Description of Reporting Variables

Region

Type of Community

Percentage of Students in School Eligible for Free/Reduced-Price Lunch

School Size

Grade Range

Percentage of Students from Race/Ethnicity Groups Historically Underrepresented in STEM in Class

Overview of Composites

Definitions of Teacher Composites

- Teacher Background and Opinions
  - Extent Professional Development Aligns With Elements of Effective Professional Development
  - Extent Professional Development Supports Student-Centered Instruction
  - Perceptions of Content Preparedness: Elementary Science
  - Perceptions of Content Preparedness: Elementary Mathematics
  - Perceptions of Content Preparedness: Secondary Science
  - Perceptions of Content Preparedness: Secondary Mathematics
  - Perceptions of Content Preparedness: High School Computer Science
  - Perceptions of Preparedness to Teach Engineering
  - Perceptions of Pedagogical Preparedness
  - Perceptions of Preparedness to Implement Instruction in Particular Unit
  - Traditional Teaching Beliefs
  - Reform-Oriented Teaching Beliefs
- Decision-Making Autonomy
  - Curriculum Control
  - Pedagogy Control
- Instructional Objectives
  - Reform-Oriented Instructional Objectives
- Teaching Practices
  - Engaging Students in Practices of Science
  - Engaging Students in Practices of Mathematics
  - Engaging Students in Practices of Computer Science
- Influences on Instruction
  - Adequacy of Resources for Science Instruction
  - Adequacy of Resources for Mathematics Instruction
  - Extent to Which Computer/Internet Access is Problematic

Definitions of Program Composites

Description of Reporting Variables

Region

Each sample school and teacher was classified as belonging to 1 of 4 census regions:

- Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI;
- Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT;
- South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, SC, TN, VA, WV; or
- West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OK, OR, TX, UT, WA, WY.

Type of Community

Each sample school and teacher was classified as belonging to 1 of 3 types of communities:

- Urban: Central city;
- Suburban: Area surrounding a central city, but still located within the counties constituting a Metropolitan Statistical Area (MSA); or
- Rural: Area outside any MSA.

Percentage of Students in School Eligible for Free/Reduced-Price Lunch

Each school was classified into one of four categories based on the proportion of students eligible for free/reduced-price lunch (FRL). Defining common categories across grades K–12 would have been misleading, as students tend to select out of the FRL program as they advance in grade due to perceived social stigma. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

School Size

Schools were classified into one of four categories based on the number of students served in the school. Defining common categories across grades K–12 would have been misleading, as average school size tends to increase from elementary to middle to high school. Therefore, the categories were defined as quartiles within groups of schools serving the same grades (e.g., schools with grades K–5, schools with grades 6–8).

Grade Range

Teachers were classified by grade range according to the information they provided about their teaching schedule. Most of the analyses in this report used elementary, middle, and high with teachers and classes being categorized based on the grade range information provided by the teacher. Elementary was defined as grades K–5 plus 6th grade self-contained; middle was defined as 6th grade non-self-contained and grades 7–8; high was defined as grades 9–12.

Percentage of Students from Race/Ethnicity Groups Historically Underrepresented STEM in Class

Each randomly selected class was classified into one of four categories based on the proportion of students in the class identified as being from race/ethnicity groups historically underrepresented in STEM (i.e., American Indian or Alaskan Native, Black or African

American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, multi-racial). As this proportion is similar in schools regardless of grades served, the categories were defined as quartiles across all classes.

Overview of Composites

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, HRI used factor analysis to identify survey questions that could be combined into "composites." Each composite represents an important construct related to computer science, mathematics or science education. Composites were calculated for the computer science, mathematics and science versions of the teacher questionnaire and for the program questionnaire completed by each responding school in the sample.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0 and the others were adjusted accordingly; so for example, an item with a scale ranging from 1 to 4 was re-coded to have a scale of 0 to 3. By doing this, someone who marks the lowest point on every item in a composite receives a composite score of 0 rather than some positive number. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a 9-item composite where each item is on a scale of 0–3 would have a denominator of 0.27. Composites values were not computed for participants who respond to fewer than two-thirds of the items that form the composite.

The composites were derived through a multi-stage process. As a first step, to test whether the items intended to target the same underlying construct indeed showed similar response patterns, an exploratory factor analysis was conducted on a subset of the data. (The complete dataset was split randomly into two subsets to allow for independent exploratory and confirmatory factor analyses.) Using Mplus version 8.1 and applying the appropriate weights (teacher, class, or school weights), several different factor solutions were produced and scree plots, eigenvalues, and factor patterns were examined. Based on item fit and conceptual coherence, preliminary composite definitions were created. Next, the preliminary composite definitions were applied to a different subset of the data and a confirmatory factor analysis was performed, again using Mplus. When analyzing data from a complex sample design, Mplus provides one fit index to evaluate the model: the standardized root mean square residual (SRMR). The psychometric literature provides multiple criteria for judging acceptable model fit using this index, ranging from 0.05–0.10.[28] The obtained values from final models[29] are presented in the tables, allowing the reader to apply his or her preferred criteria for evaluating fit. Lastly, to further aid in the assessment of the composites, Cronbach's coefficient alpha, a common measure of reliability,

[28] Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

[29] Final models were occasionally adjusted to allow for correlated errors among individual items, typically when the items were worded similarly and the modification indices suggested that the proposed correlations would lead to substantially better fit. Multi-factor models were used in situations when a single-factor specification would result in an over-identified model.

was calculated and is presented in the tables. An alpha of 0.6–0.8 is evidence of moderate reliability and a value over 0.8 is considered evidence of strong reliability.

Definitions of Teacher Composites

Composite definitions for the science, mathematics, and computer science teacher questionnaire are presented below along with the item numbers from the respective questionnaires. Composites that are identical for the two subjects are presented in the same table; composites unique to a subject are presented in separate tables.

Teacher Background and Opinions

These composites estimate the extent to which teachers feel prepared in both science and mathematics content and pedagogy.

Table D-1
Extent Professional Development Aligns With Elements of Effective Professional Development†

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
I had opportunities to engage in science investigations/engineering design challenges.‡	Q33a		
I had opportunities to engage in mathematics investigations.‡		Q21a	
I had opportunities to engage in activities to learn computer science content.‡			Q18a
I had opportunities to experience lessons, as my students would, from the textbook/ modules/units I use in my classroom.	Q33b	Q21b	Q18b
I had opportunities to examine classroom artifacts (e.g., student work samples, videos of classroom instruction, e-portfolios).	Q33c	Q21c	Q18c
I had opportunities to rehearse instructional practices during the professional development (i.e., try out, receive feedback, and reflect on those practices).	Q33d	Q21d	Q18d
I had opportunities to apply what I learned to my classroom and then come back and talk about it as part of the professional development.	Q33e	Q21e	Q18e
I worked closely with other teachers from my school.	Q33f	Q21f	Q18f
I worked closely with other teachers who taught the same grade and/or subject whether or not they were from my school.	Q33g	Q21g	Q18g
Number of Items in Composite	**7**	**7**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.78**	**0.77**	**0.70**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.05**	**0.06**

† These items were presented only to teachers who participated in science/mathematics/computer science-related professional development in the last three years.
‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

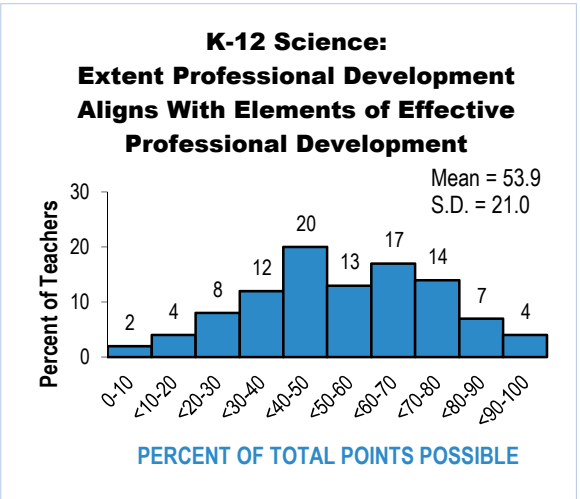


Figure D-1

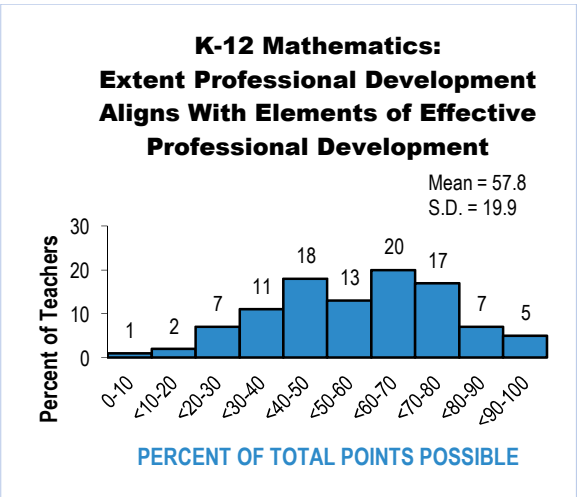


Figure D-2

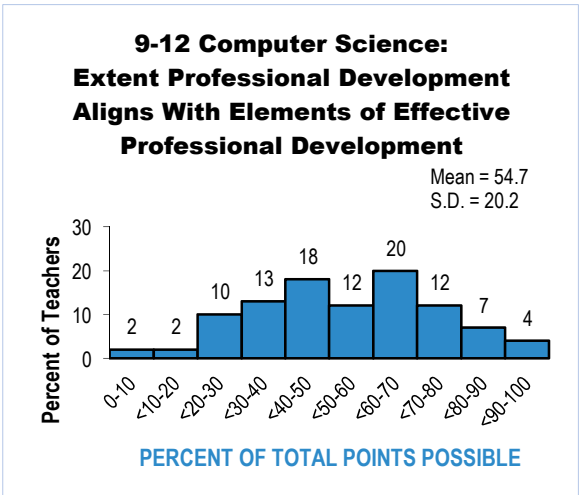


Figure D-3

Table D-2
Extent Professional Development Supports Student-Centered Instruction†

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Deepening your own science content knowledge‡	Q34a		
Deepening your own mathematics content knowledge‡		Q22a	
Deepening your own computer science content knowledge, including programming‡			Q19a
Deepening your understanding of how science is done (e.g., developing scientific questions, developing and using models, engaging in argumentation)‡	Q34b		
Deepening your understanding of how mathematics is done (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models‡		Q22b	
Deepening your understanding of how computer science is done (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)‡			Q19b
Deepening your understanding of how engineering is done (e.g., identifying criteria and constraints, designing solutions, optimizing solutions)	Q34c		
Implementing the science textbook/modules to be used in your classroom‡	Q34d		
Implementing the mathematics textbook to be used in your classroom‡		Q22c	
Implementing the computer science textbook/online course to be used in your classroom‡			Q19c
Learning how to use hands-on activities/manipulatives for mathematics instruction		Q22d	
Learning how to use programming activities that require a computer			Q19d
Learning about difficulties that students may have with particular science ideas‡	Q34e		
Learning about difficulties that students may have with particular mathematical ideas and procedures‡		Q22e	
Learning about difficulties that students may have with particular computer science ideas and/or practices‡			Q19e
Finding out what students think or already know prior to instruction on a topic	Q34f	Q22f	
Monitoring student understanding during science instruction‡	Q34g		
Monitoring student understanding during mathematics instruction‡		Q22g	
Monitoring student understanding during computer science instruction‡			Q19f
Differentiating science instruction to meet the needs of diverse learners‡	Q34h		
Differentiating mathematics instruction to meet the needs of diverse learners‡		Q22h	
Differentiating computer science instruction to meet the needs of diverse learners‡			Q19g
Number of Items in Composite	**8**	**8**	**7**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.85**	**0.97**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**	**0.03**	**0.07**

† These items were presented only to teachers who participated in science/mathematics/computer science-related professional development or coursework within the last three years.

