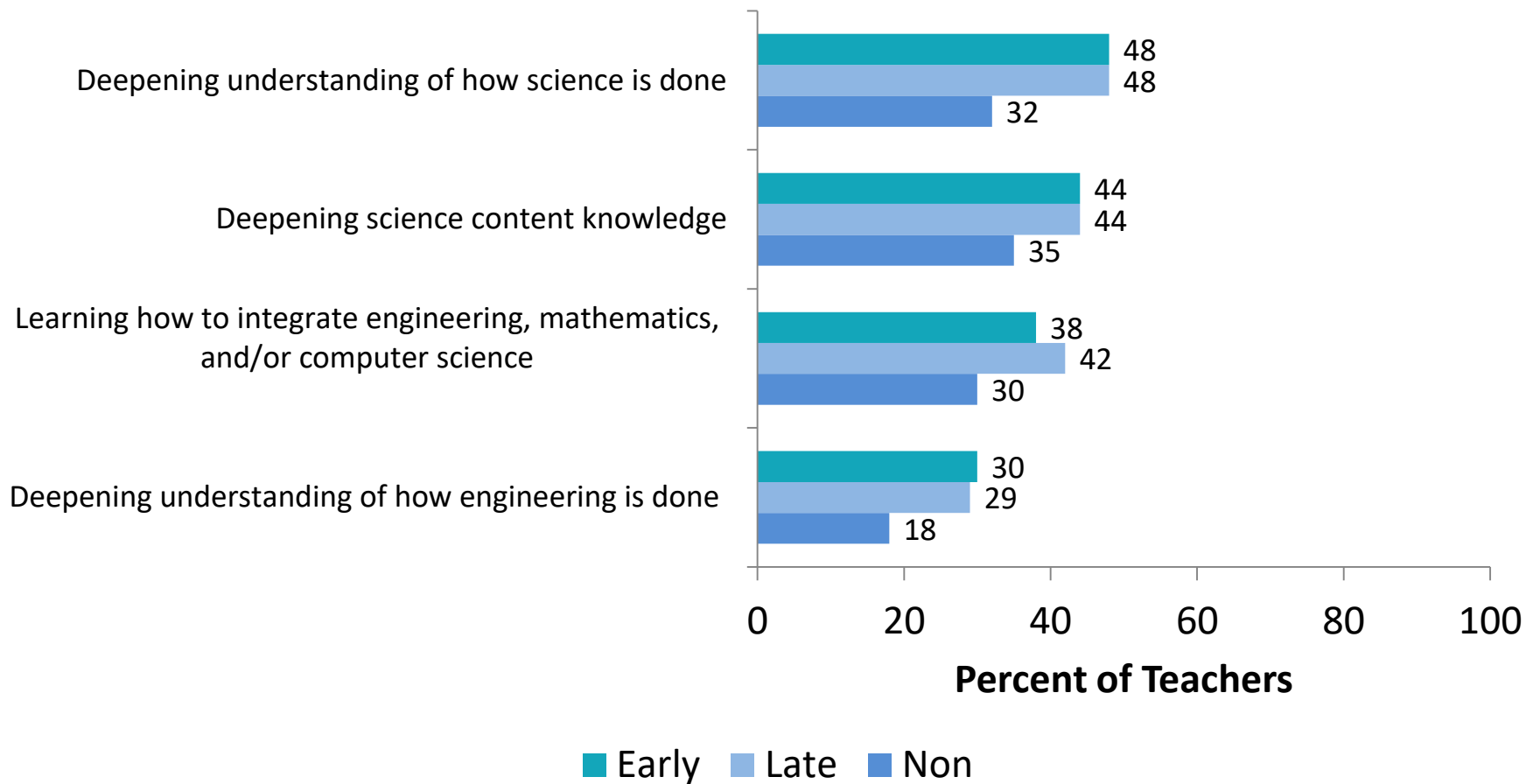


Characteristics of Effective PD in Last Three Years



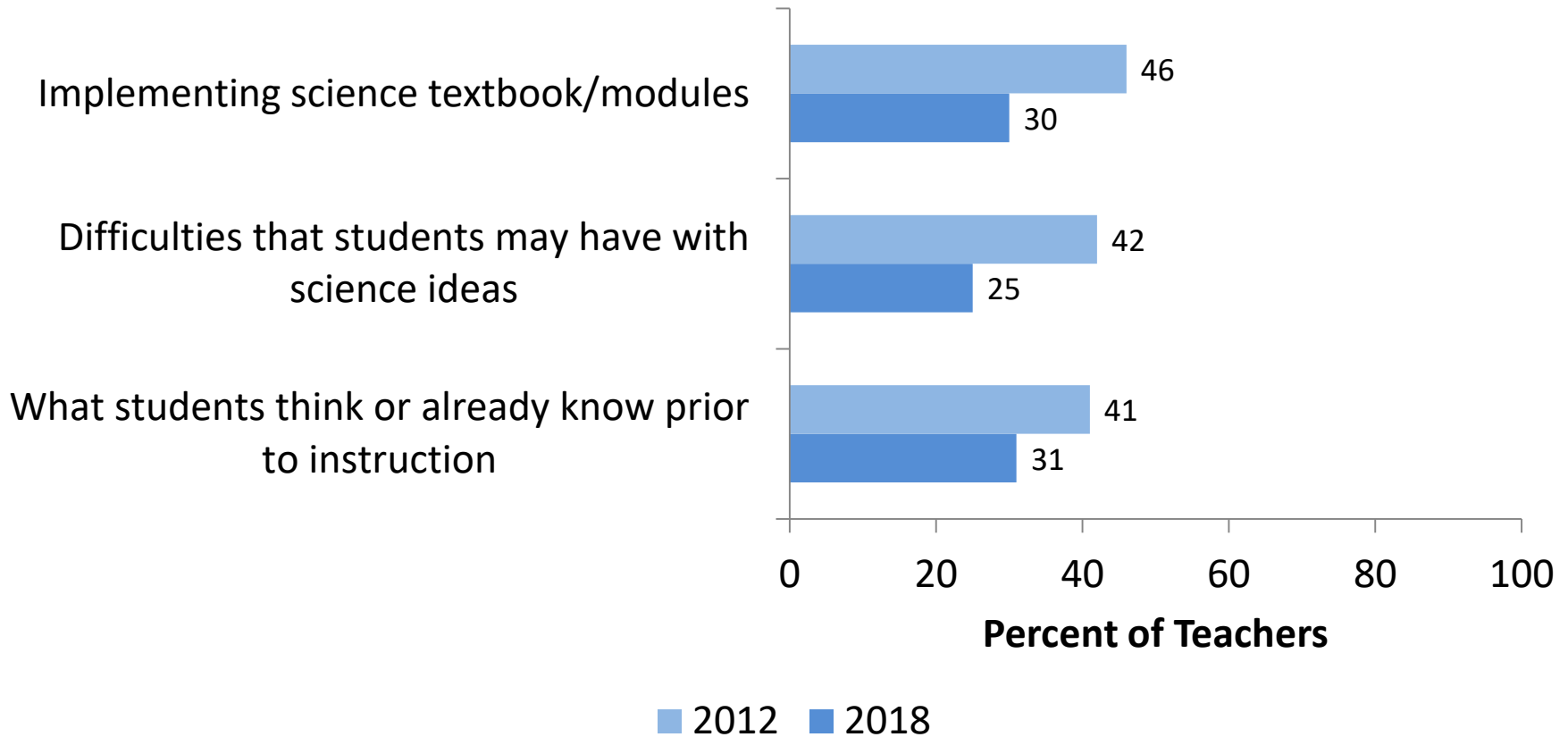


Heavy Emphasis of PD in Last Three Years



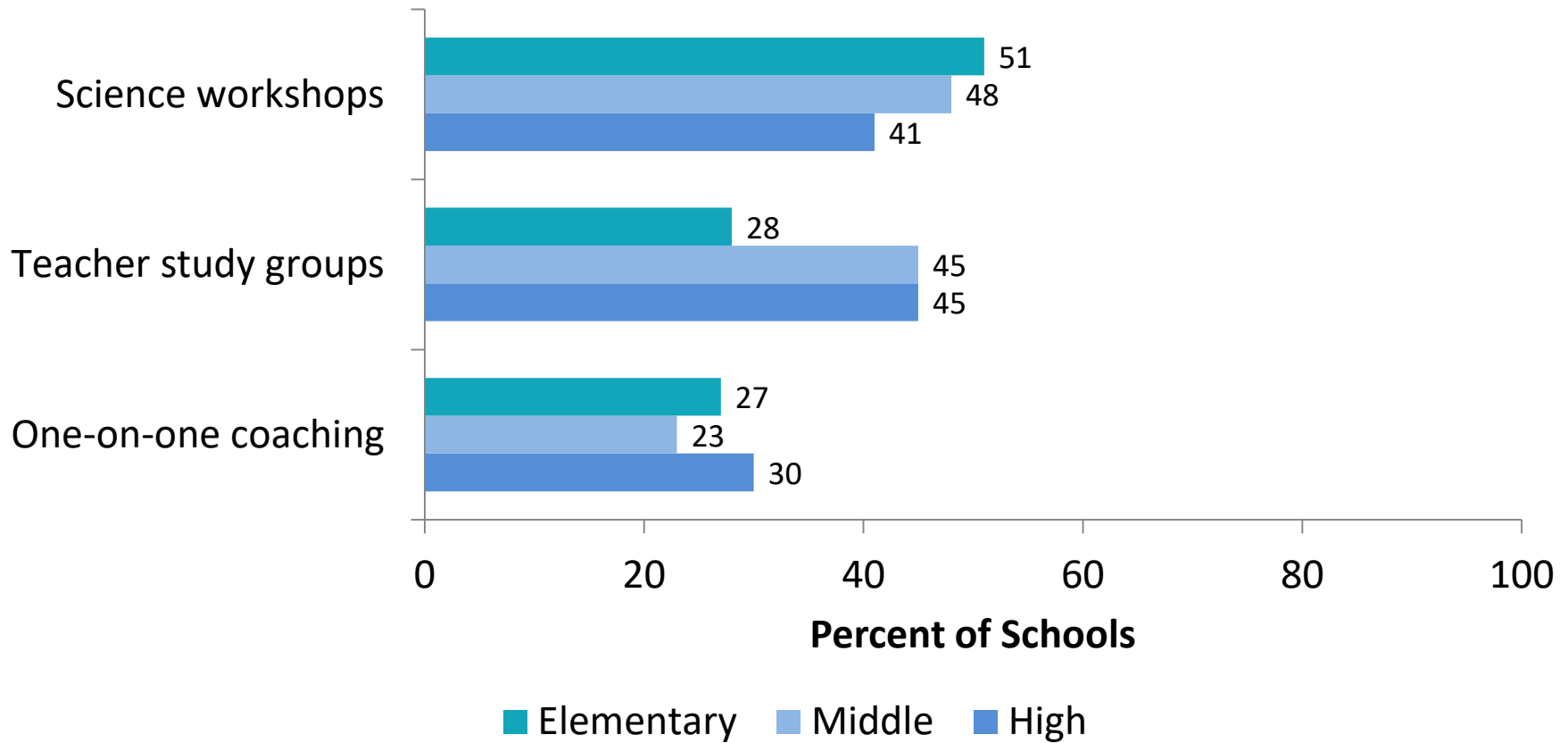


Heavy Emphasis of PD in Last Three Years – Early Adopters



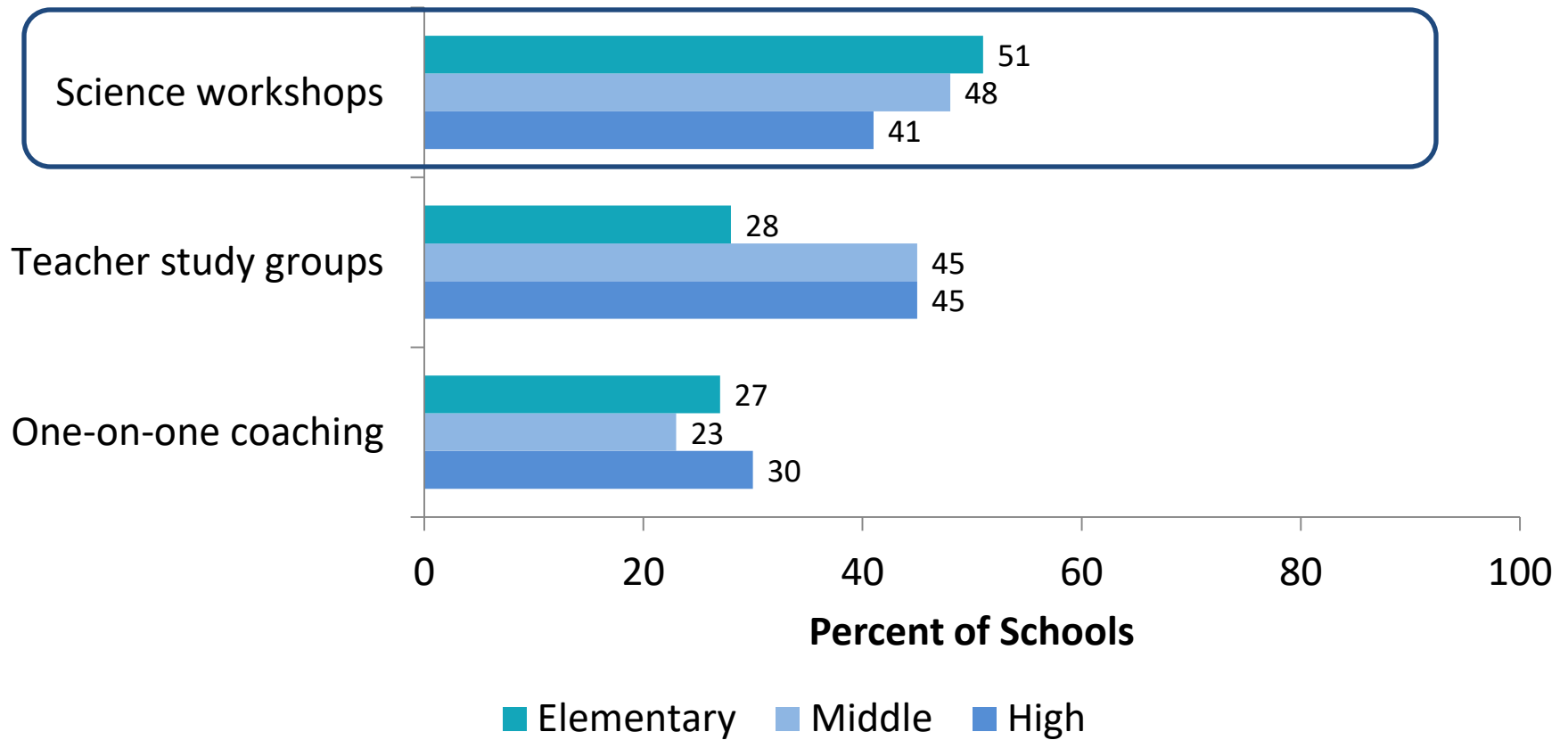


Science PD Offered Locally in Last Three Years



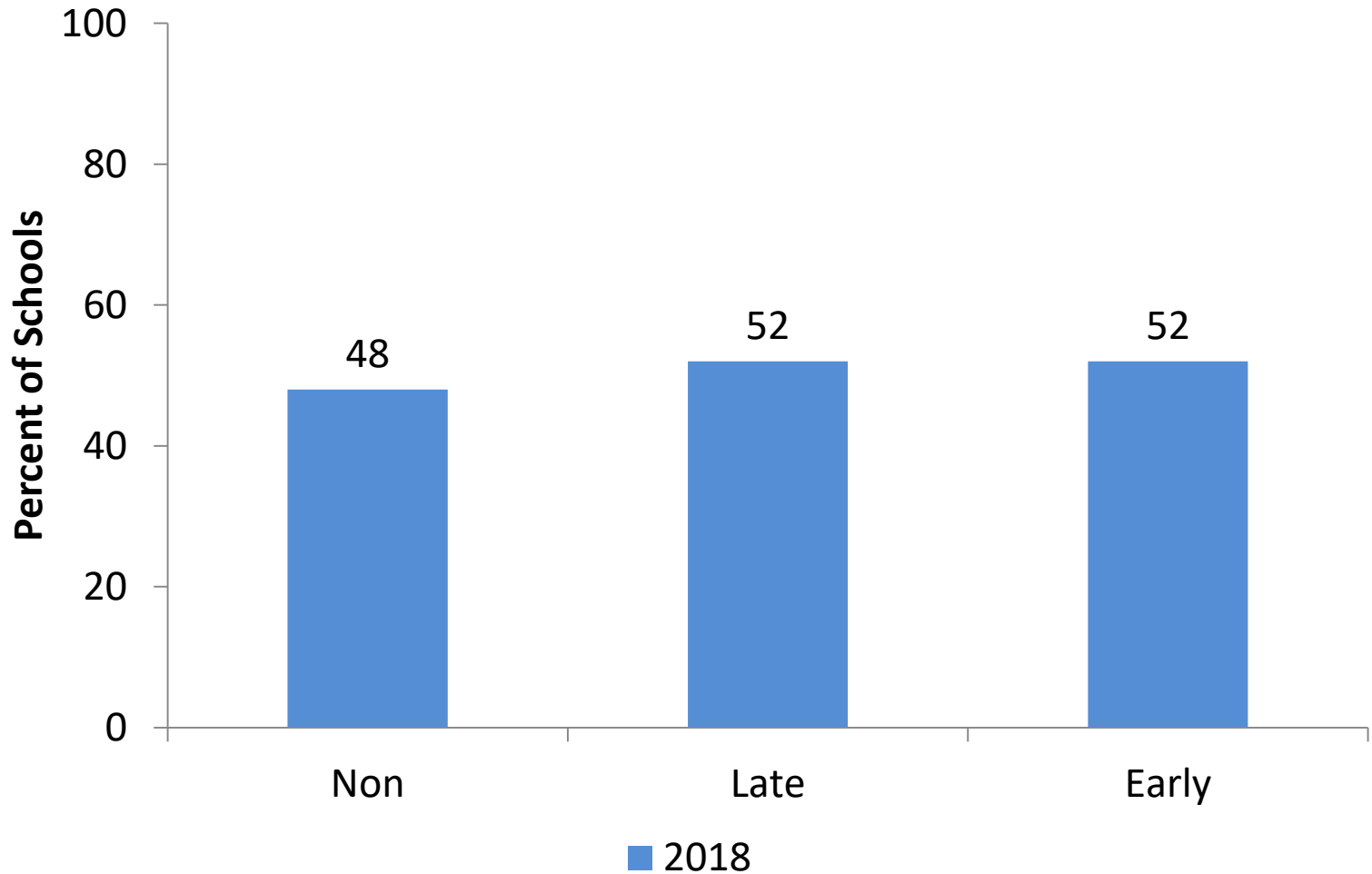


Science PD Offered Locally in Last Three Years





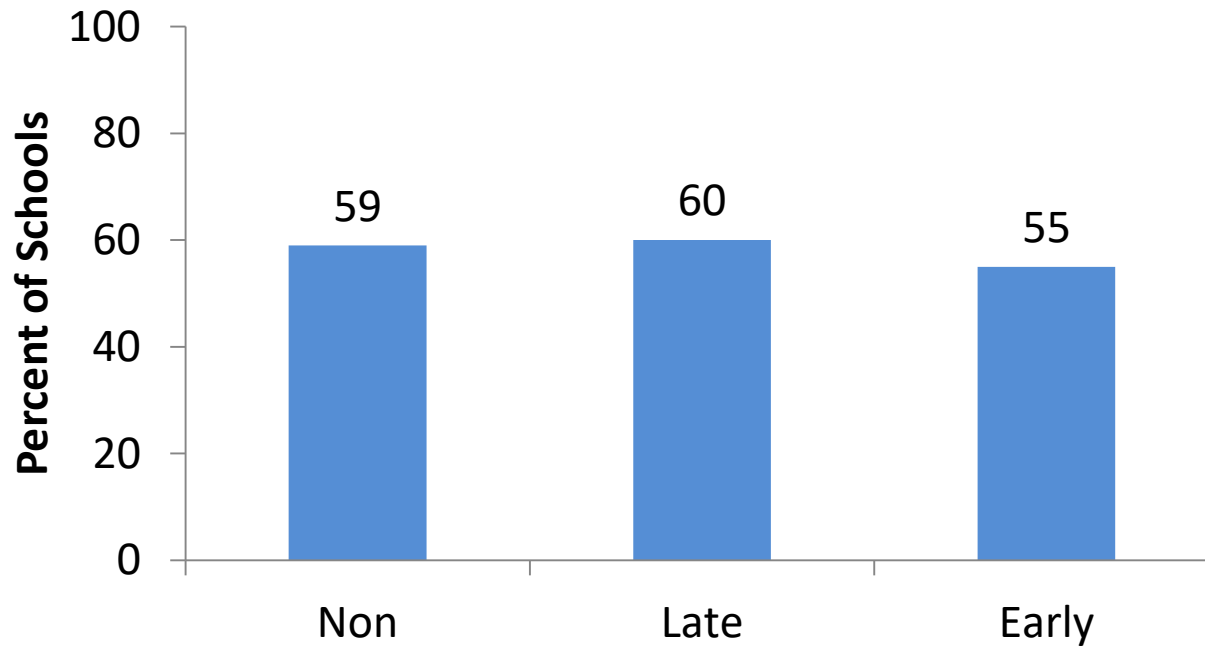
Science Workshops Offered Locally in Last Three Years





Influence of State Science Standards

The school/district/diocese organizes science professional development based on state standards.





Professional Development Takeaways

Participation in science focused PD is uneven

- elementary vs. middle and high
- NGSS adopters vs. non adopters

Quality of science focused PD is improving, but focus of PD varies

- NGSS adopters vs. non adopters

Teachers are generally not getting the PD opportunities they need to implement NGSS



