2018 WEBINAR SERIES

Improving Math Instruction: Making the Complex Understandable for Teachers and Students

VOYAGER SOPRIS LEARNING®

Presented by Dr. John Woodward
author of *TransMath*® and *NUMBERS*

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- We will save 5–10 minutes at the end the presentation for Q&A with our presenter. Please share your questions via the ‘Question Box’ at the right of your screen during today’s presentation.

- Following the webinar, all registrants will receive an email including a link to the recording of today’s webinar. Those attending the live presentation also will receive a certificate stating they attended a one-hour webinar with Voyager Sopris Learning®.

John Woodward, Ph.D.

Dr. John Woodward is a former distinguished professor and dean of the School of Education at the University of Puget Sound in Tacoma, WA. As a researcher, he has focused on mathematics education, technology-based instruction, and math curriculum for academically low-achieving students, particularly in middle schools.

Dr. Woodward has co-authored four technology-based instructional programs, and he is the senior author of *TransMath®*, a math intervention program for middle school students. He is also the co-developer of *NUMBERS*, a math professional development program for K–8 teachers.

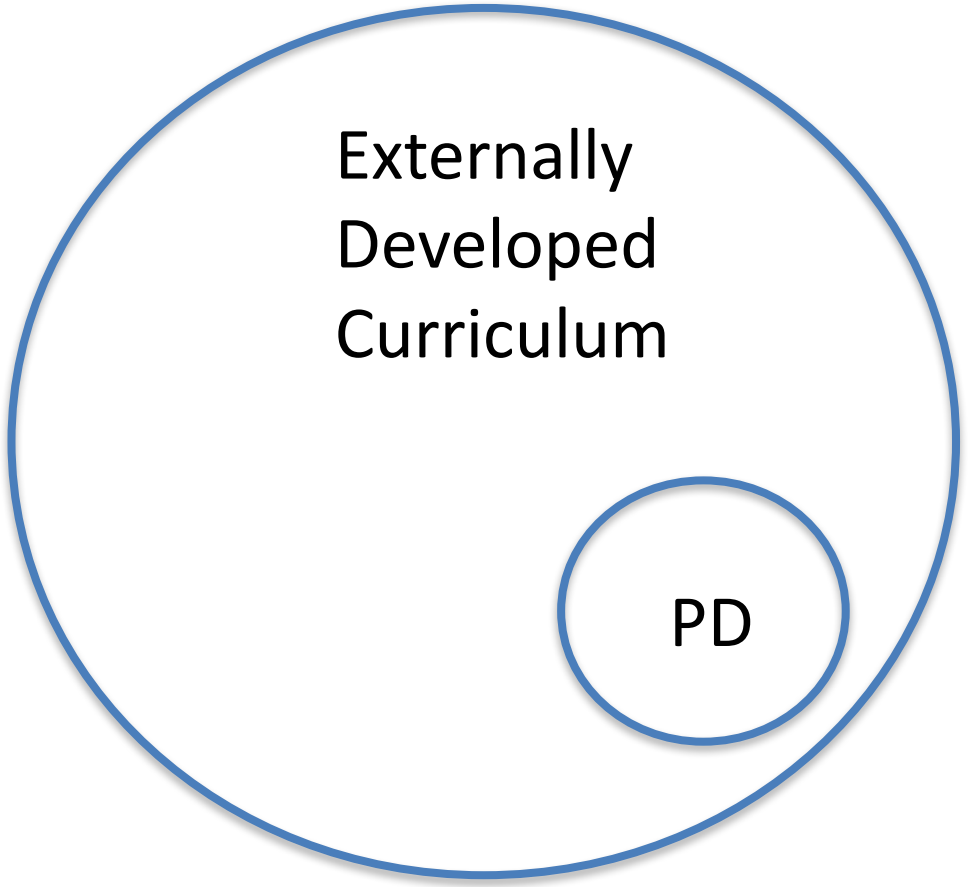
A Classic Tension: Teacher-Proof vs. Teacher-Driven

Teacher-Proof Curriculum

- A Dated Goal from the 1960s Revived with Technology-Based Instruction
  - Debunked through Extensive Classroom Observational Research
  - Technology Instruction Would Seem Natural, But:
    - Infrequent use undermines fidelity
    - Students “game” programs out of boredom
- A Style of Instruction 'Well-Suited' to Struggling Students
  - Designed for a Focus on Basic Skills
  - Rationalized because of the Varying Types of Service Providers (e.g., Paraprofessionals)