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

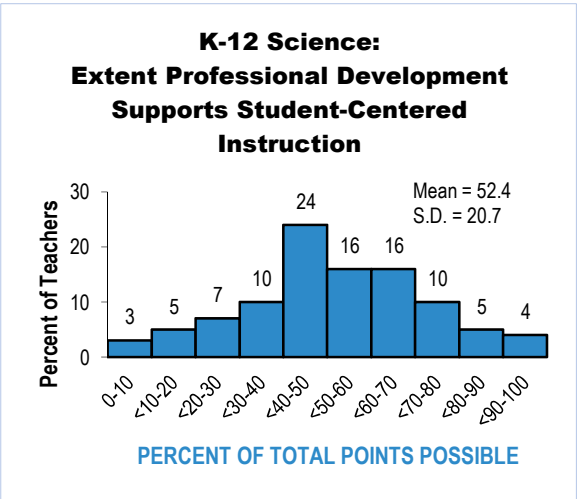


Figure D-4

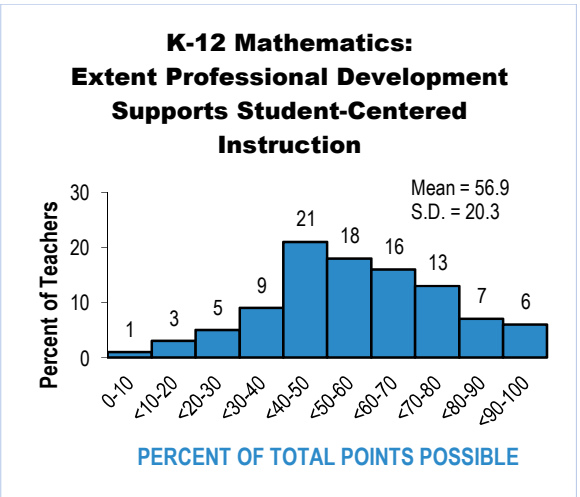


Figure D-5

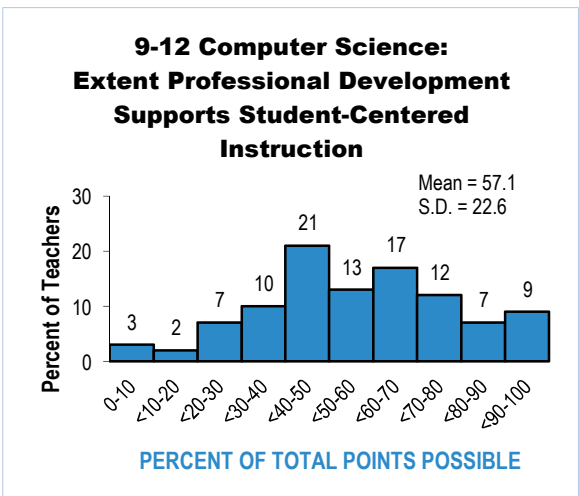


Figure D-6

The Perceptions of Content Preparedness composite was calculated based on the topics taught in the targeted class. Thus, it is defined differently across the subjects and grade ranges included in this study.

Table D-3
Perceptions of Content Preparedness: Elementary Science

	SCIENCE
Life Science	Q35a
Earth/Space Science	Q35b
Physical Science	Q35c
Engineering	Q35d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

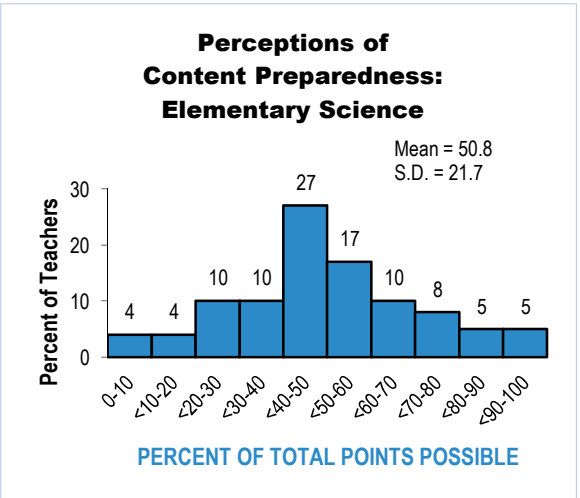


Figure D-7

Table D-4
Perceptions of Content Preparedness: Elementary Mathematics

	MATHEMATICS
Number and Operations	Q23a
Early Algebra	Q23b
Geometry	Q23c
Measurement and Data Representation	Q23d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.82**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**

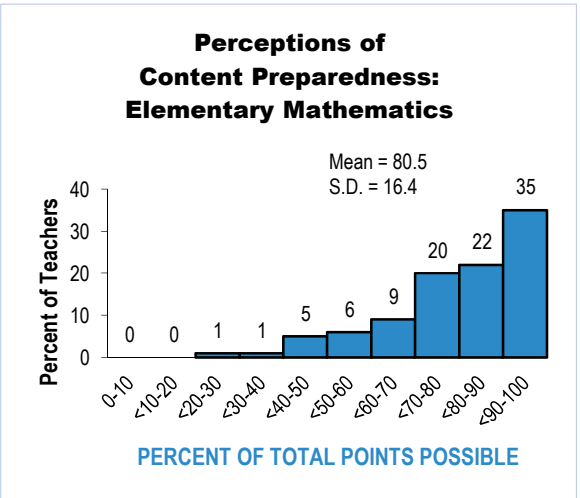


Figure D-8

Table D-5
Perceptions of Content Preparedness: Secondary Science†

	BIOLOGY/LIFE SCIENCE	CHEMISTRY	EARTH SCIENCE	INTEGRATED/ GENERAL SCIENCE	PHYSICAL SCIENCE	PHYSICS
Earth's features and physical processes			Q36ai	Q36ai		
The solar system and the universe			Q36aii	Q36aii		
Climate and weather			Q36aiii	Q36aiii		
Cell biology	Q36bi			Q36bi		
Structures and functions of organisms	Q36bii			Q36bii		
Ecology/ecosystems	Q36biii			Q36biii		
Genetics	Q36biv			Q36biv		
Evolution	Q36bv			Q36bv		
Atomic structure		Q36ci		Q36ci	Q36ci	
Chemical bonding, equations, nomenclature, and reactions		Q36cii		Q36cii	Q36cii	
Elements, compounds, and mixtures		Q36ciii		Q36ciii	Q36ciii	
The Periodic Table		Q36civ		Q36civ	Q36civ	
Properties of solutions		Q36cv		Q36cv	Q36cv	
States, classes, and properties of matter		Q36cvi		Q36cvi	Q36cvi	
Forces and motion				Q36di	Q36di	Q36di
Energy transfers, transformations, and conservation				Q36dii	Q36dii	Q36dii
Properties and behaviors of waves				Q36diii	Q36diii	Q36diii
Electricity and magnetism				Q36div	Q36div	Q36div
Modern physics (e.g., special relativity)				Q36dv	Q36dv	Q36dv
Defining engineering problems				Q36ei		
Developing possible solutions				Q36eii		
Optimizing a design solution				Q36eii		
Environmental and resource issues (e.g., land and water use, energy resources and consumption, sources and impacts of pollution)				Q36f		
Number of Items in Composite	**5**	**6**	**3**	**23**	**11**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.89**	**0.96**	**0.80**	**0.93**	**0.92**	**0.89**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.02**	**0.00**	**0.13**	**0.17**	**0.06**

† Items in these composites were presented only to non-self-contained teachers.

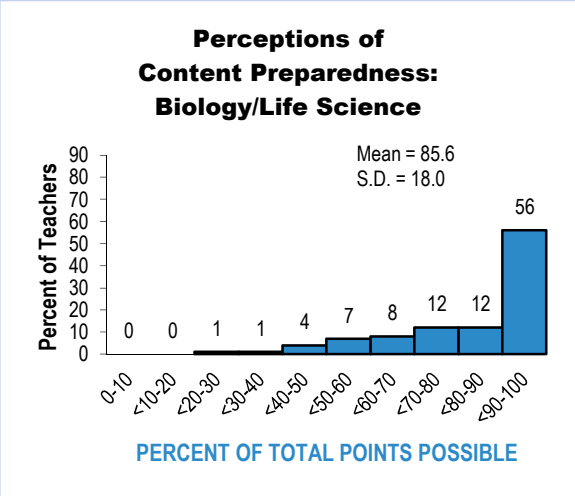


Figure D-9

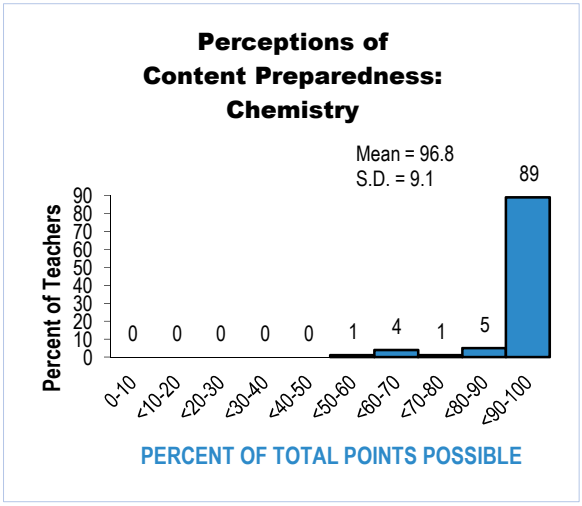
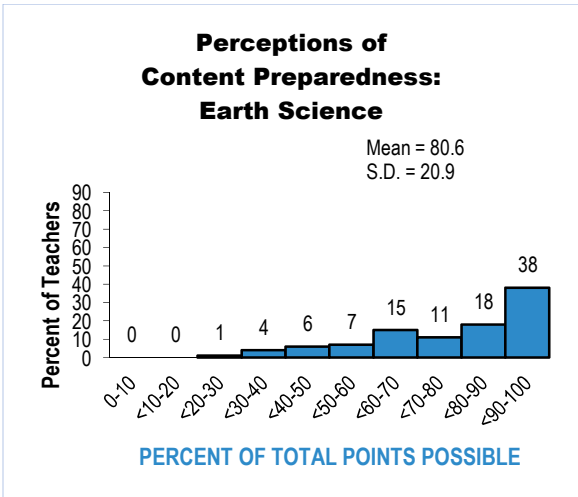


Figure D-10



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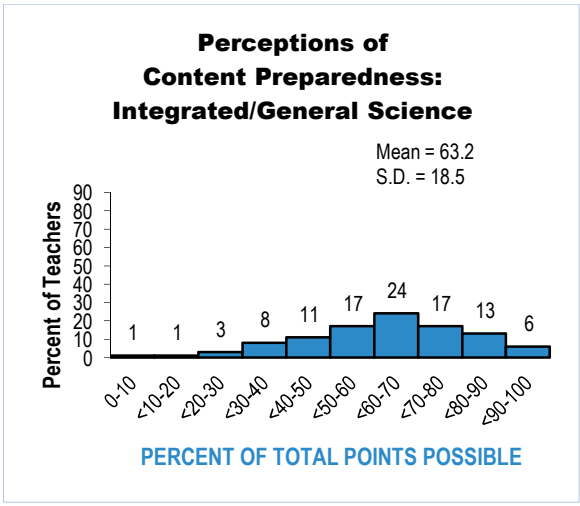
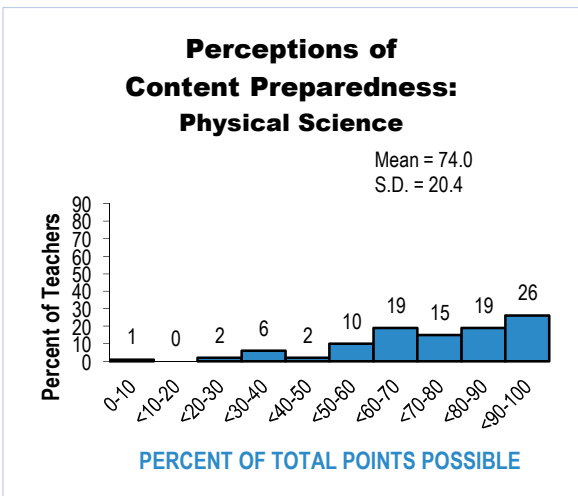