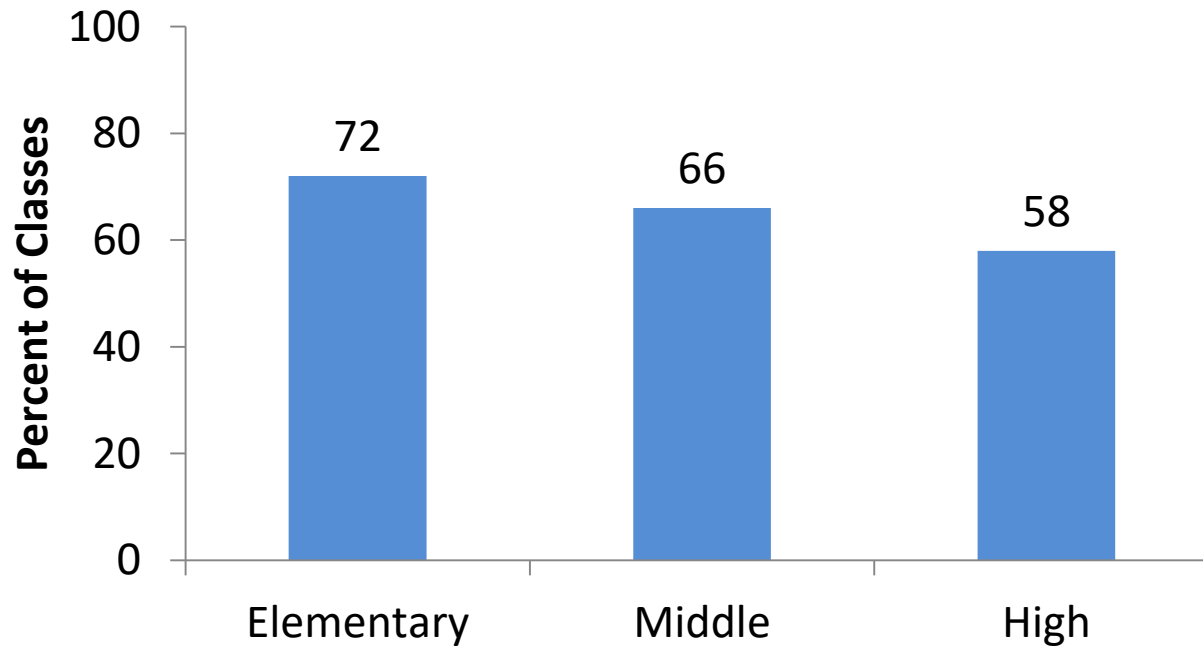
Resources for Instruction

- Instructional materials
- Other material resources



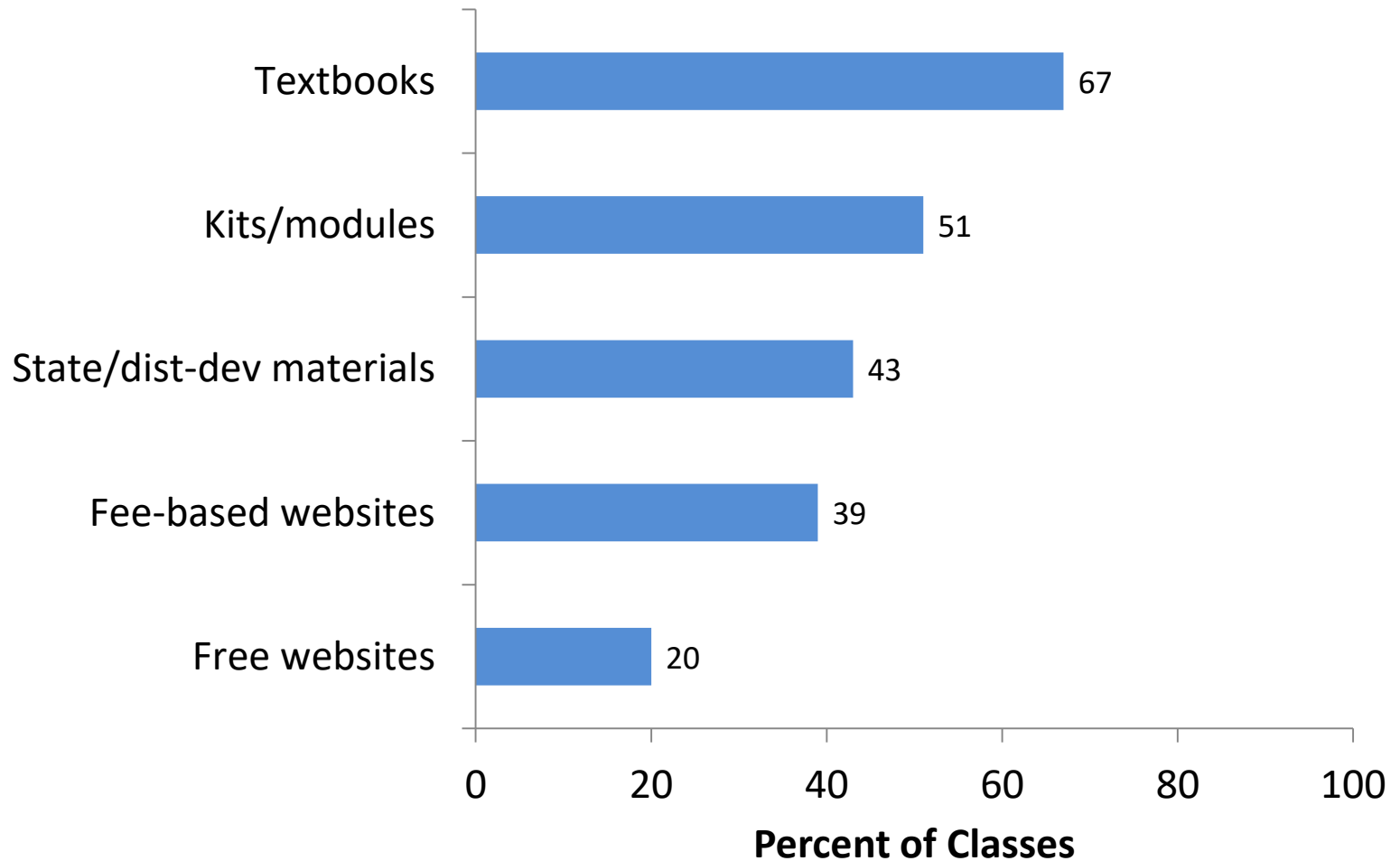
Instructional Materials

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



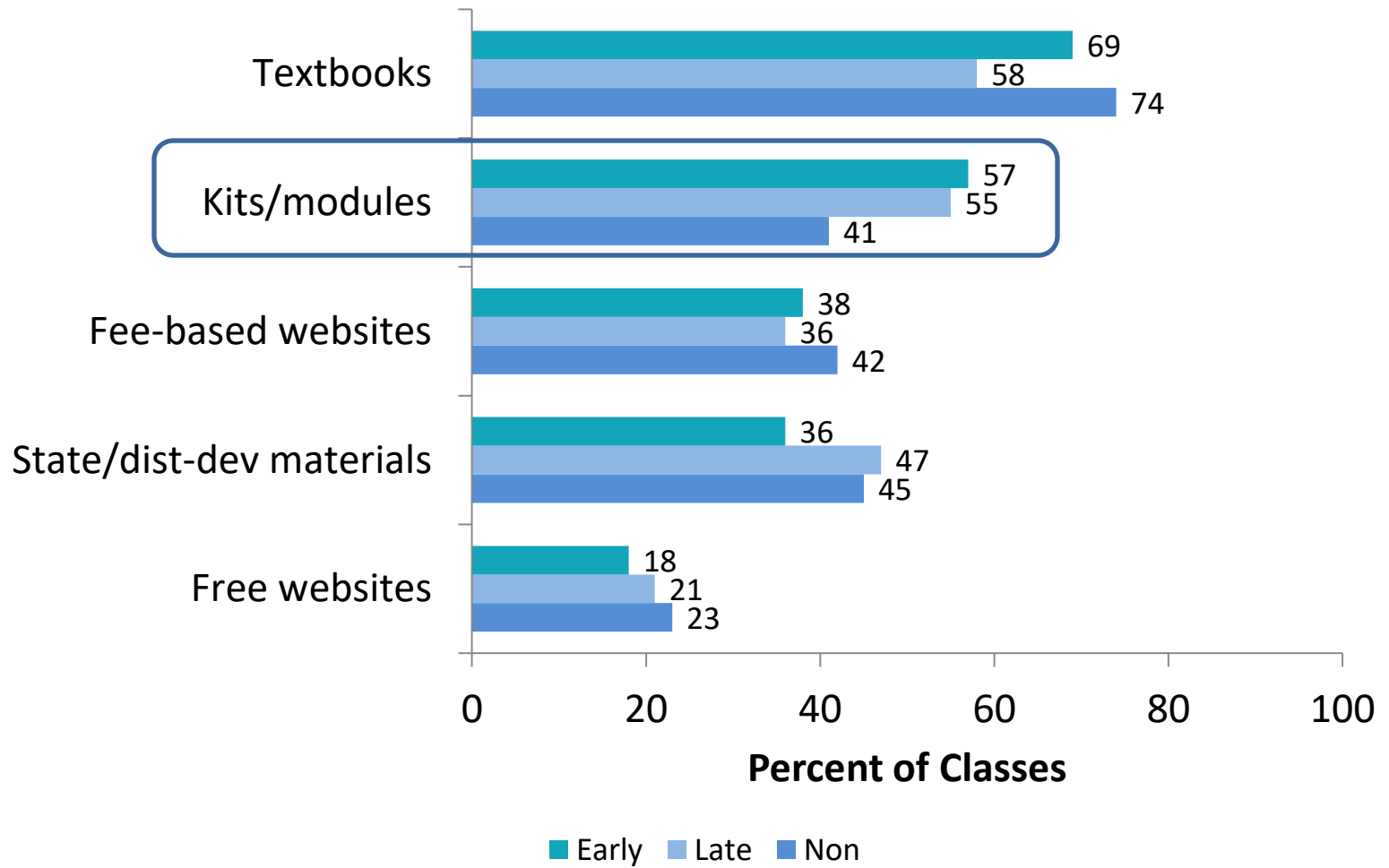