A Classic Tension: Teacher-Proof vs. Teacher-Driven

Teacher-Proof Curriculum



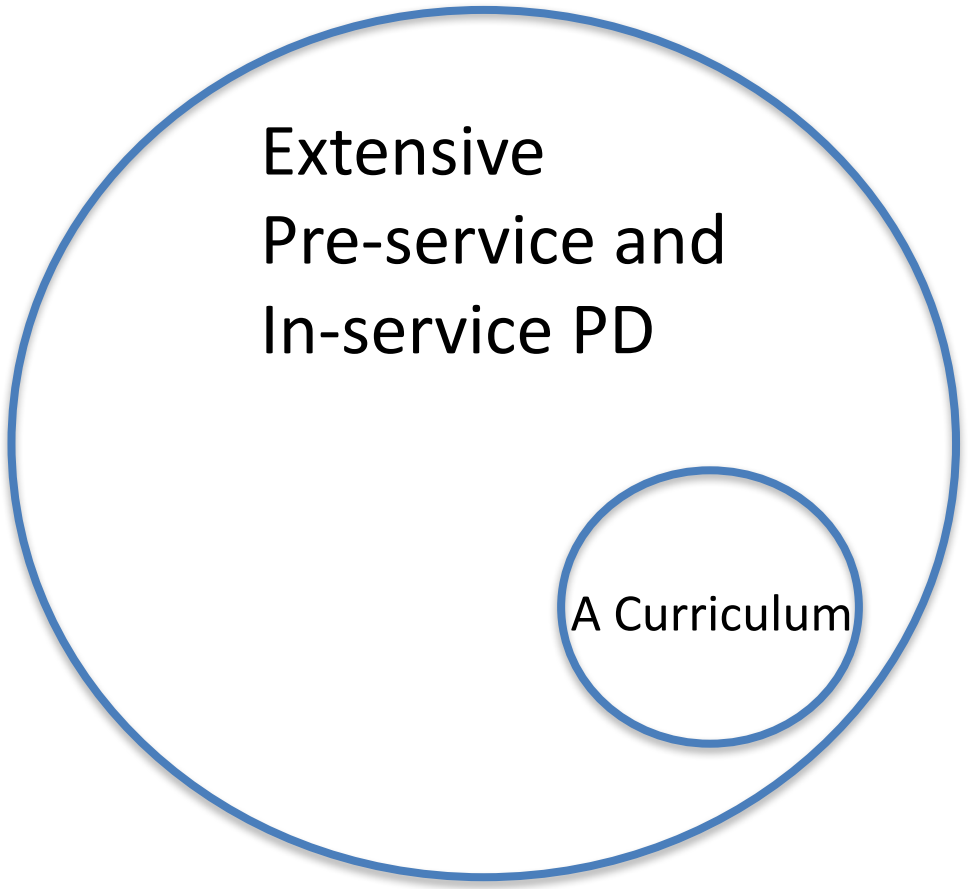
- The Curriculum
  - Externally Developed and Validated (the latter is optimal)
- The PD
  - A Traditionally Brief “How To” Format
  - Focus on the Curricular Structure

A Classic Tension: Teacher-Proof vs. Teacher-Driven

Teacher-Driven Instruction

- A Tilt Away from Teacher-Proof Texts as Instructional Goals and Standards Rose
  - Professional Literature Documenting Expert Teachers Came into Vogue
  - A Shift toward a Different Narrative Structure of Texts
- A Period of Infatuation with Asian Instruction
  - Teachers Are Well Trained
  - Textbooks Are “Thin”

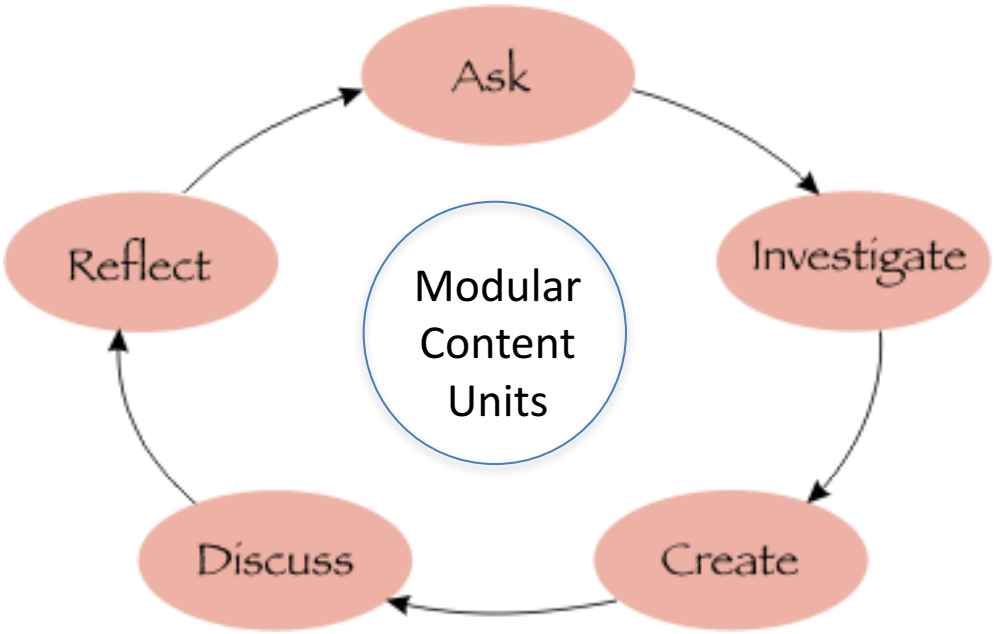
A Classic Tension: Teacher-Proof vs. Teacher-Driven