Figure D-12



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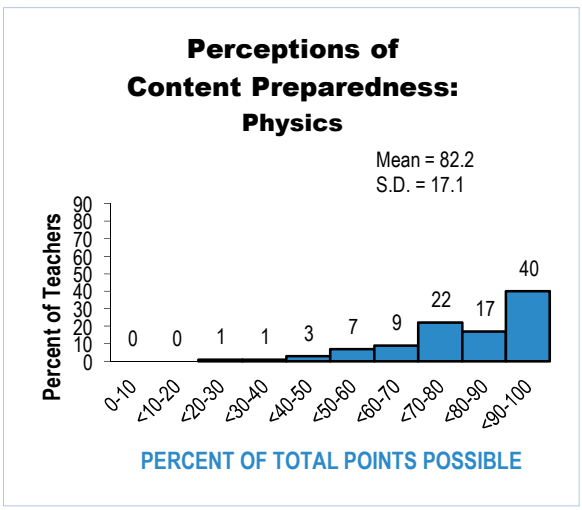


Figure D-14

Table D-6
Perceptions of Content Preparedness: Secondary Mathematics†

	MATHEMATICS
The number system and operations	Q24a
Algebraic thinking	Q24b
Functions	Q24c
Modeling	Q24d
Measurement	Q24e
Geometry	Q24f
Statistics and probability	Q24g
Discrete mathematics	Q24h
Number of Items in Composite	**8**
Reliability – Cronbach's Coefficient Alpha	**0.79**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**

† These items were presented only to non-self-contained teachers.

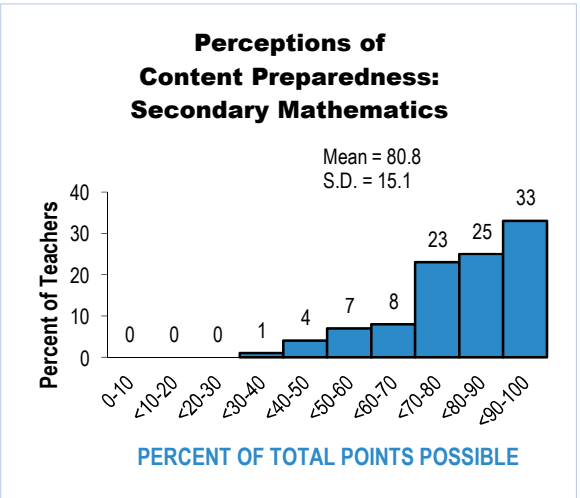


Figure D-15

Table D-7
Perceptions of Content Preparedness: High School Computer Science

	COMPUTER SCIENCE
Computing systems	Q20a
Networks and the Internet	Q20b
Data and analysis	Q20c
Algorithms and programming	Q20d
Impacts of computing	Q20e
Number of Items in Composite	**5**
Reliability – Cronbach's Coefficient Alpha	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**

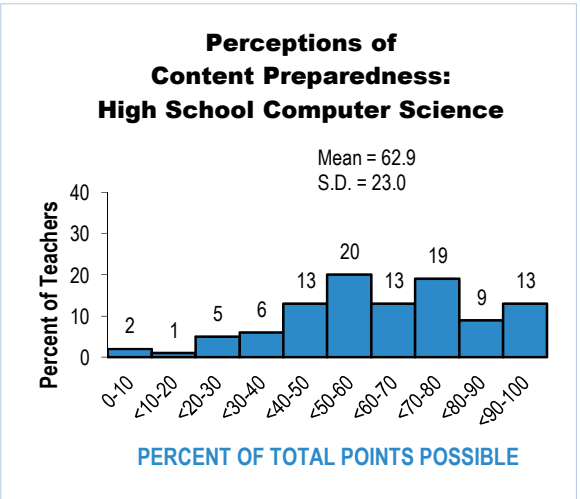


Figure D-16

Table D-8
Perceptions of Preparedness to Teach Engineering

	ENGINEERING
Defining engineering problems	Q36ei
Developing possible solutions	Q36eii
Optimizing a design solution	Q36eiii
Number of Items in Composite	**3**
Reliability – Cronbach's Coefficient Alpha	**0.96**
Confirmatory Factor Analysis Fit Index – SRMR	**0.00**

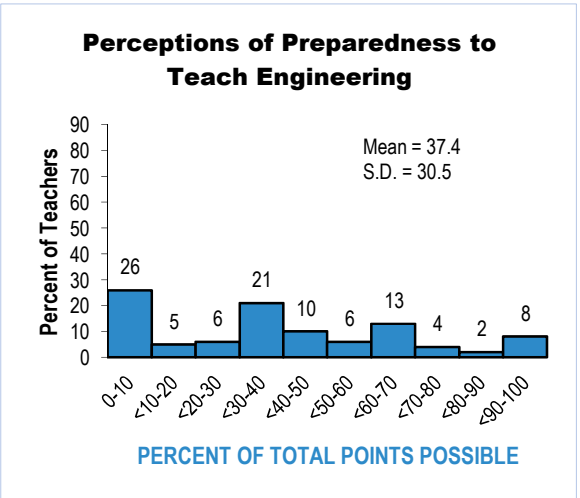
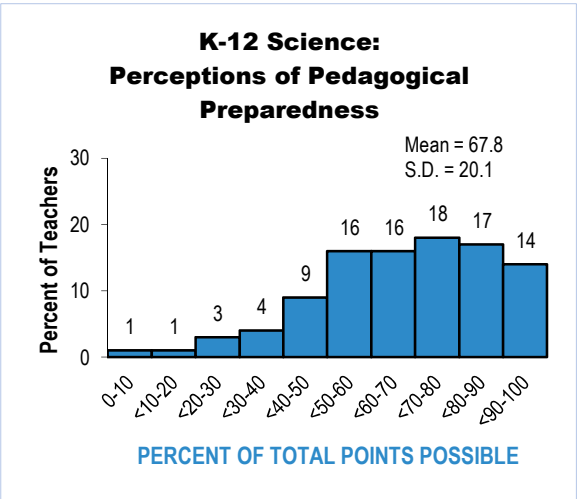


Figure D-17

Table D-9
Perceptions of Pedagogical Preparedness

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Develop students' conceptual understanding of the science ideas you teach‡	Q37a		
Develop students' conceptual understanding of the mathematical ideas you teach‡		Q25a	
Develop students' conceptual understanding of the computer science ideas you teach‡			Q21a
Develop students' abilities to do science (e.g., develop scientific questions; design and conduct investigations; analyze data; develop models, explanations, and scientific arguments)‡	Q37b		
Develop students' abilities to do mathematics (e.g., consider how to approach a problem, explain and justify solutions, create and use mathematical models)‡		Q25b	
Develop students' abilities to do computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts)‡			Q21b
Develop students' awareness of STEM careers	Q37c	Q25c	Q21c
Provide science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡	Q37d		
Provide mathematics instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡		Q25d	
Provide computer science instruction that is based on students' ideas (whether completely correct or not) about the topics you teach‡			Q21d
Use formative assessment to monitor student learning	Q37e	Q25e	Q21e
Differentiate science instruction to meet the needs of diverse learners‡	Q37f		
Differentiate mathematics instruction to meet the needs of diverse learners‡		Q25f	
Differentiate computer science instruction to meet the needs of diverse learners‡			Q21f
Incorporate students' cultural backgrounds into science instruction‡	Q37g		
Incorporate students' cultural backgrounds into mathematics instruction‡		Q25g	
Incorporate students' cultural backgrounds into computer science instruction‡			Q21g
Encourage students' interest in science and/or engineering‡	Q37h		
Encourage students' interest in mathematics‡		Q25h	
Encourage students' interest in computer science‡			Q21h
Encourage participation of all students in science and/or engineering‡	Q37i		
Encourage participation of all students in mathematics‡		Q25i	
Encourage participation of all students in computer science‡			Q21i
Number of Items in Composite	**9**	**9**	**9**
Reliability – Cronbach's Coefficient Alpha	**0.90**	**0.84**	**0.89**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.04**	**0.04**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.



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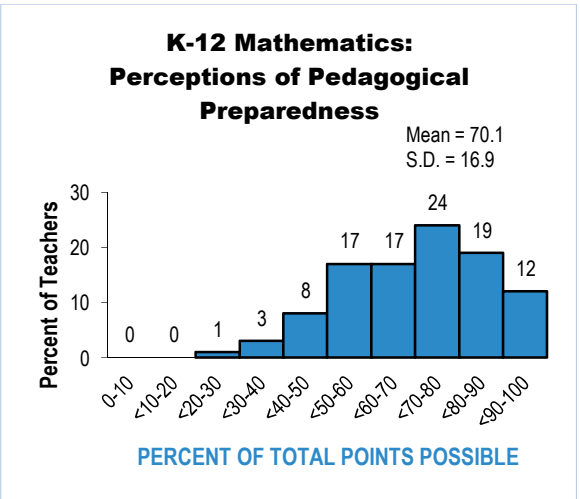


Figure D-19

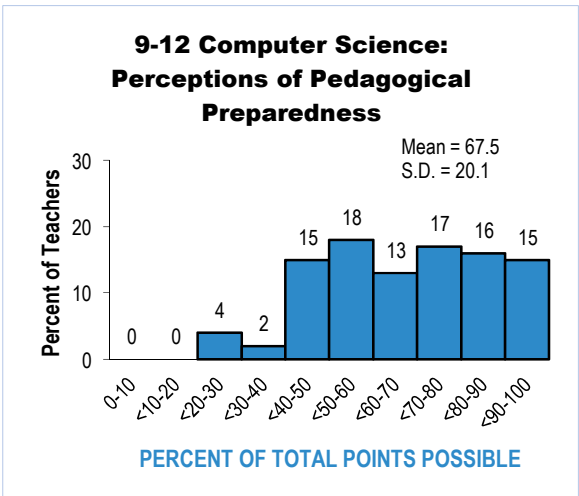


Figure D-20

Table D-10
Perceptions of Preparedness to Implement Instruction in Particular Unit

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Anticipate difficulties that students will have with particular science ideas and procedures in this unit‡	Q67a		
Anticipate difficulties that students will have with particular mathematical ideas and procedures in this unit‡		Q53a	
Anticipate difficulties that students may have with particular computer science ideas and procedures in this unit‡			Q49a
Find out what students thought or already knew about the key science ideas‡	Q67b		
Find out what students thought or already knew about the key mathematical ideas‡		Q53b	
Find out what students thought or already knew about the key computer science ideas‡			Q49b
Implement the instructional materials (e.g., textbook, module, online course) to be used during this unit	Q67c	Q53c	Q49c
Monitor student understanding during this unit	Q67d	Q53d	Q49d
Assess student understanding at the conclusion of this unit	Q67e	Q53e	Q49e
Number of Items in Composite	**5**	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.90**	**0.87**	**0.88**
Confirmatory Factor Analysis Fit Index – SRMR	**<0.01**	**<0.01**	**0.04**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.