Designated Instructional Materials—All Grades



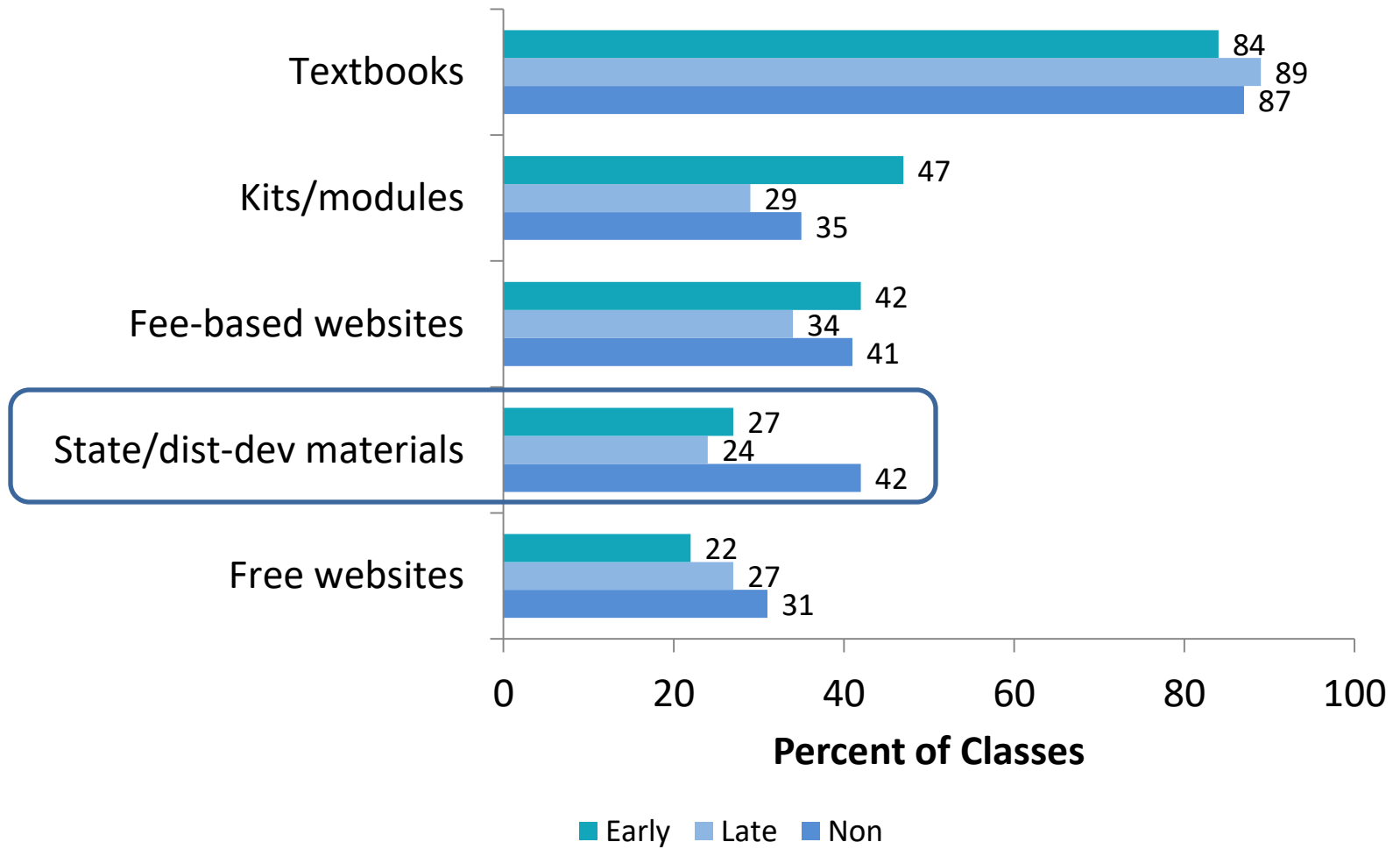


Designated Instructional Materials—Elementary



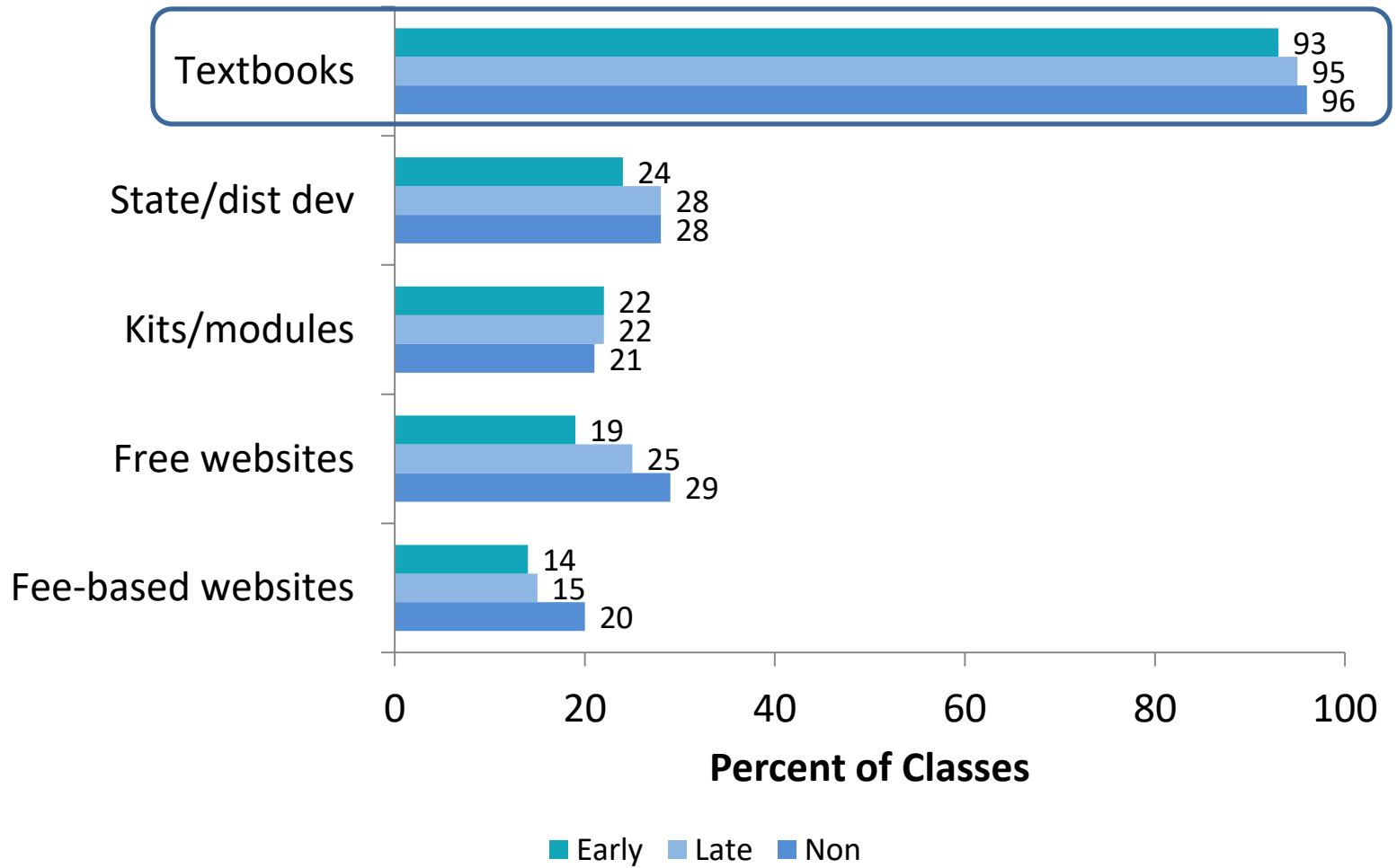


Designated Instructional Materials—Middle





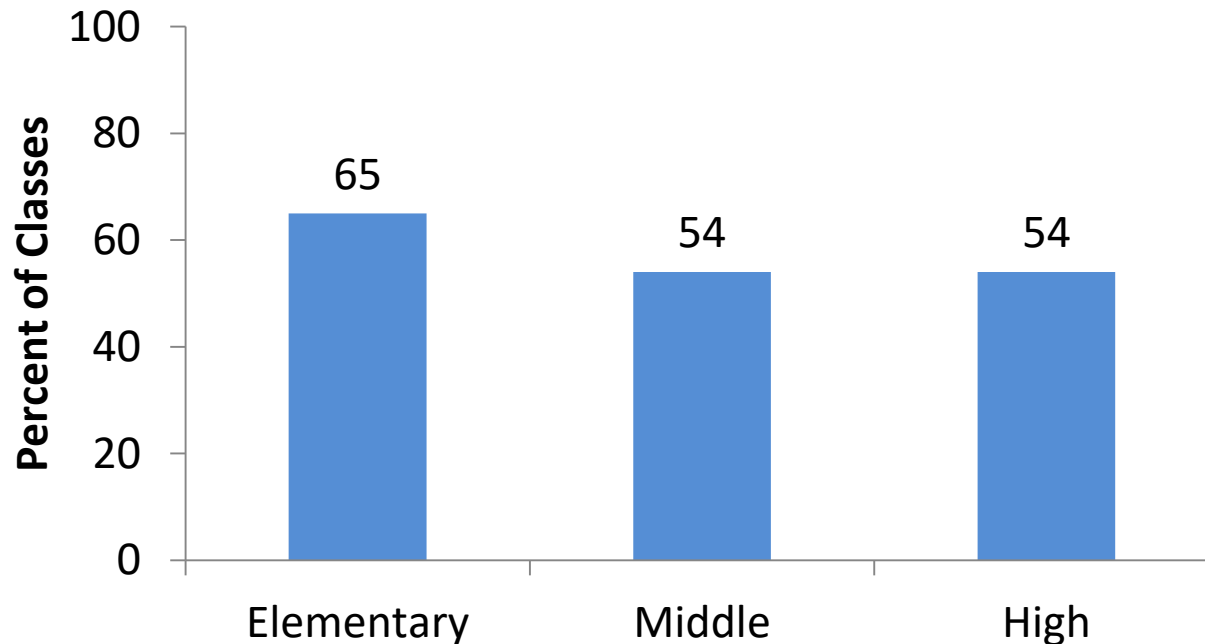