Teacher-Driven Instruction

- The PD
  - Obtained Somewhere
    (Pre-service, In-service, Undergrad Studies)
  - In-service PD is Extensive by Nature
  - What a Teacher “Needs to Know” Can be Enormous
- The Curriculum
  - From Traditional Commercial Texts to Externally Developed and/or Validated Materials

Teacher Driven Demands for Scientific Inquiry



- Asking and Answering Scientific Questions
- Making Predictions
- Collecting, Recording, Analyzing, Representing, and Interpreting Data
- Constructing Evidence-Based Explanations
- Constructing, Using, Evaluating, and Revising Scientific Models

Davis, et al. (2014). Designing Educative Curriculum Materials: A Theoretically and Empirically Driven Process. *Harvard Education Review*.

A Classic Tension: Teacher-Proof vs. Teacher-Driven

Today's Twist

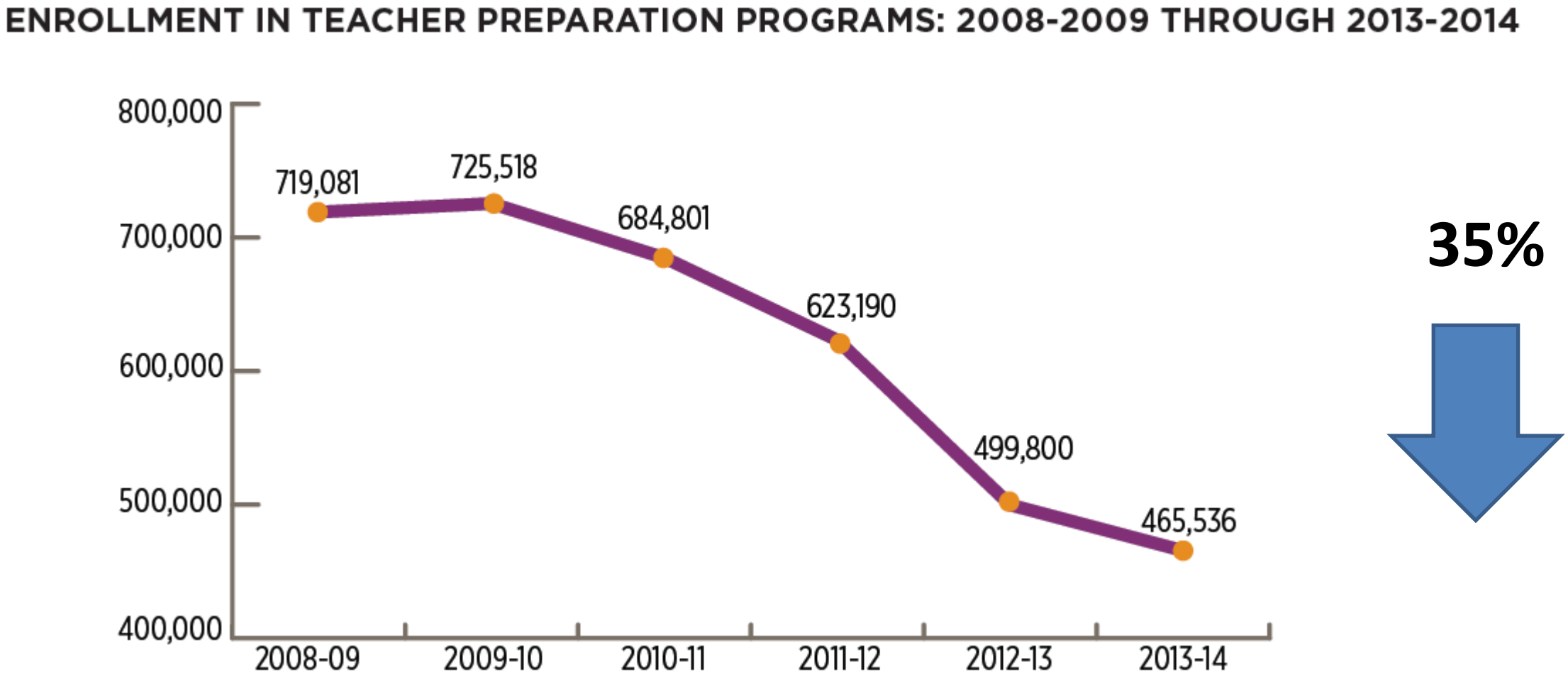
- Standards Have Pushed Teaching Toward Higher-Level Knowledge and Tasks
  - Reasoning and Problem Solving as a Reaction the Knowledge Explosion