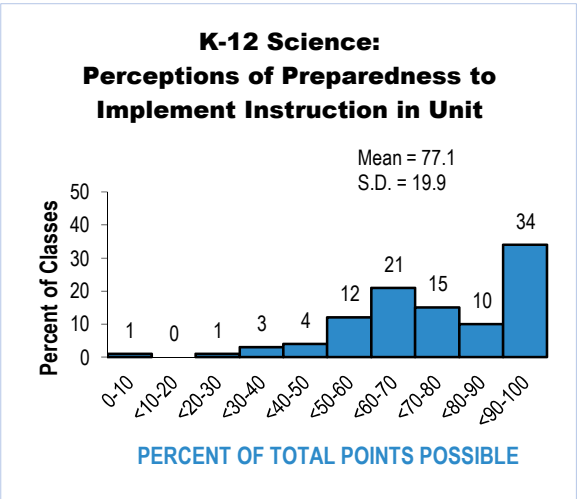
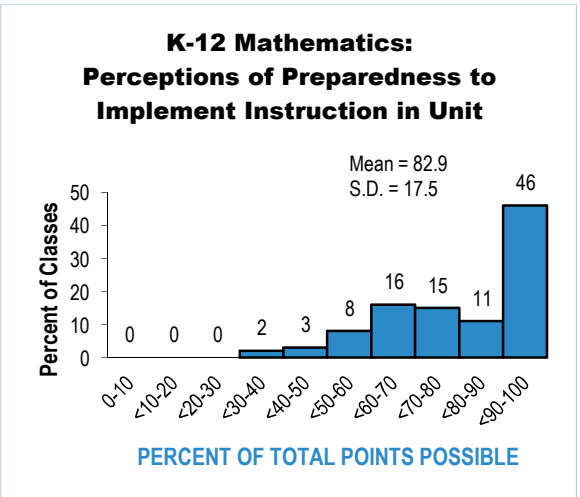


Figure D-21



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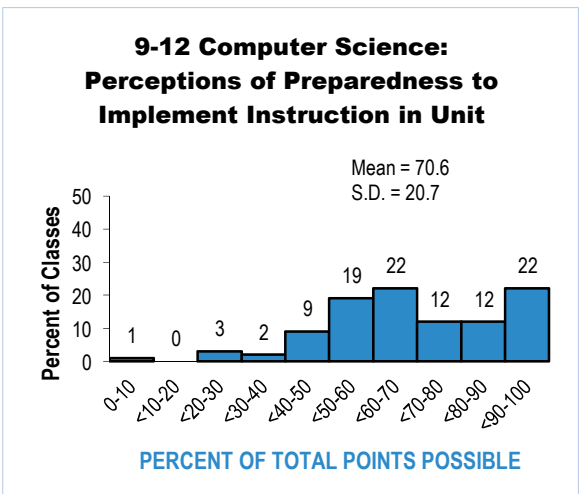


Figure D-23

Table D-11
Traditional Teaching Beliefs

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Students learn science best in classes with students of similar abilities.‡	Q38a		
Students learn mathematics best in classes with students of similar abilities.‡		Q26a	
Students learn computer science best in classes with students of similar abilities.‡			Q22a
At the beginning of instruction on a science idea, students should be provided with definitions for new scientific vocabulary that will be used.‡	Q38c		
At the beginning of instruction on a mathematical idea, students should be provided with definitions for new mathematics vocabulary that will be used.‡		Q26c	
At the beginning of instruction on a computer science idea, students should be provided with definitions for new vocabulary that will be used.‡			Q22c
Teachers should explain an idea to students before having them consider evidence that relates to the idea.‡	Q38d		
Teachers should explain an idea to students before having them investigate the idea.‡		Q26d	
Hands-on/laboratory activities should be used primarily to reinforce a science idea that the students have already learned.‡	Q38f		
Hands-on activities/manipulatives should be used primarily to reinforce a mathematical idea that the students have already learned.‡		Q26f	
Hands-on/manipulatives/programming activities should be used primarily to reinforce a computer science idea that the students have already learned.‡			Q22e
Number of Items in Composite	**4**	**4**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.65**	**0.60**	**0.37†**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.05**	**0.05**

† Although the Cronbach's alpha is lower than typically accepted standards, the composite was computed for computer science because the SRMR statistic is good to maintain consistency across subjects.

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.

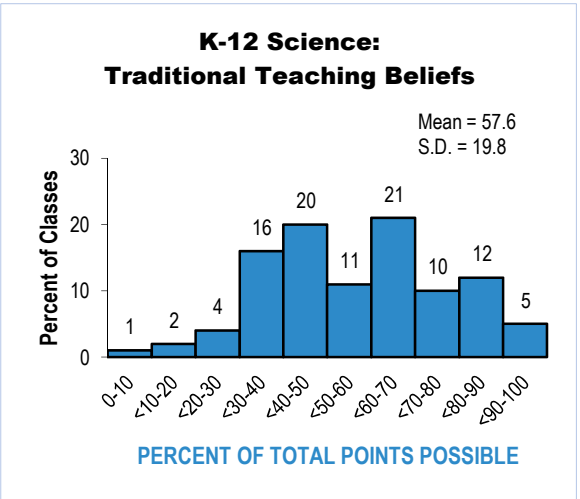


Figure D-24

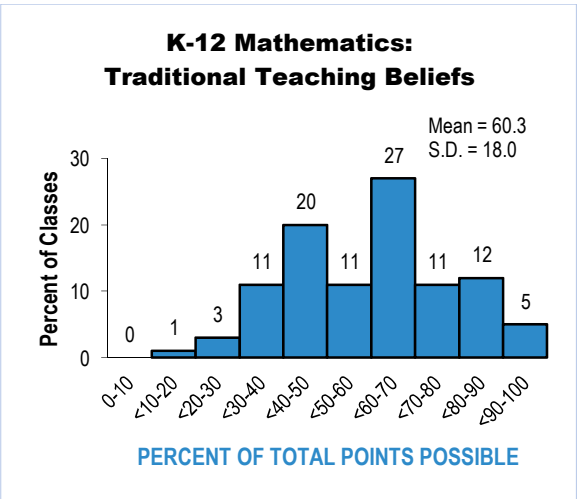


Figure D-25

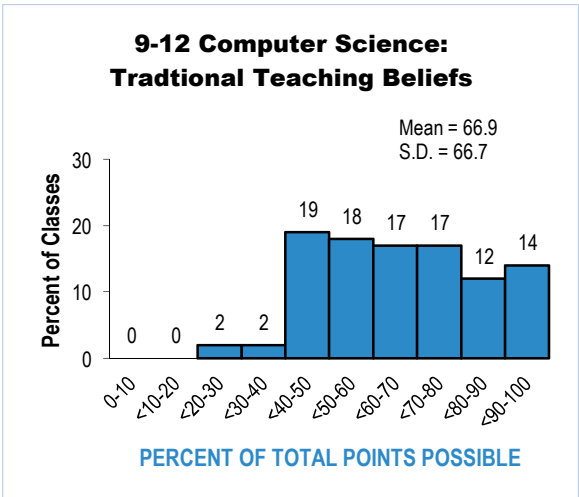
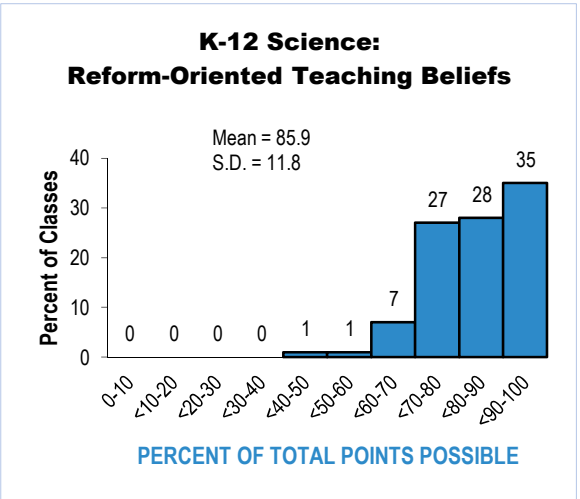


Figure D-26

Table D-12
Reform-Oriented Teaching Beliefs

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Most class periods should provide opportunities for students to share their thinking and reasoning.	Q38e	Q26e	Q22d
Teachers should ask students to support their conclusions about a science concept with evidence.‡	Q38g		
Teachers should ask students to justify their mathematical thinking.‡		Q26g	
Teachers should ask students to justify their solutions to a computational problem.‡			Q22f
Students learn best when instruction is connected to their everyday lives.	Q38h	Q26h	Q22g
Most class periods should provide opportunities for students to apply scientific ideas to real-world contexts.‡	Q38i		
Most class periods should provide opportunities for students to apply mathematical ideas to real-world contexts.‡		Q26i	
Most class periods should provide opportunities for students to apply computer science ideas to real-world contexts.‡			Q22h
Students should learn science by doing science (e.g., developing scientific questions; designing and conducting investigations; analyzing data; developing models, explanations, and scientific arguments).‡	Q38j		
Students should learn mathematics by doing mathematics (e.g., considering how to approach a problem, explaining and justifying solutions, creating and using mathematical models).‡		Q26j	
Students should learn computer science by doing computer science (e.g., breaking problems into smaller parts, considering the needs of a user, creating computational artifacts).‡			Q22i
Number of Items in Composite	**5**	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.77**	**0.72**	**0.65**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.05**	**0.05**

‡ The science, mathematics, and computer science versions of these items are considered equivalent, worded appropriately for that discipline.



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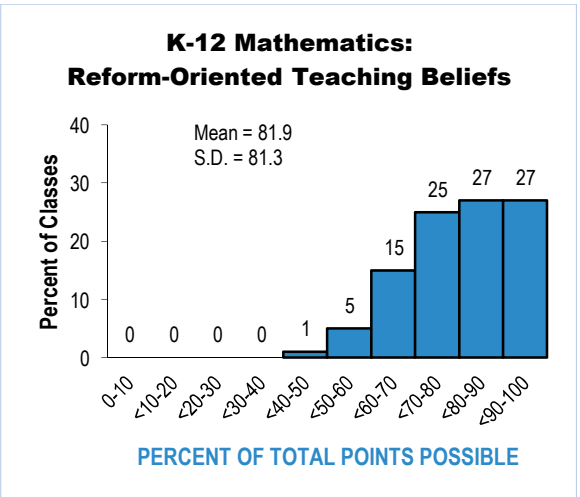

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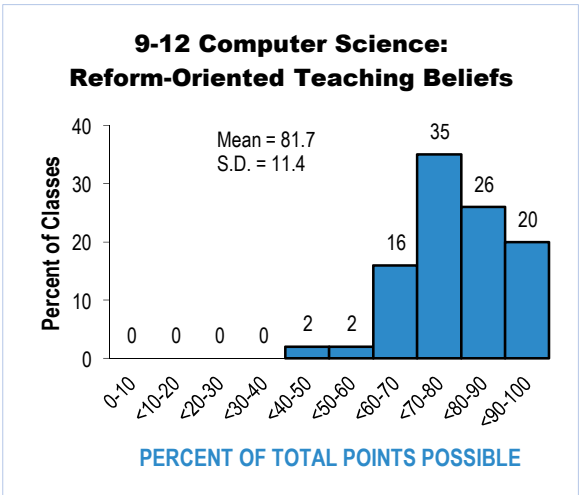


Figure D-29

Decision-Making Autonomy

These composites estimate the level of control teachers perceive having over curriculum and pedagogy decisions for their classrooms.