Designated Instructional Materials—High





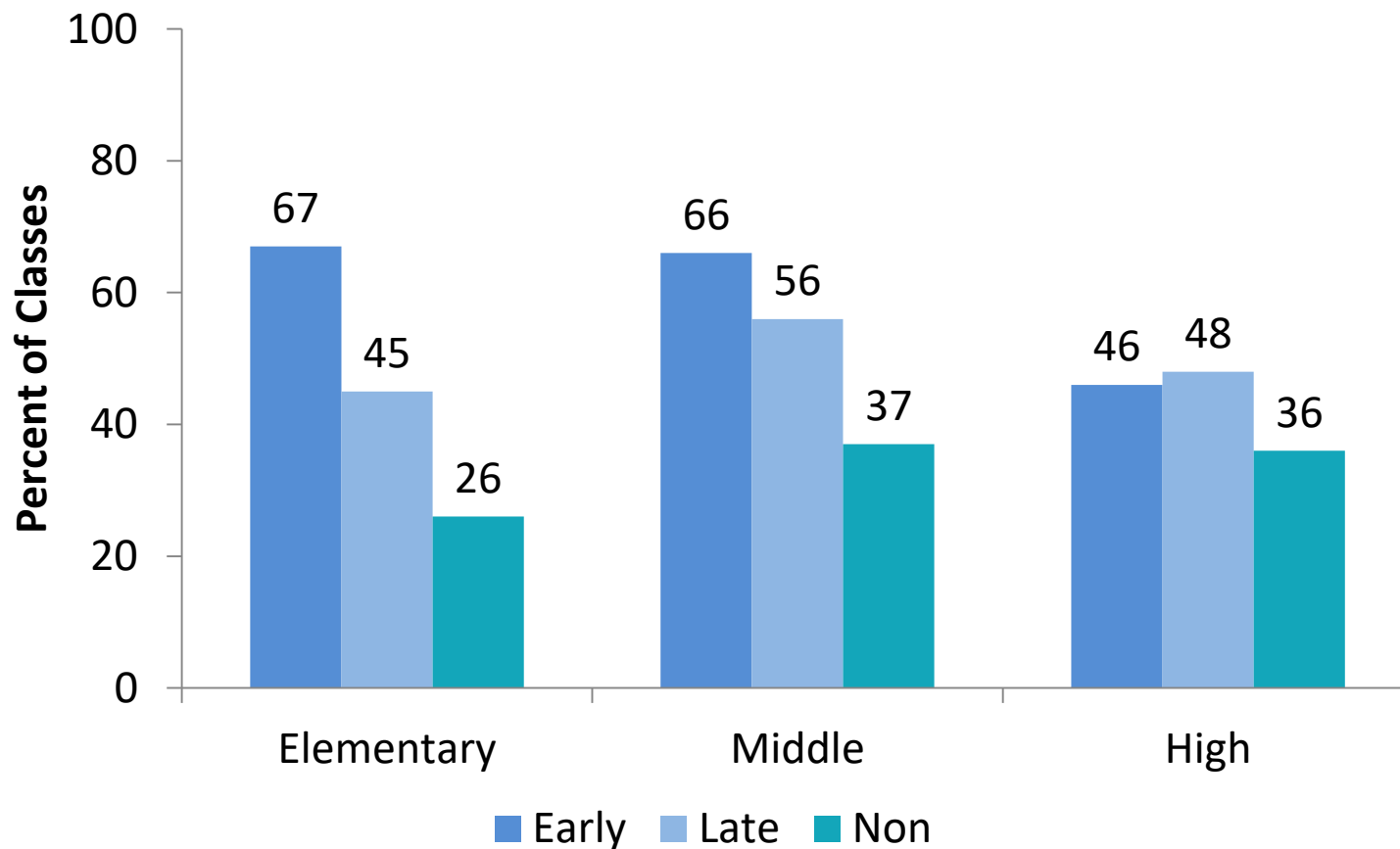
Instructional Materials

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





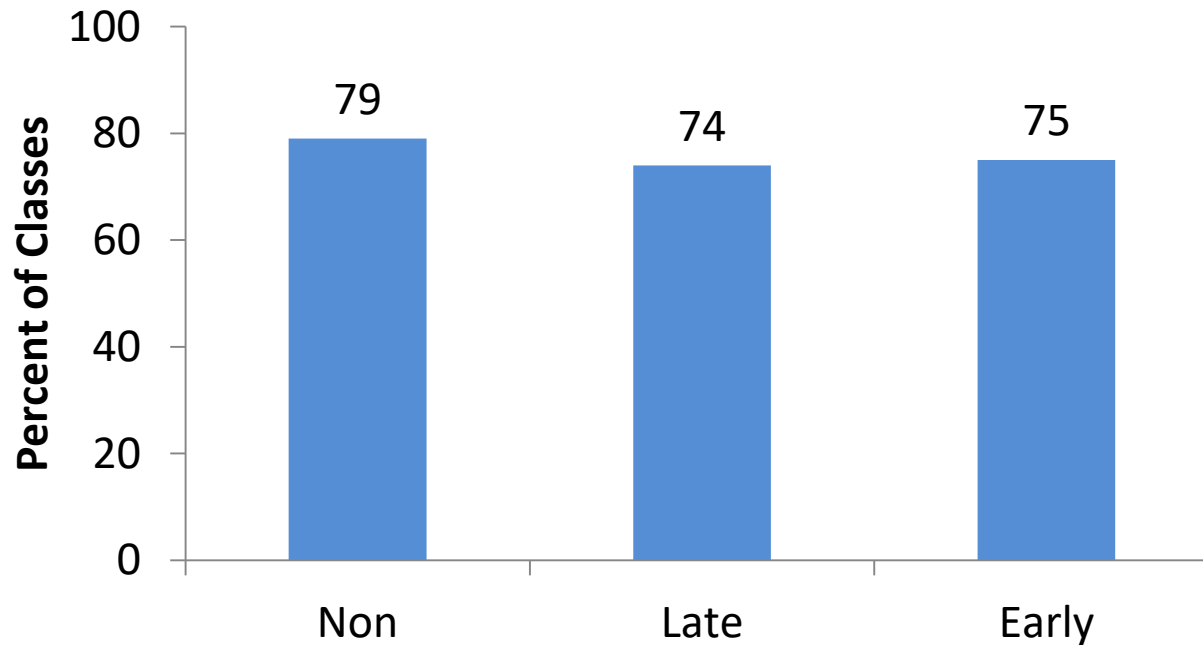
Science Classes Using Textbooks Published in 2009 or Earlier