- Pre-service Elementary Preparation Still Focuses Largely on Reading
  - Elementary Teachers
    - Receive little in-service training in science education
    - Variable in-service training in math
  - Middle School Teachers*
    - 58% of teachers are certified in science
    - 54% of teachers are certified in math

- Special Education Services are Notoriously Under Certified

***Institute of Education Sciences. (2017). Certification Status and Experience of US Public School Teachers. *US Department of Education*.**

Today's Reality: Demography is Destiny

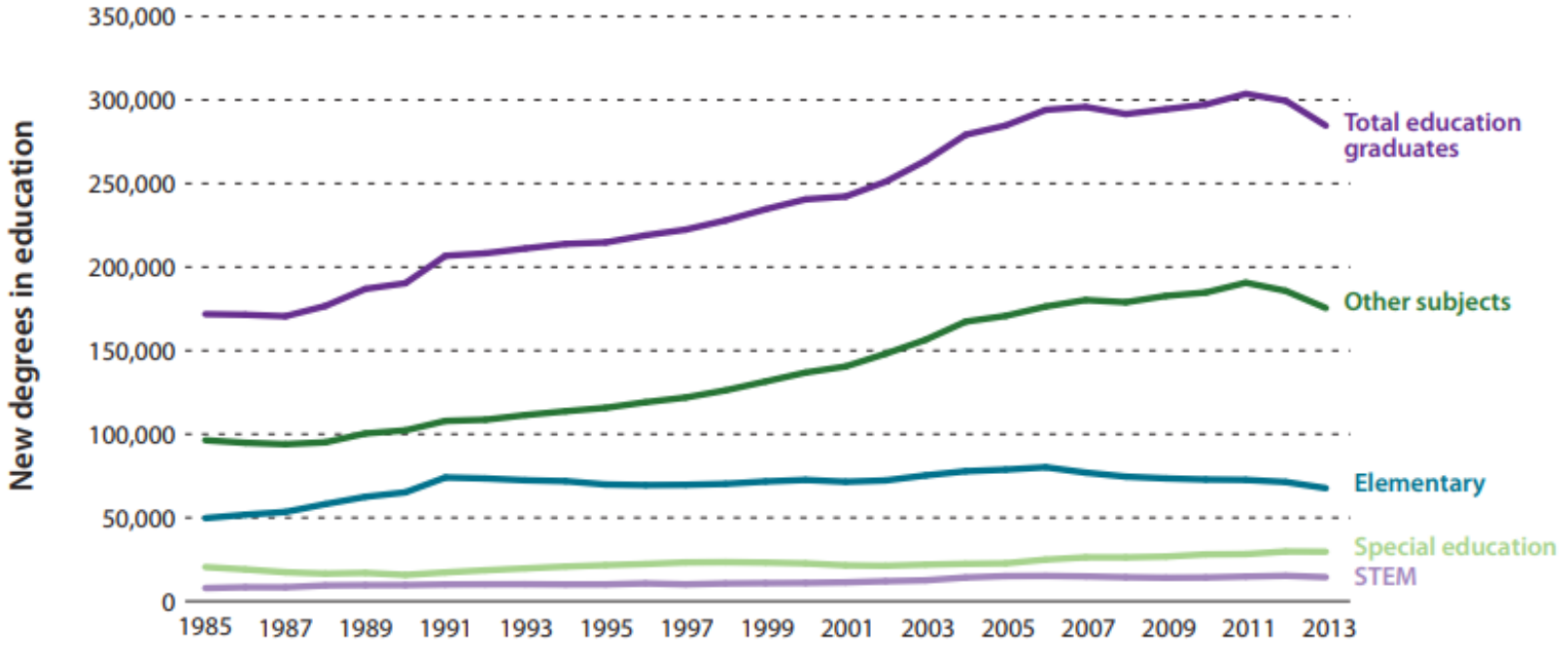


Source: US Department of Education, Office of Postsecondary Education, Enrollment in Teacher Preparation Programs (Washington, DC: US Department of Education 2015), 5-6.