Table D-13
Curriculum Control

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Determining course goals and objectives	Q44a	Q32a	Q28a
Selecting curriculum materials (e.g., textbooks/modules)	Q44b	Q32b	Q28b
Selecting content, topics, and skills to be taught	Q44c	Q32c	Q28c
Selecting programming languages to use			Q28d
Selecting the sequence in which topics are covered	Q44d	Q44d	Q28e
Number of Items in Composite	**4**	**4**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.85**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**	**0.04**	**0.05**

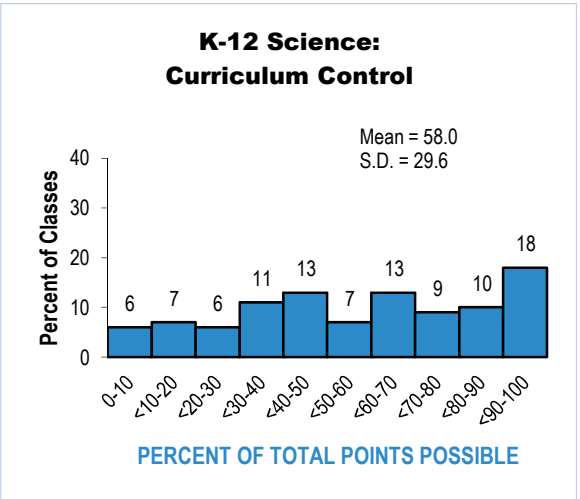


Figure D-30

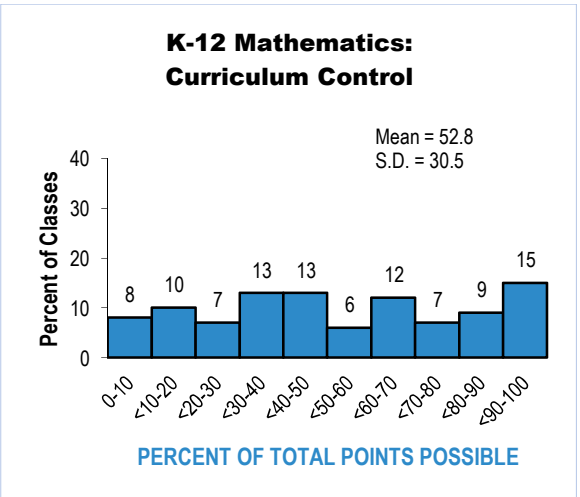


Figure D-31

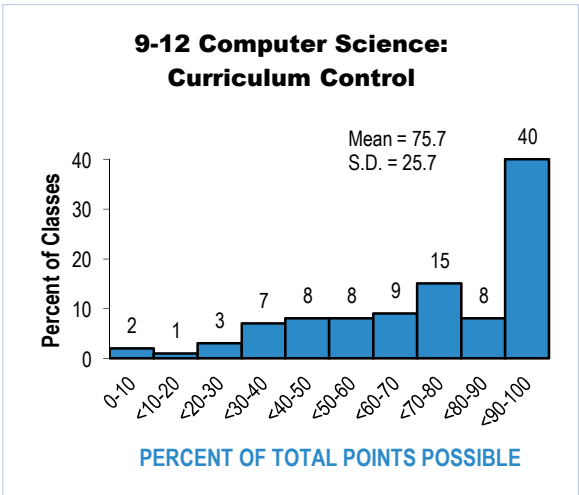


Figure D-32

Table D-14
Pedagogy Control

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Selecting teaching techniques	Q44f	Q32f	Q28g
Determining the amount of homework to be assigned	Q44g	Q32g	Q28h
Choosing criteria for grading student performance	Q44h	Q32h	Q28i
Number of Items in Composite	**3**	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.77**	**0.70**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**	**0.04**	**0.05**

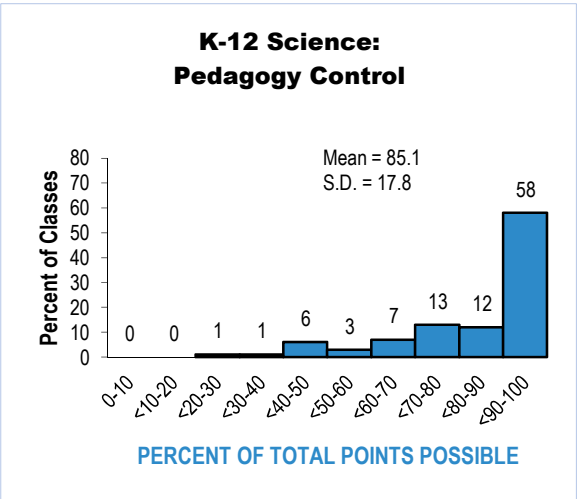


Figure D-33

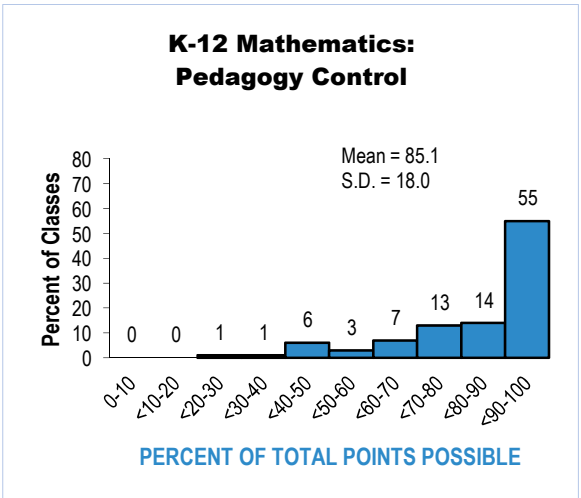


Figure D-34

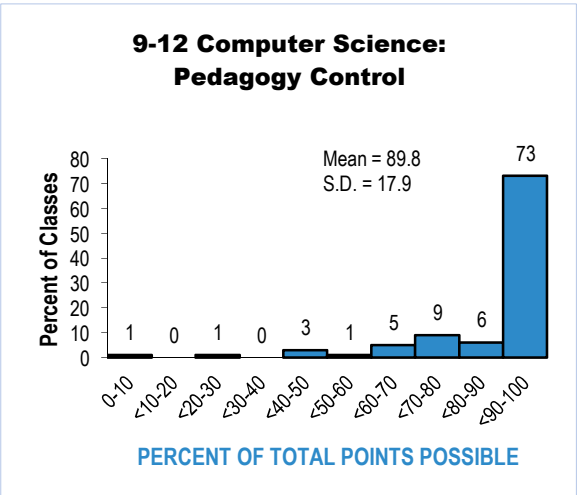


Figure D-35

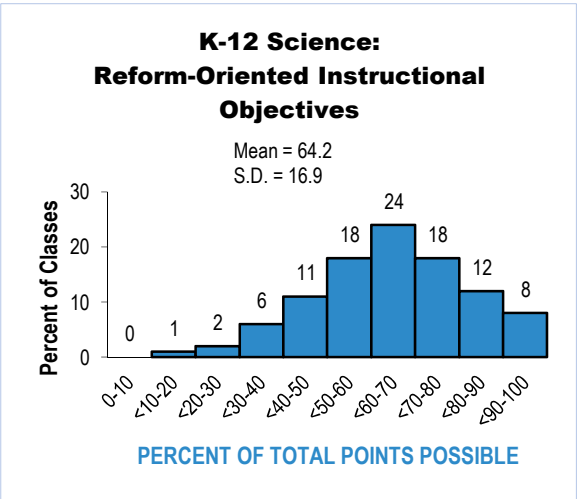
Instructional Objectives

These composites estimate the amount of emphasis teachers place on reform-oriented instructional objectives.

Table D-15
Reform-Oriented Instructional Objectives

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Understanding science concepts‡	Q45b		
Understanding mathematical ideas‡		Q33d	
Understanding computer science concepts‡			Q29b
Learning about different fields of science/engineering	Q45c		
Learning how to do science‡	Q45d		
Learning how to do mathematics‡		Q33e	
Learning how to do computer science‡			Q29c
Learning how to develop computational solutions			Q29d
Learning how to do engineering	Q45e		
Learning about real-life applications of science/engineering‡	Q45f		
Learning about real-life applications of mathematics‡		Q33f	
Learning about real-life applications of computer science‡			Q29e
Increasing students' interest in science‡	Q45g		
Increasing students' interest in mathematics‡		Q33g	
Increasing students' interest in computer science‡			Q29f
Developing students' confidence that they can successfully pursue careers in science/engineering‡	Q45h		
Developing students' confidence that they can successfully pursue careers in mathematics‡		Q33h	
Developing students' confidence that they can successfully pursue careers in computer science‡			Q29g
Number of Items in Composite	**7**	**5**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.73**	**0.72**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.08**	**0.10**

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.



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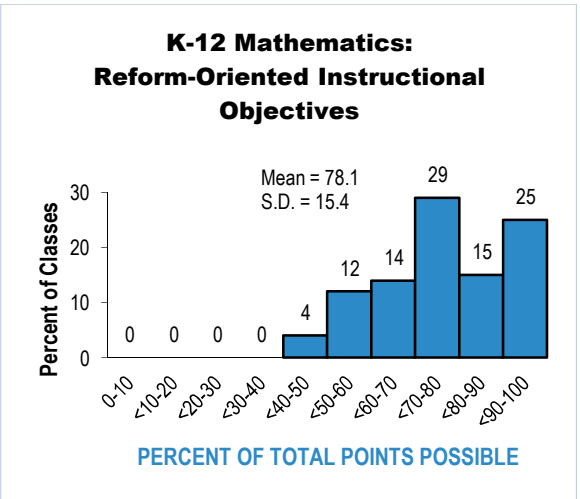


Figure D-37

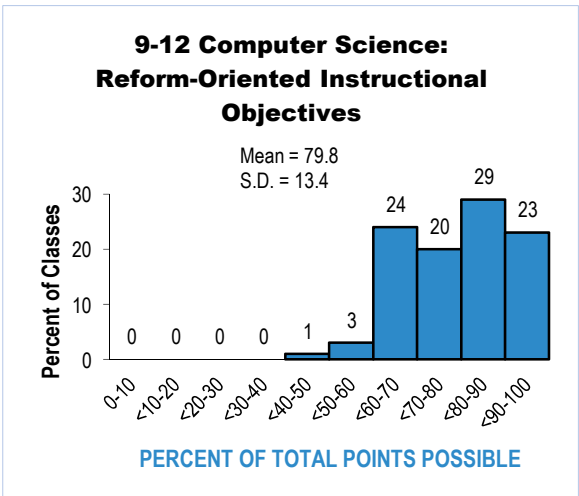


Figure D-38

Teaching Practices

These composites estimate the extent to which teachers engage students in the practices of their discipline.

Table D-16
Engaging Students in Practices of Science

	SCIENCE
Determine whether or not a question is "scientific"	Q47a
Generate scientific questions based on their curiosity, prior knowledge, careful observation of real-world phenomena, scientific models, or preliminary data from an investigation	Q47b
Determine what data would need to be collected in order to answer a scientific question	Q47c
Develop procedures for a scientific investigation to answer a scientific question	Q47d
Conduct a scientific investigation	Q47e
Organize and/or represent data using tables, charts, or graphs in order to facilitate analysis of the data	Q47f
Compare data from multiple trials or across student groups for consistency in order to identify potential sources of error or inconsistencies in the data	Q47g
Analyze data using grade-appropriate methods in order to identify patterns, trends, or relationships	Q47h
Consider how missing data or measurement error can affect the interpretation of data	Q47i
Make and support claims (proposed answers to scientific questions) with evidence	Q47j
Use multiple sources of evidence (e.g., different investigations, scientific literature) to develop an explanation	Q47k
Revise their explanations (claims supported by evidence and reasoning) for real-world phenomena based on additional evidence	Q47l
Develop scientific models—physical, graphical, or mathematical representations of real-world phenomena—based on data and reasoning	Q47m
Identify the strengths and limitations of a scientific model—in terms of accuracy, clarity, generalizability, accessibility to others, strength of evidence supporting it—regardless of who created the model	Q47n
Select and use grade-appropriate mathematical and/or statistical techniques to analyze data	Q47o
Use mathematical and/or computational models to generate data to support a scientific claim	Q47p
Determine what details about an investigation (e.g., its design, implementation, and results) might persuade a targeted audience about a scientific claim	Q47q
Use data and reasoning to defend, verbally or in writing, a claim or refute alternative scientific claims about a real-world phenomenon	Q47r
Evaluate the strengths and weaknesses of competing scientific explanations (claims supported by evidence) for a real-world phenomenon	Q47s
Construct a persuasive case, verbally or in writing, for the best scientific model or explanation for a real-world phenomenon	Q47t
Pose questions that elicit relevant details about the important aspects of a scientific argument	Q47u
Evaluate the credibility of scientific information—e.g., its reliability, validity, consistency, logical coherence, lack of bias, or methodological strengths and weaknesses	Q47v
Summarize patterns, similarities, and differences in scientific information obtained from multiple sources	Q47w
Number of Items in Composite	**23**
Reliability – Cronbach's Coefficient Alpha	**0.96**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**