Ways Teachers Used Their Textbook in Most Recent Unit

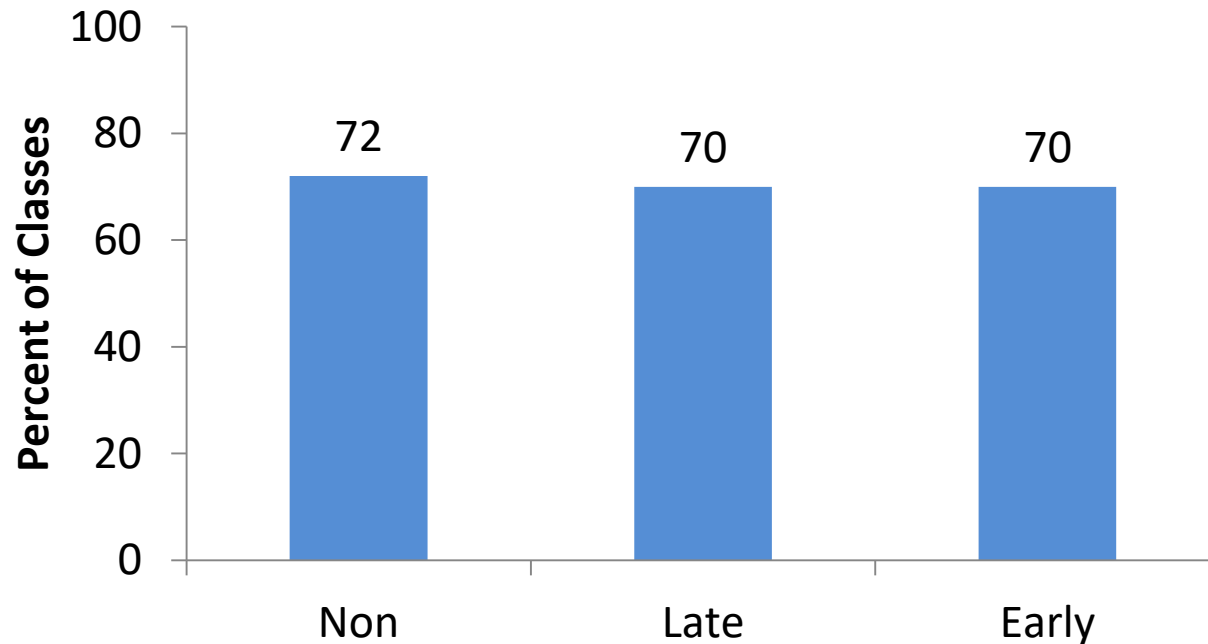
I used these materials to guide the structure and content emphasis of the unit.





Ways Teachers Used Their Textbook in Most Recent Unit

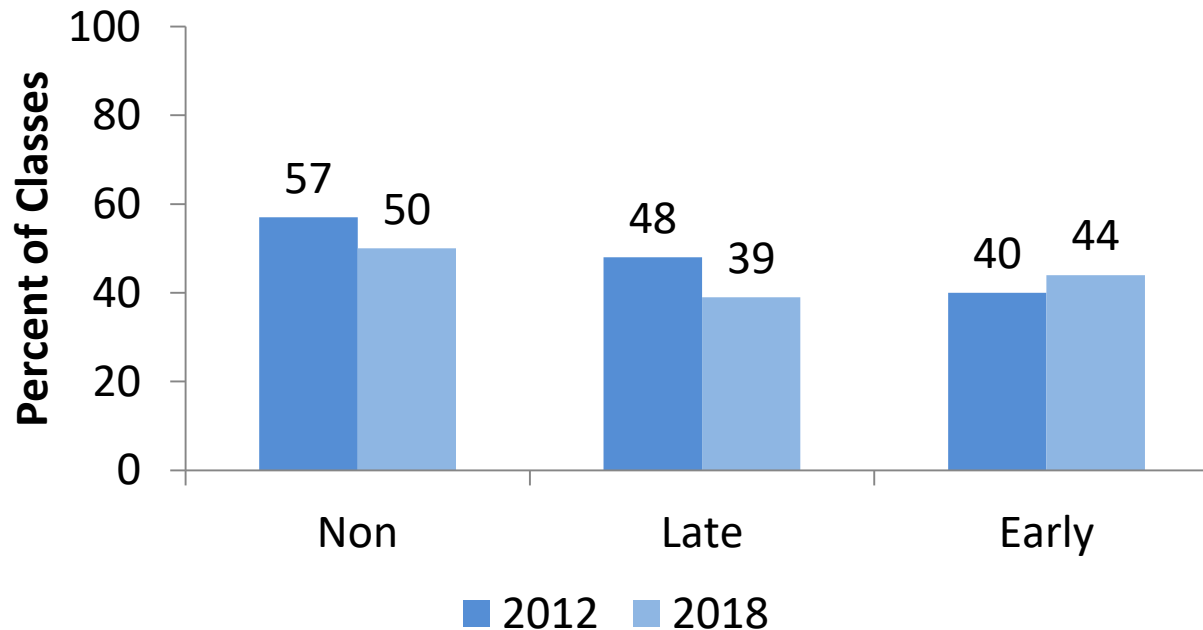
I incorporated activities (e.g., problems, investigations, readings) from other sources to supplement what these materials were lacking.





Reasons Why Science Materials Are Supplemented in Science Classes

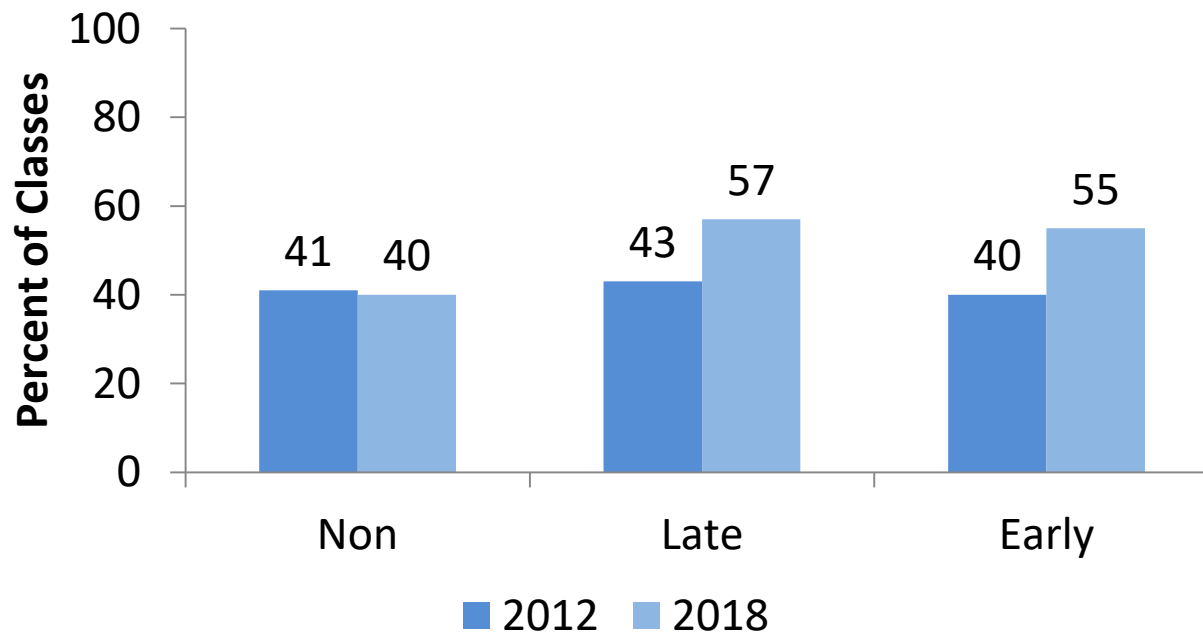
My pacing guide indicated that I should use supplemental activities.





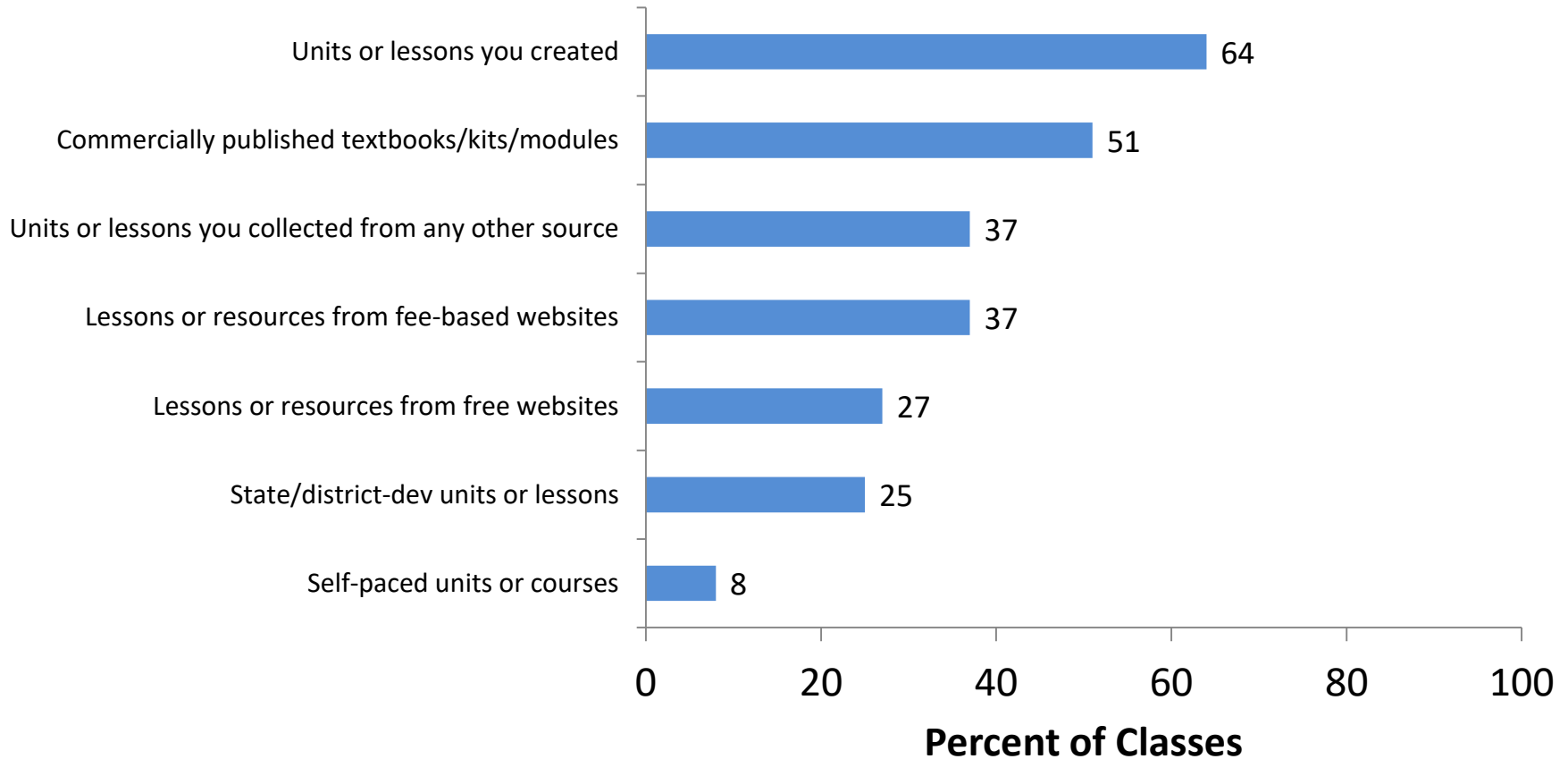
Ways Elementary Teachers Used Their Textbook in Most Recent Unit

I picked what was important and skipped the rest.