Today's Reality: Demography is Destiny

Realities of STEM and Special Education Personnel

Annual Education Graduates, 1985–2013

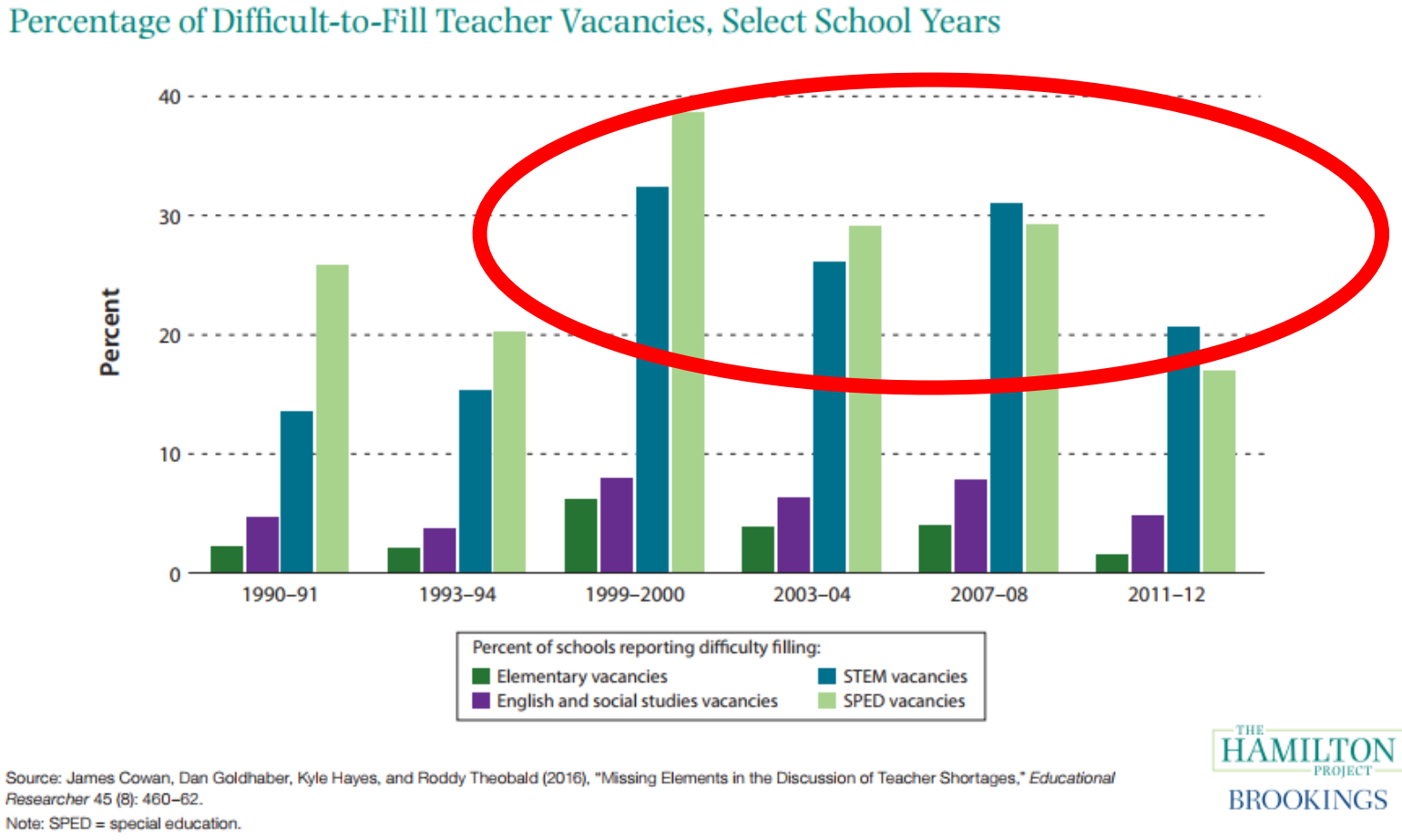


Source: James Cowan, Dan Goldhaber, Kyle Hayes, and Roddy Theobald (2016), "Missing Elements in the Discussion of Teacher Shortages," *Educational Researcher* 45 (8): 460–62.

THE HAMILTON PROJECT
BROOKINGS

Today's Reality: Demography is Destiny

Realities of STEM and Special Education Personnel



Source: James Cowan, Dan Goldhaber, Kyle Hayes, and Roddy Theobald (2016), "Missing Elements in the Discussion of Teacher Shortages," *Educational Researcher* 45 (8): 460–62.
Note: SPED = special education.

THE HAMILTON PROJECT
BROOKINGS

Curriculum in the Era of Standards

Recent Educational Research 'Factors Out' Curricular Effects

- **A Mixed Model:**
  - Teacher Content Knowledge
  - Teaching or Pedagogical Knowledge
  - Well-Designed, Empirically Validated Curriculum

The Intended Curriculum

The Enacted Curriculum

An Educative Curricula

Finding the Middle Ground in Curricular Materials

- **“Speak to Teachers, not Through Them”**
- **Acknowledge that Individual Teachers Marshall Their Knowledge of the Subject Matter, How to Teach It, and the Instructional Conditions**
- **Accept and Encourage the Fact that Teachers Will Learn *Along with* the Students**

Davis, et al. (2014). Designing Educative Curriculum Materials: A Theoretically and Empirically Driven Process. *Harvard Education Review*.