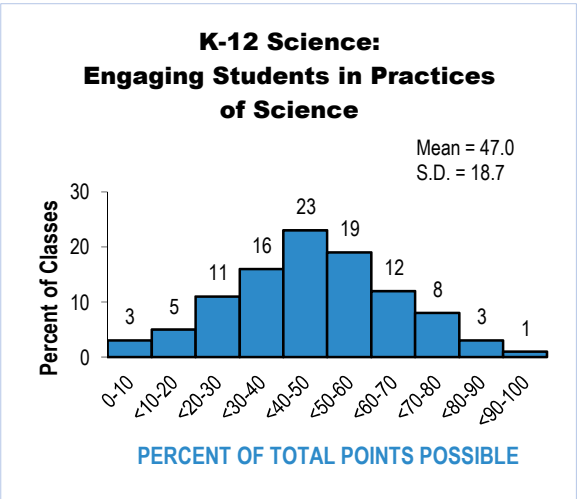

K-12 Science:
Engaging Students in Practices of Science
Mean = 47.0
S.D. = 18.7
Percent of Classes
30
20
10
0
3
5
11
16
23
19
12
8
3
1
0-10
<10-20
<20-30
<30-40
<40-50
<50-60
<60-70
<70-80
<80-90
<90-100
PERCENT OF TOTAL POINTS POSSIBLE

Figure D-39

Table D-17
Engaging Students in Practices of Mathematics

	MATHEMATICS
Work on challenging problems that require thinking beyond just applying rules, algorithms, or procedures	Q35a
Figure out what a challenging problem is asking	Q35b
Reflect on their solution strategies as they work through a mathematics problem and revise as needed	Q35c
Continue working through a mathematics problem when they reach points of difficulty, challenge, or error	Q35d
Determine whether their answer makes sense	Q35e
Represent aspects of a problem using mathematical symbols, pictures, diagrams, tables, or objects in order to solve it	Q35f
Provide mathematical reasoning to explain, justify, or prove their thinking	Q35g
Compare and contrast different solution strategies for a mathematics problem in terms of their strengths and limitations	Q35h
Analyze the mathematical reasoning of others	Q35i
Pose questions to clarify, challenge, or improve the mathematical reasoning of others	Q35j
Identify relevant information and relationships that could be used to solve a mathematics problem	Q35k
Develop a mathematical model (i.e., a representation of relevant information and relationships such as an equation, tape diagram, algorithm, or function) to solve a mathematics problem	Q35l
Determine what tools (e.g., pencil and paper, manipulatives, ruler, protractor, calculator, spreadsheet) are appropriate for solving a mathematics problem	Q35m
Determine what units are appropriate for expressing numerical answers, data, and/or measurements	Q35n
Discuss how certain terms or phrases may have specific meanings in mathematics that are different from their meaning in everyday language	Q35o
Identify patterns or characteristics of numbers, diagrams, or graphs that may be helpful in solving a mathematics problem	Q35p
Work on generating a rule or formula	Q35q
Number of Items in Composite	**17**
Reliability – Cronbach's Coefficient Alpha	**0.92**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**

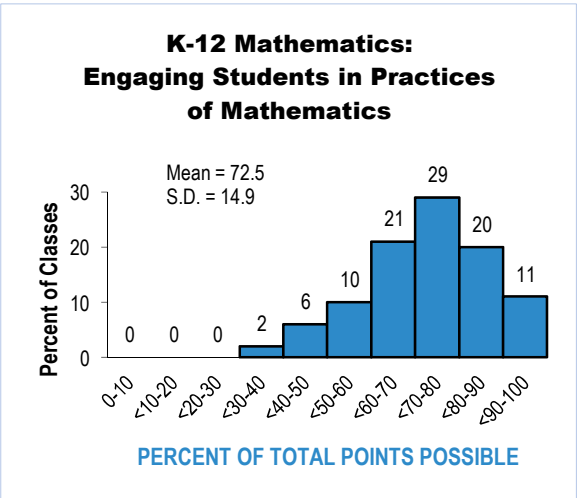


Figure D-40

Table D-18
Engaging Students in Practices of Computer Science

	COMPUTER SCIENCE
Create computational artifacts	Q31a
Create a computational artifact designed to be used by someone outside the class or other students	Q31b
Provide feedback on other students' computational products or designs	Q31c
Get input on computational products or designs from people with different perspectives	Q31d
Systematically use test cases to verify program performance and/or identify problems	Q31e
Identify real-world problems that might be solved computationally	Q31f
Consider how a program they are creating can be separated into modules/procedures/objects	Q31g
Identify and adapt existing code to solve a new computational problem	Q31h
Use computational methods to simulate events or processes	Q31i
Analyze datasets using a computer to detect patterns	Q31j
Write comments within code to document purposes or features	Q31k
Create instructions for an end-user explaining how to use a computational artifact	Q31l
Explain computational solution strategies verbally or in writing	Q31m
Compare and contrast the strengths and limitations of different representations such as flow charts, tables, code, or pictures	Q31n
Number of Items in Composite	**14**
Reliability – Cronbach's Coefficient Alpha	**0.87**
Confirmatory Factor Analysis Fit Index – SRMR	**0.07**

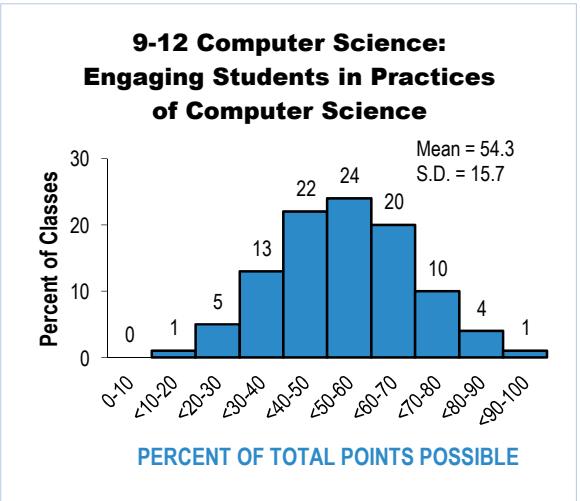


Figure D-41

Influences on Instruction

These composites estimate the extent to which teachers perceive various factors as promoting/ inhibiting effective instruction.

Table D-19
Adequacy of Resources for Science Instruction

	SCIENCE
Instructional technology (e.g., calculators, computers, probes/sensors)	Q54a
Consumable supplies (e.g., chemicals, living organisms, batteries)	Q54b
Equipment (e.g., thermometers, magnifying glasses, microscopes, beakers, photogate timers, Bunsen burners)	Q54c
Facilities (e.g., lab tables, electric outlets, faucets and sinks)	Q54d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.85**
Confirmatory Factor Analysis Fit Index – SRMR	**0.01**

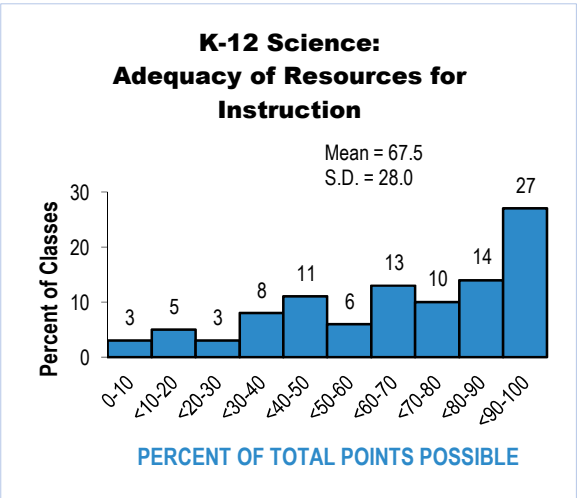


Figure D-42

Table D-20
Adequacy of Resources for Mathematics Instruction

	MATHEMATICS
Instructional technology (e.g., calculators, computers, probes/sensors)	Q40a
Measurement tools (e.g., protractors, rulers)	Q40b
Manipulatives (e.g., pattern blocks, algebra tiles)	Q40c
Consumable supplies (e.g., graphing paper, batteries)	Q40d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.72**
Confirmatory Factor Analysis Fit Index – SRMR	**0.05**

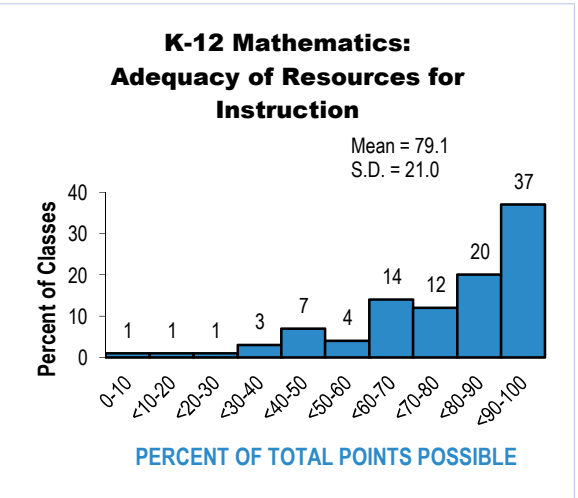


Figure D-43

Table D-21
Extent to Which Computer/Internet Access is Problematic

	COMPUTER SCIENCE
Lack of reliable access to the Internet	Q42a
Lack of functioning computing devices (e.g., desktop computers, laptop computers, tablets, smartphones)	Q42b
Insufficient power sources for devices (e.g., electrical outlets, charging stations)	Q42c
Lack of support to maintain technology (e.g., repair broken devices, install software)	Q42d
Number of Items in Composite	**4**
Reliability – Cronbach's Coefficient Alpha	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.02**

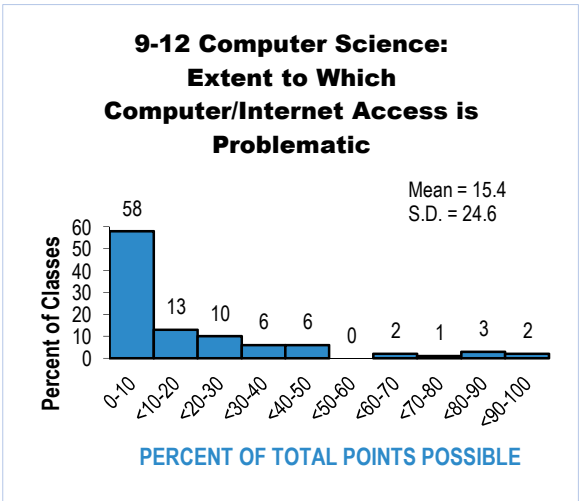
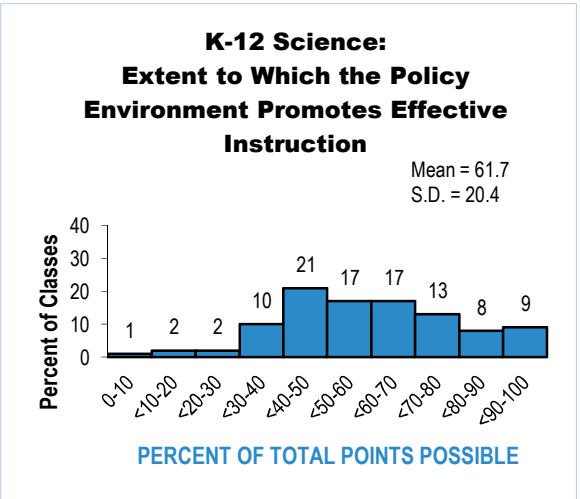


Figure D-44

Table D-22
Extent to Which the Policy Environment Promotes Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Current state standards	Q60a	Q46a	Q41a
School/District/Diocese pacing guides	Q60b	Q46b	
State/District/Diocese testing/accountability policies†	Q60c	Q46c	
Textbook/module selection policies	Q60d	Q46d	Q41b
Teacher evaluation policies	Q60e	Q46e	Q41c
Number of Items in Composite	**5**	**5**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.79**	**0.73**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

† This item was presented only to teachers in public and Catholic schools.