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





Other Material Resources

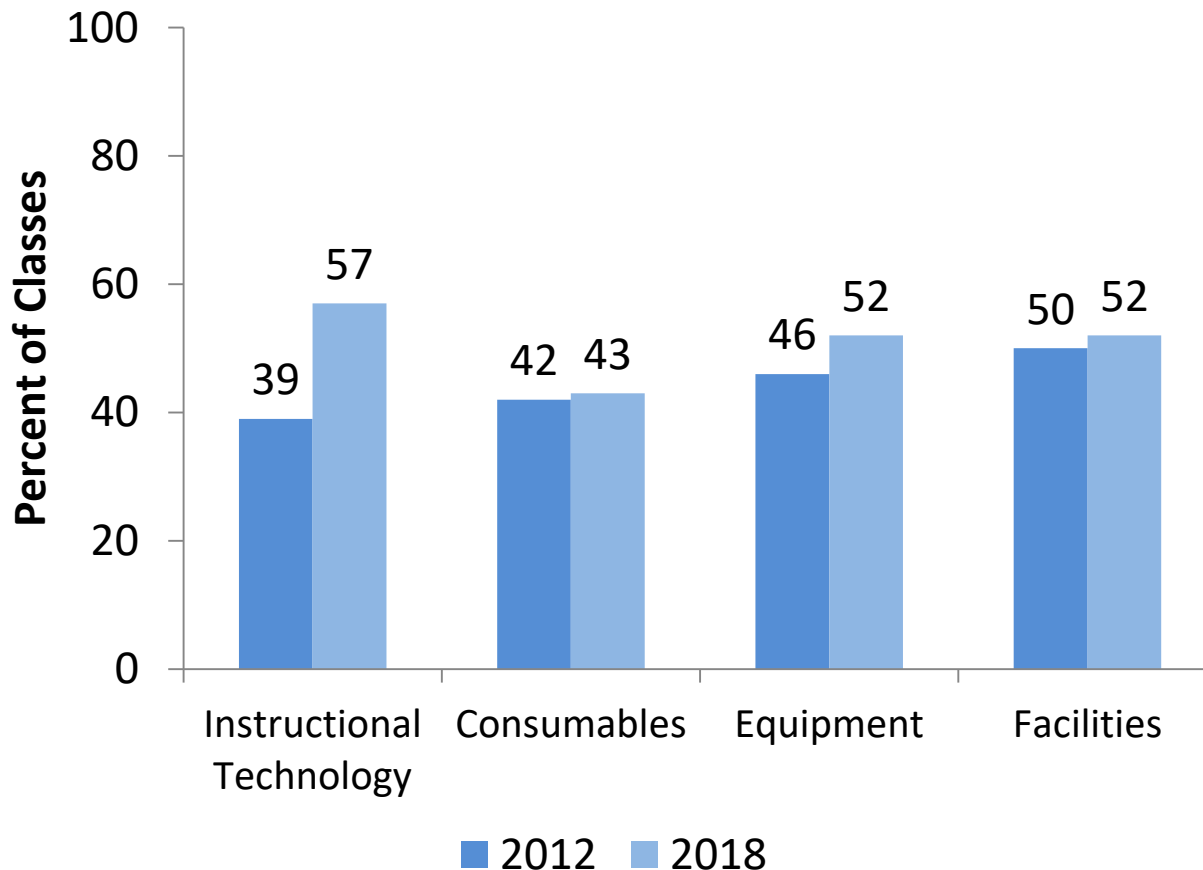
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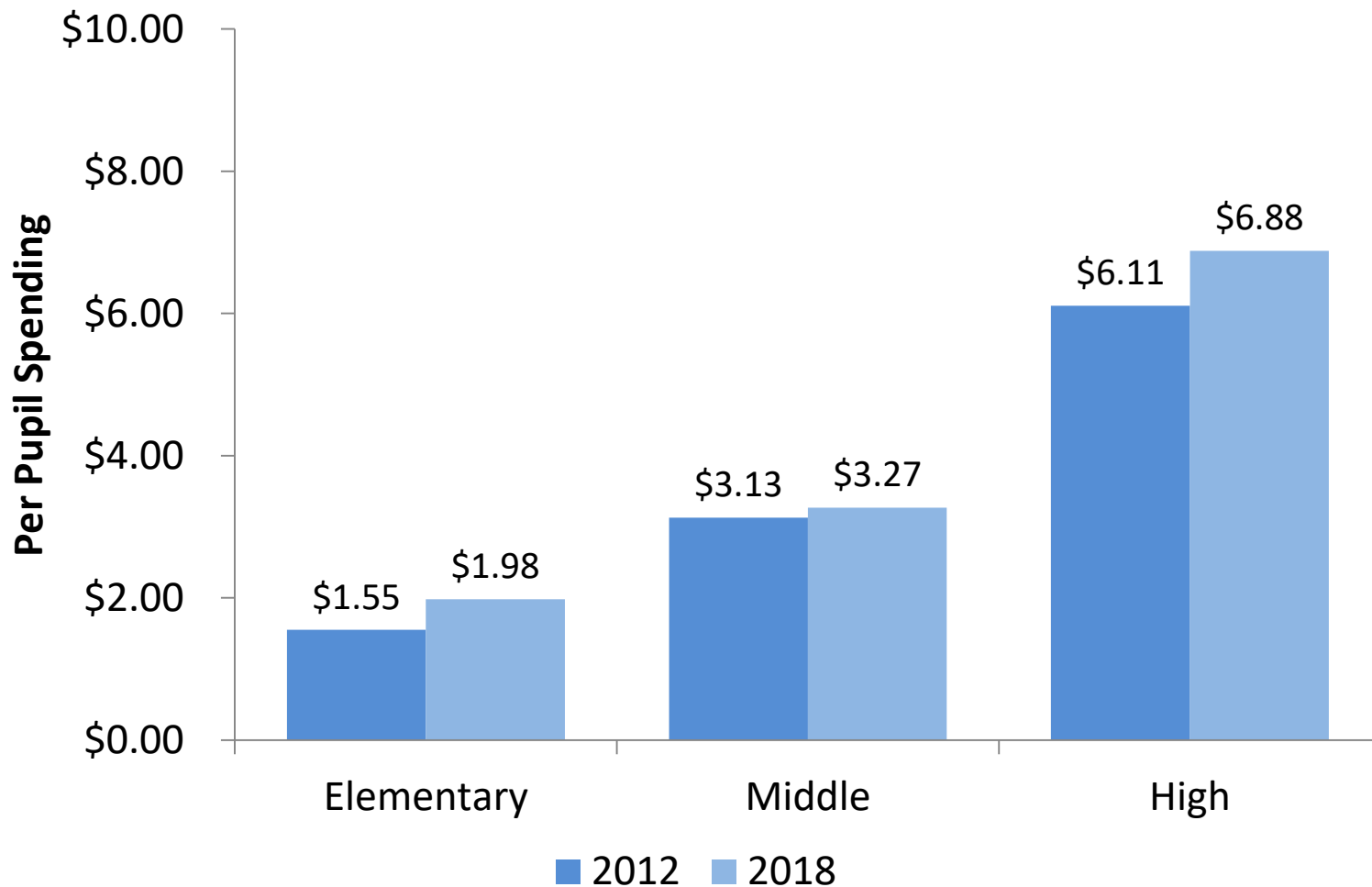