An Educative Curricula

Characteristics of Educative Curricular Materials

- **They Are Standards Based**
- **Based on Research Findings**
- **They Undergo Rounds of Field Testing and Revision**
  - They are sensitive to teacher/consumer feedback
- **They Present Clear Rationales for Practices**

Remillard, J. (2016). How to Partner With Your Curriculum. *Educational Leadership*.

Design Principles for an Educative Curricula

Principle 1: Structure Incremental Progress for the Teacher

- **Allow Topical Complexity to Build Over Time**
- **Start with Abbreviated Opportunities for High Level Tasks**
- **Link to PD that Shows What New Teaching Looks Like**

Davis, Palincsar, Smith, Arias, & Kademian (2017). Educative Curriculum Materials: Uptake, Impact, and Implications for Research and Design. *Educational Researcher.*

Design Principles for an Educative Curricula

Principle 2: Attention to Big Ideas

- **Make Big Ideas Explicit in Teacher AND Student Materials**

- **Support the Understanding of Big Ideas through:**
  - Rationales for “Why and How” of Certain Practices
  - Clear Textual or Narrative Explanations
  - Visual Supports (Well-chosen visual representations, graphs, page design of text)
  - Call-Out and Reminder Boxes

Rationales for Practice

The Concept of Fractions

Key Questions That Guide Student Understanding

- *How can we think about the whole to find the unit fraction?*
- *How can the unit fraction be used to make a proper or improper fraction?*
- *How can we work from a proper fraction to find the whole?*

Enduring Understandings for the Concept of Fractions and Part-to-Whole Relationships

Many students have limited experience with fractions. They often see fractions as just one number above another separated by a line. The treatment of part and whole also tends to be superficial. Students may learn that there are fractions between 0 and 1, but they may not know there are an infinite number of fractions between these two numbers as there are between any two numbers.

Two interrelated ideas form the basis of this unit. The first is the importance of fair shares as a foundation for dividing up or partitioning number lines or shapes such as rectangles. These fair shares allow students to count fractions in a systematic fashion (e.g., $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \ldots$).

The second idea is a dynamic understanding of part-to-whole relationships. Students initially work from the whole to a unit fraction. Then students repeatedly add, or *iterate*, fair-share units to a desired length. For example, students construct $\frac{3}{4}$ in relation to the whole by finding the unit fraction $\frac{1}{4}$ and iterating two more $\frac{1}{4}$-units to make a total of $\frac{3}{4}$.

Students then work in the other direction by starting from a fraction and creating the whole. For example, the whole is found from $\frac{2}{5}$ by finding the unit fraction $\frac{1}{5}$ and then repeatedly iterating the $\frac{1}{5}$ four more times to make $\frac{5}{5}$, or 1 whole.

Narratives

Teachers Thinking about How They Implemented a Lesson or Module

Page Design

Information Overload

Visuals and Call-Out Boxes

What are equivalent fractions?

In the last unit, we frequently used Cuisenaire rods. Some of the rods we compared had the same length. Consider these two pairs of fractions. How do the fractions compare?

$$\frac{1}{2} \quad ? \quad \frac{2}{4}$$

$$\frac{1}{2} \quad ? \quad \frac{4}{8}$$

Use Cuisenaire rods to model each fraction so that they have the same whole.

The models for the fractions all have the *same* length. The fractions $\frac{1}{2}$, $\frac{2}{4}$, and $\frac{4}{8}$ are *equivalent*. So,

$$\frac{1}{2} = \frac{2}{4} \text{ and } \frac{1}{2} = \frac{4}{8}.$$

Equivalent fractions have the *same magnitude*. In other words, equivalent fractions are the same size.

Lesson Vocabulary

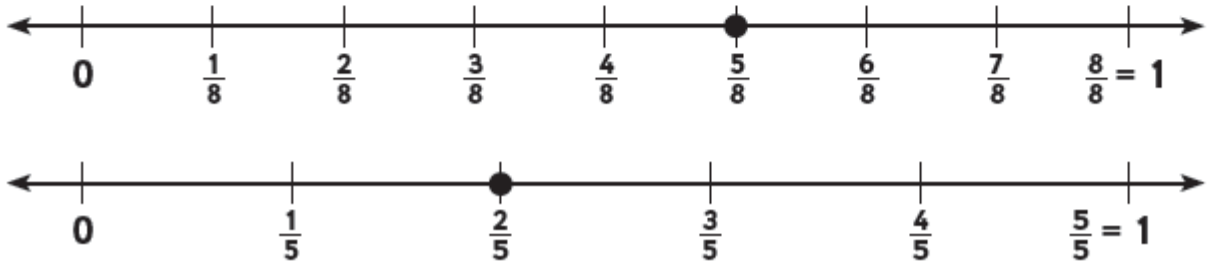
How do benchmarks and relative size help us with number sense?