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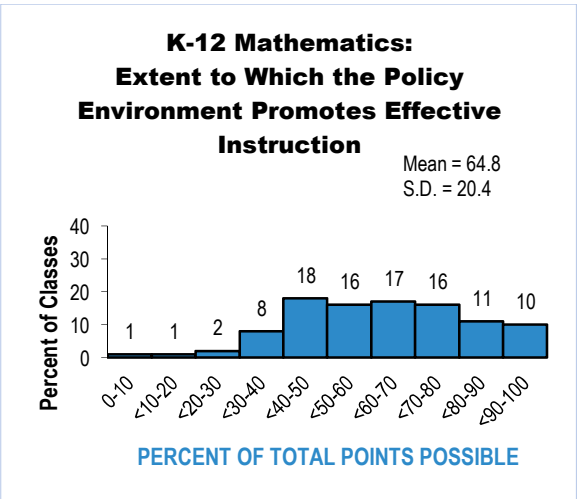


Figure D-46

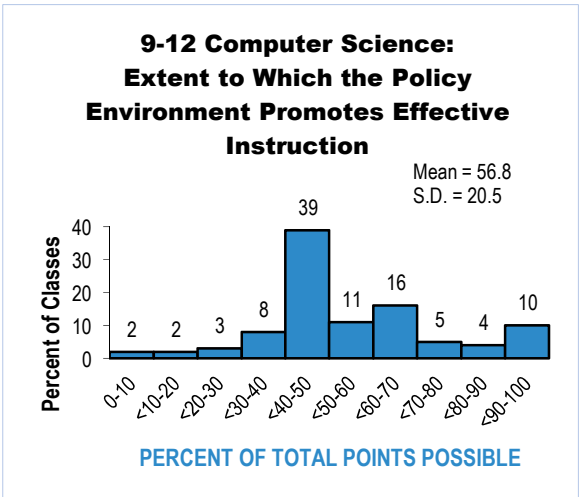


Figure D-47

Table D-23
Extent to Which Stakeholders Promote Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Students' prior knowledge and skills	Q60g	Q46g	Q41e
Students' motivation, interest, and effort in science‡	Q60h		
Students' motivation, interest, and effort in mathematics‡		Q46h	
Students' motivation, interest, and effort in computer science‡			Q41f
Parent/guardian expectations and involvement	Q60i	Q46i	Q41g
Number of Items in Composite	**3**	**3**	**3**
Reliability – Cronbach's Coefficient Alpha	**0.85**	**0.88**	**0.70**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

‡ The science, mathematics, and computer science versions of this item are considered equivalent, worded appropriately for that discipline.

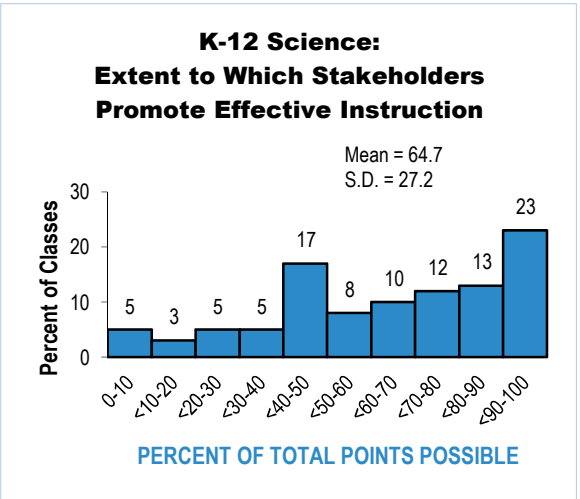
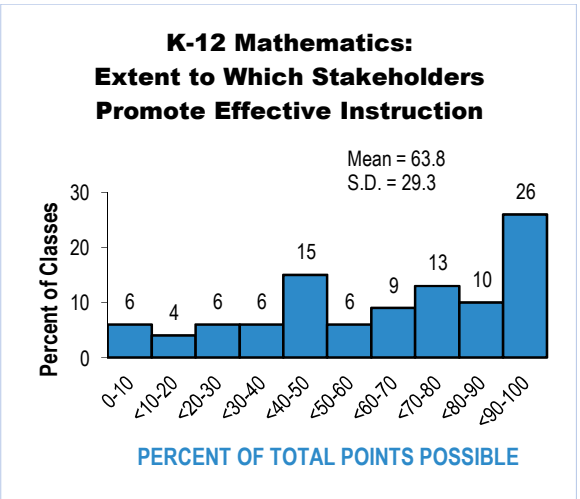


Figure D-48



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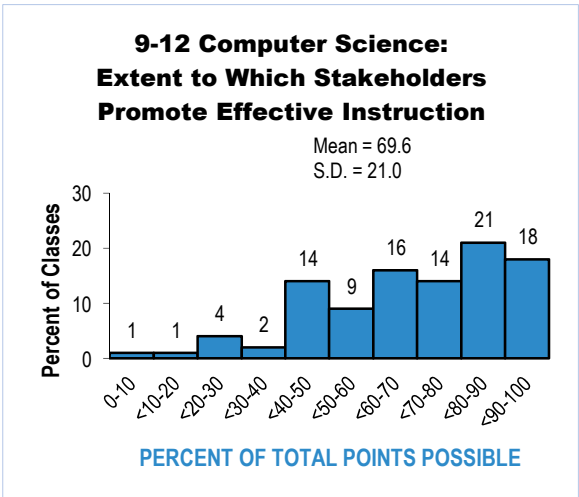

Figure D-50

Table D-24
Extent to Which School Support Promotes Effective Instruction

	SCIENCE	MATHEMATICS	COMPUTER SCIENCE
Amount of time for you to plan, individually and with colleagues	Q60k	Q46k	Q41i
Amount of time available for your professional development	Q60l	Q46l	Q41j
Number of Items in Composite	**2**	**2**	**2**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.79**	**0.77**
Confirmatory Factor Analysis Fit Index – SRMR	**0.06**	**0.06**	**0.04**

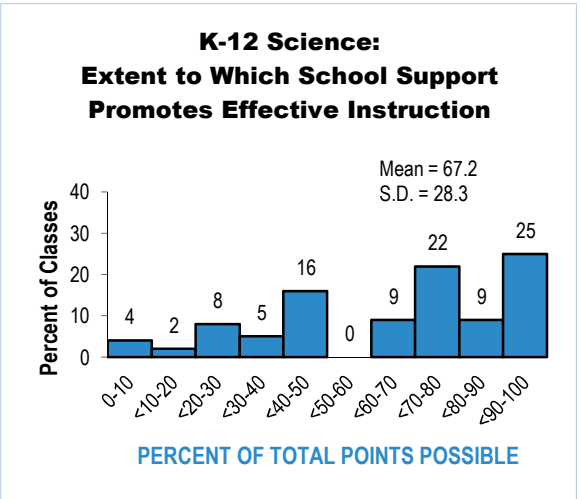

Figure D-51

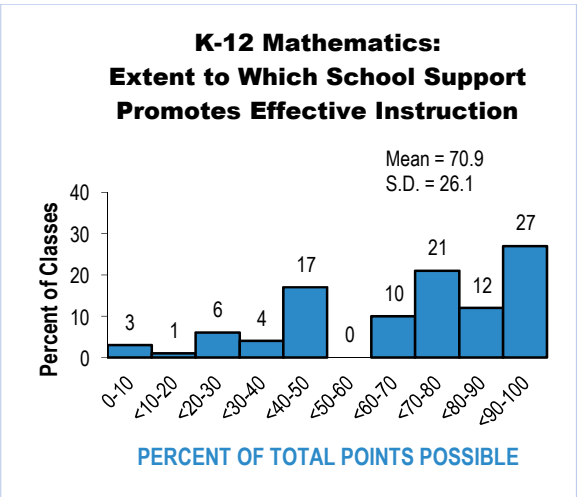

Figure D-52

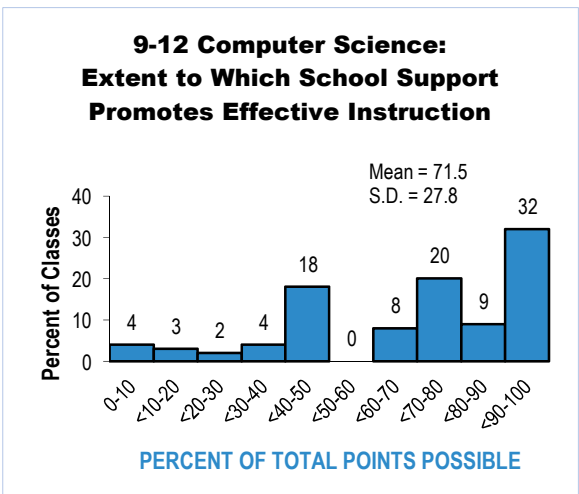

Figure D-53

Definitions of Program Composites

Composite definitions for the science and mathematics program questionnaire are presented below along with the item numbers from the respective questionnaires.

State Standards for Science and Mathematics Education

These composites estimate the level of attention to state standards given by teachers and other stakeholders.

Table D-25
Focus on State Science/Mathematics Standards

	SCIENCE	MATHEMATICS
State science standards have been thoroughly discussed by science teachers in this school.‡	Q5a	
State mathematics standards have been thoroughly discussed by mathematics teachers in this school.‡		Q5a
There is a school-wide effort to align science instruction with the state science standards.‡	Q5b	
There is a school-wide effort to align mathematics instruction with the state mathematics standards.‡		Q5b
Most science teachers in this school teach to the state standards.‡	Q5c	
Most mathematics teachers in this school teach to the state standards.‡		Q5c
Your district/diocese organizes science professional development based on state standards.†,‡	Q5d	
Your district/diocese organizes mathematics professional development based on state standards.†,‡		Q5d
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.86**	**0.87**
Confirmatory Factor Analysis Fit Index – SRMR	**<0.01**	**0.01**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

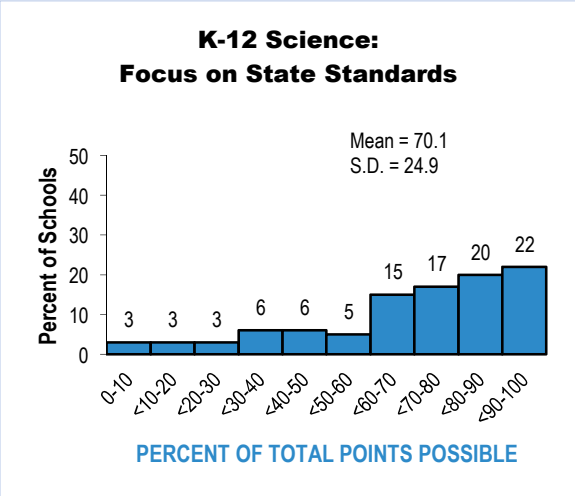

Figure D-54

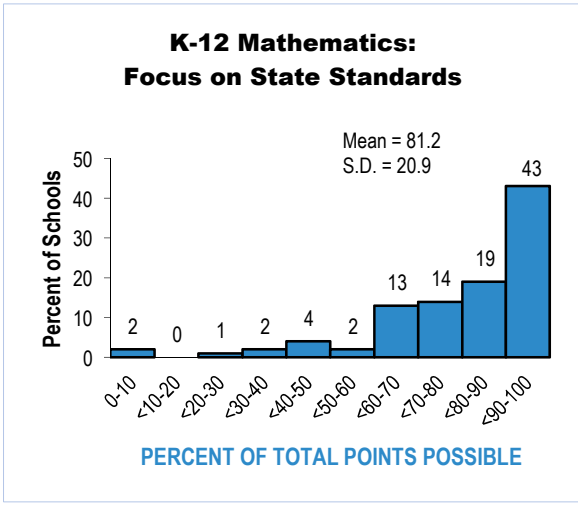

Figure D-55

Factors Affecting Instruction

These composites estimate the extent to which various factors impact science/mathematics instruction in schools.