Adequacy of Resources for Science Instruction in Science Classes



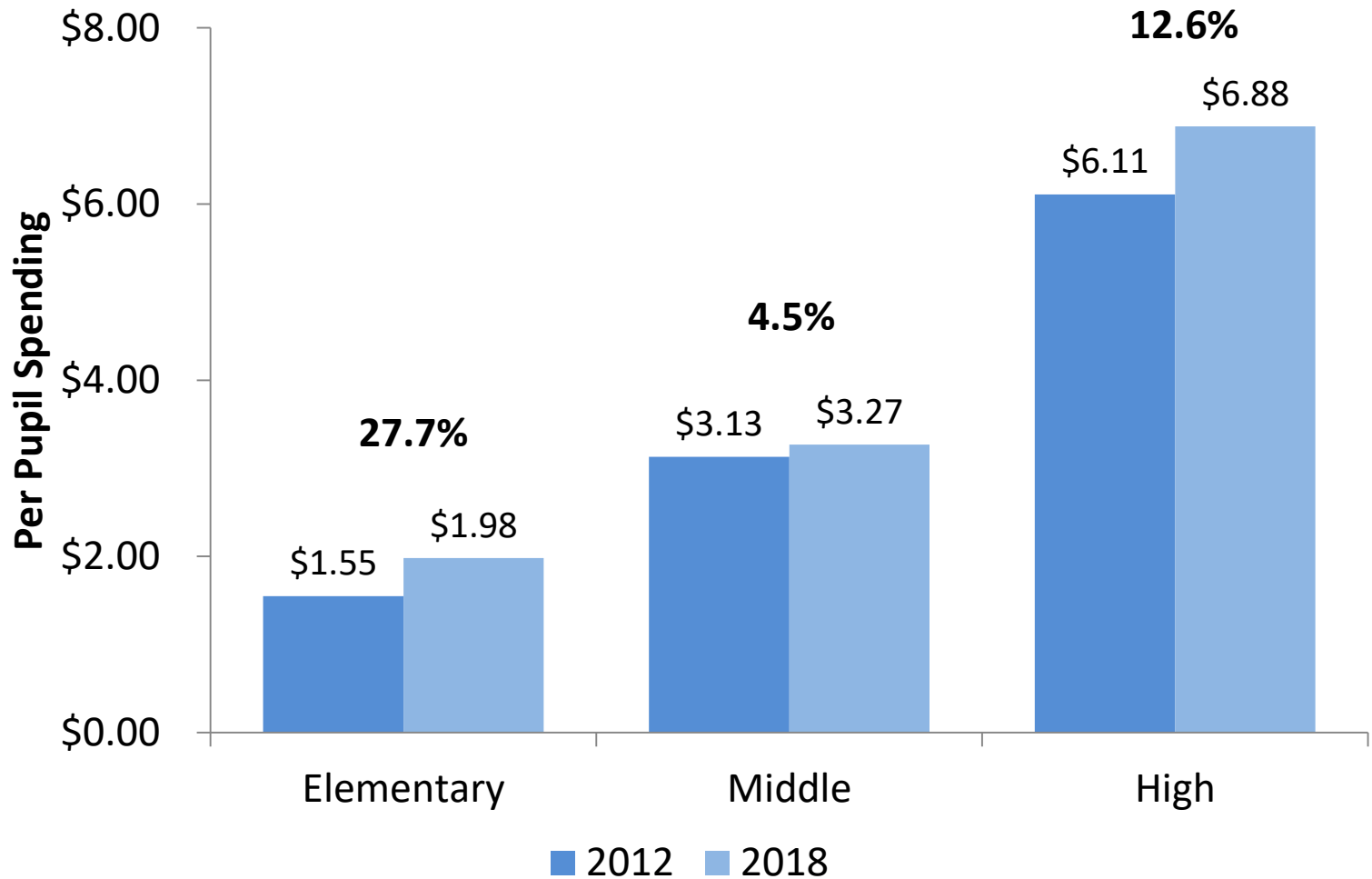


Median School Spending Per Pupil for Science





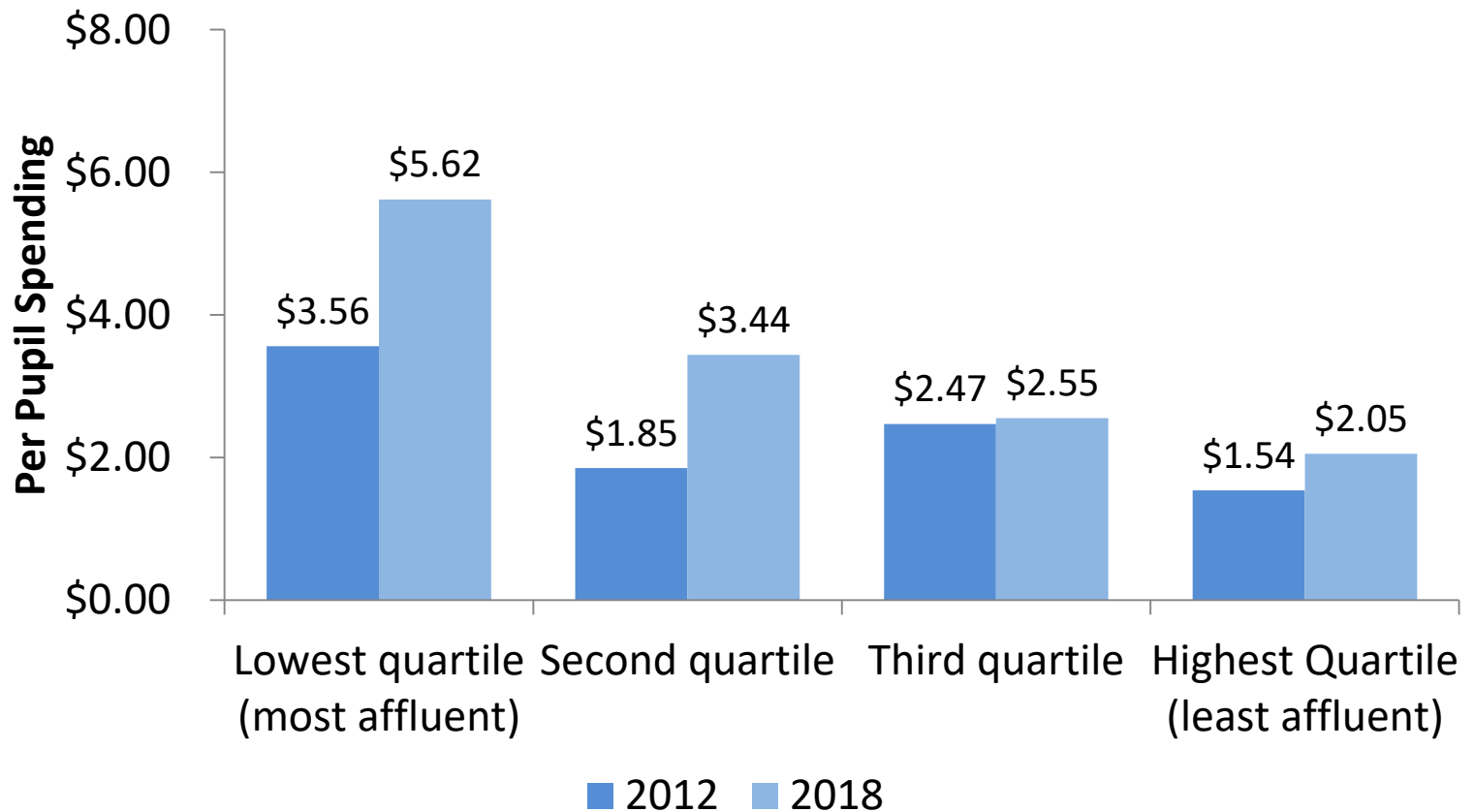
Median School Spending Per Pupil for Science





Equity Analysis

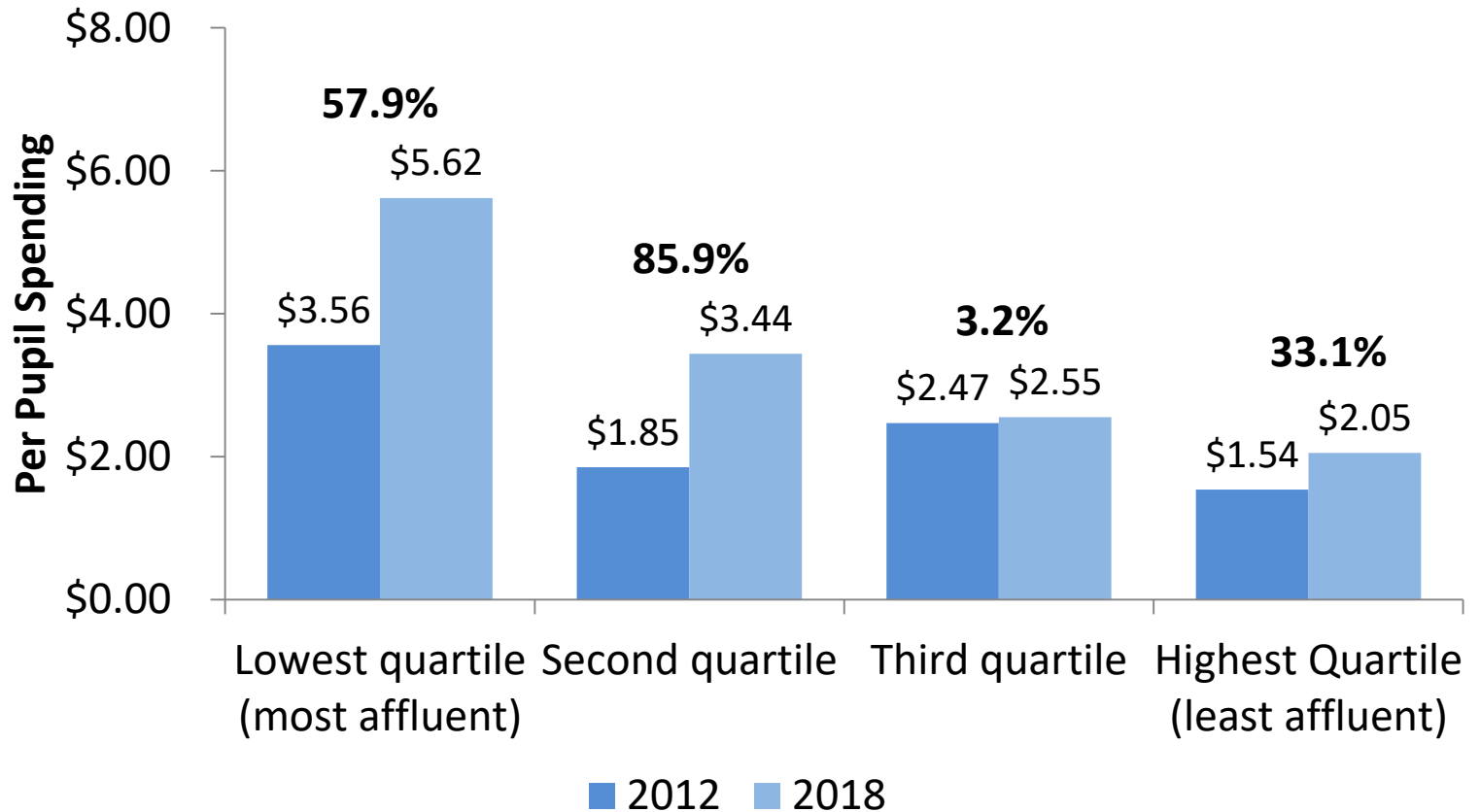
Spending by percentage of students eligible for free or reduced-price lunch in school





Equity Analysis

Spending by percentage of students eligible for free or reduced-price lunch in school





Resources for Instruction Takeaways

Commercially published materials heavily influence instruction, but most classes in NGSS states are using pre-NGSS materials.

The lack of NGSS-aligned materials is a formidable obstacle to implementation.

Schools appear to be only moderately well resourced for NGSS implementation, and less affluent schools are particularly underresourced.



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Current reports:

- Technical report
- Highlights report
- Compendium of Tables

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