Most of the time we cannot use a pattern to compare fractions. The fractions usually have different parts and wholes that make comparisons difficult.

What if we compare $\frac{5}{8}$ and $\frac{2}{5}$? How do we make sense of the magnitude, or size, of these two fractions that do not share common numerators or denominators?

Vocabulary
benchmark numbers **equivalent**

One way to compare these fractions is to locate $\frac{5}{8}$ and $\frac{2}{5}$ on a number line.



Design Principles for an Educative Curricula

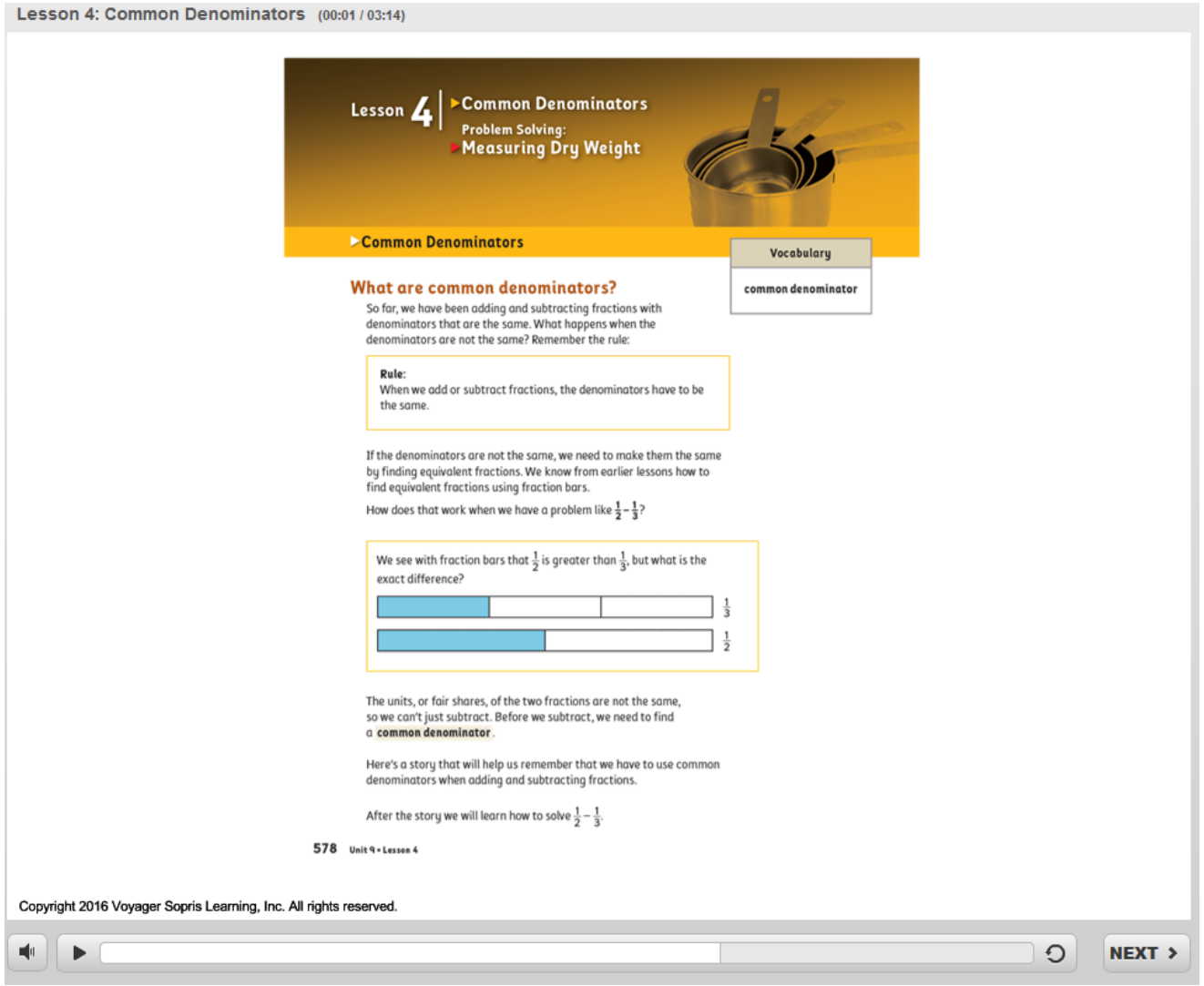
Principle 2: Attention to Big Ideas

- **Make Big Ideas Explicit in Teacher AND Student Materials**

- **Support the Understanding of Big Ideas through:**
  - Added Technology for Explanations
  - Common Misconceptions
  - Student Work
  - Rubrics

Added Technology for Explanations

Brief Explanations of Concepts



Standard-Based Assessments

Performance Assessment for the End of a Unit on Percent

Name_____ Date_____

PROBLEM: Mega Music Hall is a popular venue for band concerts. There is a VIP section in the hall with 120 seats, which represents 10% of the total seating available. The remaining seats are called general seating. There was a concert at the hall last evening, and 90% of the general seats where full as well as the entire VIP section.