Table D-26
Supportive Context for Science/Mathematics Instruction

	SCIENCE	MATHEMATICS
School/district/Diocese science professional development policies and practices†,‡	Q16a	
School/district/Diocese mathematics professional development policies and practices†,‡		Q19a
Amount of time provided for teacher professional development in science‡	Q16b	
Amount of time provided for teacher professional development in mathematics‡		Q19b
Importance that the school places on science‡	Q16c	
Importance that the school places on mathematics‡		Q19c
Other school and/or district and/or diocese initiatives‡	Q16d	
Other school and/or district and/or diocese initiatives‡		Q19d
The amount of time provided by the school/district/diocese for teachers to share ideas about science instruction‡	Q16e	
The amount of time provided by the school/district/diocese for teachers to share ideas about mathematics instruction‡		Q19e
How science instructional resources are managed (e.g., distributing and refurbishing materials)‡	Q16f	
How mathematics instructional resources are managed (e.g., distributing and replacing materials)‡		Q19f
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.89**	**0.86**
Confirmatory Factor Analysis Fit Index – SRMR	**0.03**	**0.05**

† This item was presented only to teachers in public and Catholic schools.
‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

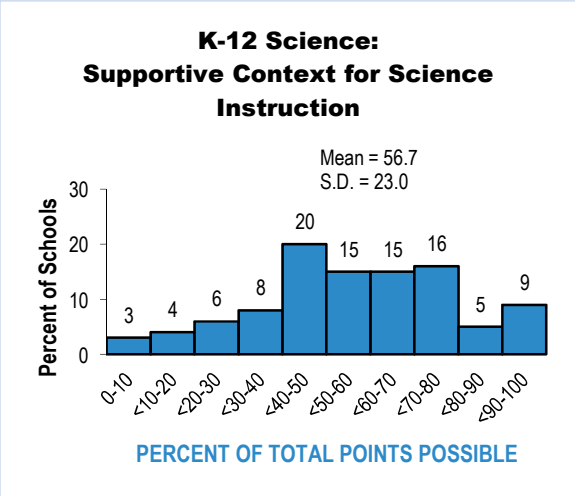

Figure D-56

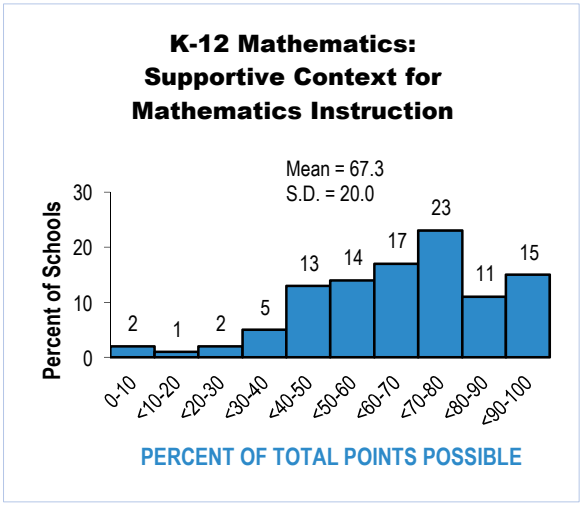

Figure D-57

Table D-27
Extent to Which a Lack of Resources Is Problematic

	SCIENCE	MATHEMATICS
Lack of science facilities (e.g., lab tables, electric outlets, faucets and sinks in classrooms)‡	Q17a	
Lack of equipment and supplies and/or manipulatives for teaching mathematics (e.g., materials for students to draw, cut, and build in order to make sense of problems)‡		Q20a
Inadequate funds for purchasing science equipment and supplies‡	Q17b	
Inadequate funds for purchasing mathematics equipment and supplies‡		Q20b
Lack of science textbooks/modules‡	Q17c	
Lack of mathematics textbooks‡		Q20c
Poor quality science textbooks/modules‡	Q17d	
Poor quality mathematics textbooks‡		Q20d
Inadequate materials for differentiating science instruction‡	Q17e	
Inadequate materials for differentiating mathematics instruction‡		Q20e
Number of Items in Composite	**5**	**5**
Reliability – Cronbach's Coefficient Alpha	**0.80**	**0.80**
Confirmatory Factor Analysis Fit Index – SRMR	**0.09**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

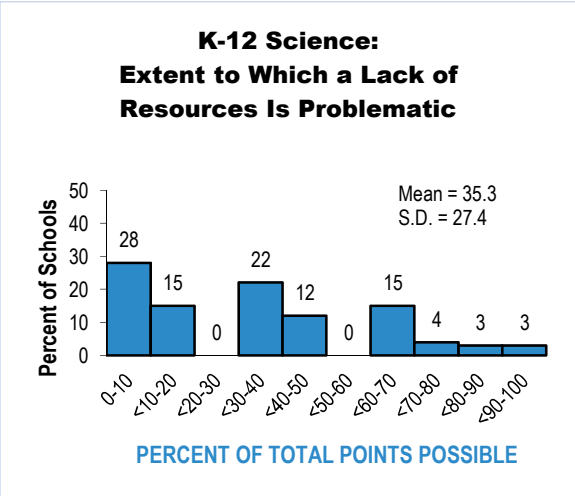

Figure D-58

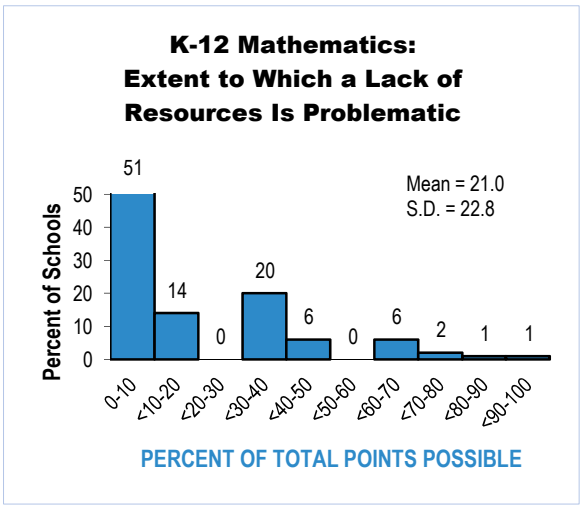

Figure D-59

Table D-28
Extent to Which Student Issues Are Problematic

	SCIENCE	MATHEMATICS
Low student interest in science‡	Q17f	
Low student interest in mathematics‡		Q20f
Low student prior knowledge and skills	Q17g	Q20g
High student absenteeism	Q17n	Q20n
Inappropriate student behavior	Q17o	Q20o
Lack of parent/guardian support and involvement	Q17p	Q20p
Community resistance to the teaching of "controversial" issues in science (e.g., evolution, climate change)‡	Q17q	
Community attitudes toward mathematics instruction‡		Q20q
Number of Items in Composite	**6**	**6**
Reliability – Cronbach's Coefficient Alpha	**0.78**	**0.85**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

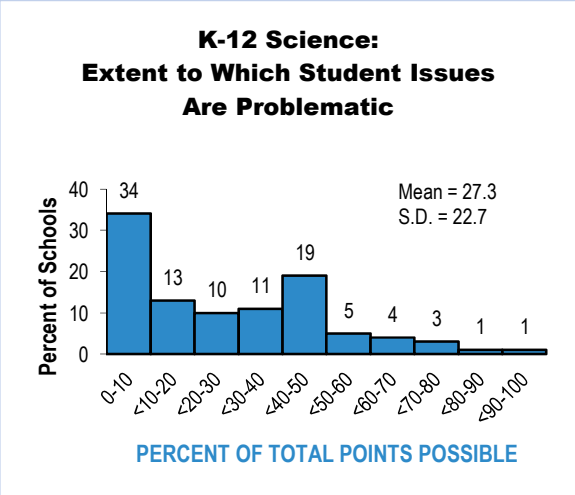

Figure D-60

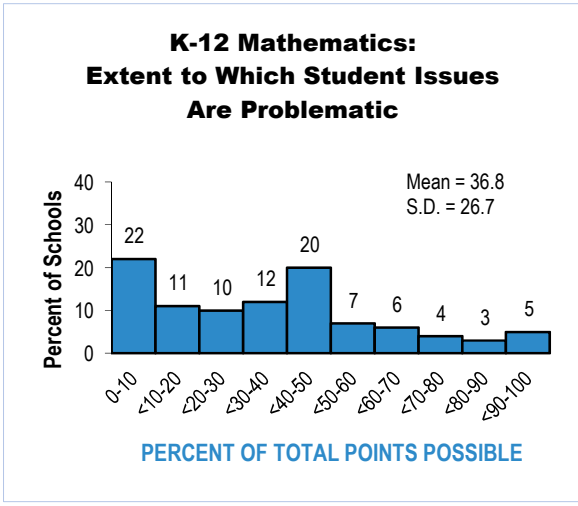

Figure D-61

Table D-29
Extent to Which Teacher Issues Are Problematic

	SCIENCE	MATHEMATICS
Lack of teacher interest in science‡	Q17h	
Lack of teacher interest in mathematics‡		Q20h
Inadequate teacher preparation to teach science‡	Q17i	
Inadequate teacher preparation to teach mathematics‡		Q20i
Insufficient instructional time to teach science‡	Q17k	
Insufficient instructional time to teach mathematics‡		Q20k
Inadequate science-related professional development opportunities‡	Q17l	
Inadequate mathematics-related professional development opportunities‡		Q20l
Number of Items in Composite	**4**	**4**
Reliability – Cronbach's Coefficient Alpha	**0.74**	**0.62**
Confirmatory Factor Analysis Fit Index – SRMR	**0.08**	**0.06**

‡ The science and mathematics versions of this item are considered equivalent, worded appropriately for that discipline.

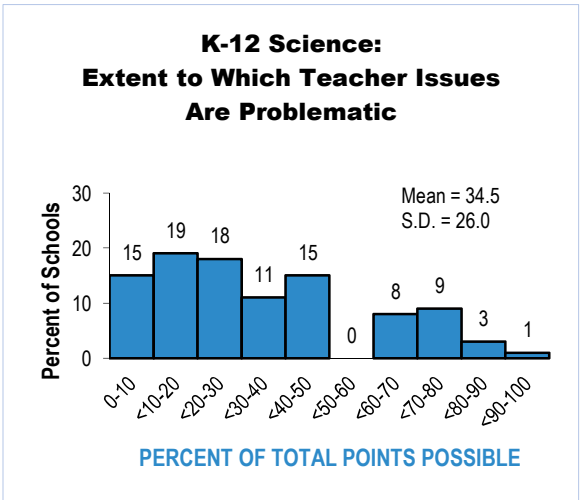

Figure D-62

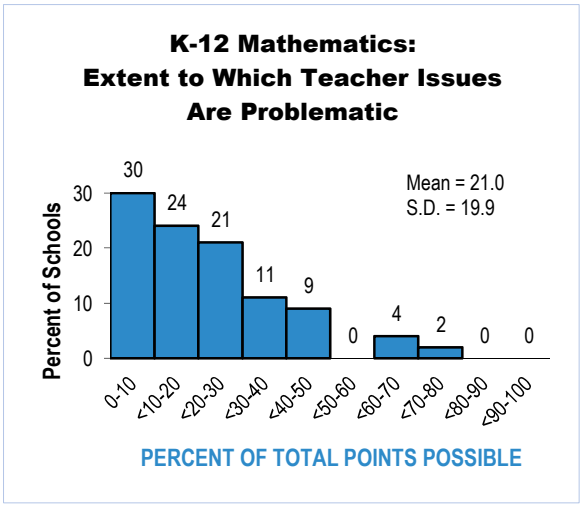

Figure D-63