Check all of the statements below that accurately describe the seating at the concert.

- ☐ You could figure out the total number of filled seats at the concert by finding 90% of the total number of seats in the hall and adding 120 for the VIP seats.
- ☐ There were 108 unfilled seats at the concert.
- ☐ The number of filled seats at the concert was 120 + 90% of 90% of the total seats in the hall.
- ☐ To find the number of unfilled seats, subtract 120 from 972.
- ☐ If you add the number of seats in general seating plus the VIP seats, you get a total of 1200 seats in the hall.

Explain your reasoning for each selection you made.

A scenario that requires students to make sense of a problem and reason about it.

Integrates several skills in the style of today's high-stake assessments

Representation, communication, and reasoning.

Standard-Based Assessments

A Grading Rubric

0	**Nothing on the paper or just some irrelevant doodles**
1	**States some information. They may restate information given in the problem. They may have a strategy, but it is not relevant or it doesn't make sense. The student is not able to organize and work on the information.**
2	**Gives a partial answer. The answer includes *stating an explicit strategy* that makes sense. The student is definitely "going in the right direction." S/he is missing a "major" step (e.g., if it's a two-step problem, s/he has done only one step). The student is starting to show a higher level of organization.**
3	**Has the correct answer. No real reasons. It is evident that the information is organized insofar as the student performed the right steps. But the student still can't give much of an answer.**
4	**Correct answer. The explanation is complete *for the problem*. At times, this may mean that a drawing does 90 percent of the work and the student simply says, here's how I figured it out. In that case, correct use of labels, etc., are important.**

Standard-Based Assessments

Sample Student Work

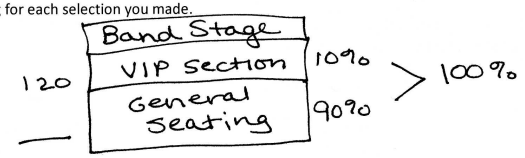
Name Sample Response #1 Date

PROBLEM: Mega Music Hall is a popular venue for band concerts. There is a VIP section in the hall with 120 seats, which represents 10% of the total seating available. The remaining seats are called general seating. There was a concert at the hall last evening, and 90% of the general seats where full as well as the entire VIP section.

Check all of the statements below that accurately describe the seating at the concert.

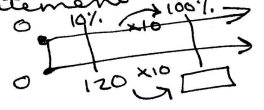
- ☐ You could figure out the total number of filled seats at the concert by finding 90% of the total number of seats in the hall and adding 120 for the VIP seats. no
- ☒ There were 108 unfilled seats at the concert. yes
- ☒ The number of filled seats at the concert was 120 + 90% of 90% of the total seats in the hall. yes
- ☐ To find the number of unfilled seats, subtract 120 from 972. no
- ☒ If you add the number of seats in general seating plus the VIP seats, you get a total of 1200 seats in the hall. yes

Explain your reasoning for each selection you made.



① Statement #1 is not true 90% of Total seats = General seats
General + VIP or 120 not equal to filled seats. It's equal to Total

② Statement # 2 is True.



120 x 10 = 1200 Total
1200 − 120 = 1080 General
10% × 1080 = 108 unfille

$\frac{VIP}{120} + \frac{90\%\ General}{108 \times 9 = 972} + \frac{unfilled}{108} = 1200$ True

③ Statement # 3 is right. You add VIP + filled seats in general to get total filled seats
90% of 1200 = General 90% of General = Fi

④ NO. 972 = filled General and 120 = VIP. You add not subtract to get filled seats Not unfilled

⑤ True VIP + General = 1200 → 120 + 1080 = 1200

Name Sample Response # 6 Date

PROBLEM: Mega Music Hall is a popular venue for band concerts. There is a VIP section in the hall with 120 seats, which represents 10% of the total seating available. The remaining seats are called general seating. There was a concert at the hall last evening, and 90% of the general seats where full as well as the entire VIP section.

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- ☐ To find the number of unfilled seats, subtract 120 from 972.
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Explain your reasoning for each selection you made.

120 × 10 = 1200
.9 × 1200 = 1080
.9 × 1080 = 972
120 + 972 = 1,092
.1 × 1080 = 108

1080
− 972
108

Design Principles for an Educative Curricula

Principle 3: Support Engaging Classroom Practices

- **Teacher Talk and Thinking Aloud**
  - Ways that Teachers Can Model and/or Scaffold Thinking

- **Help in Eliciting Student Communication**
  - Classroom Discussion Techniques
  - Added Help on Specific Communication Goals (e.g., Explanation, Argumentation)
  - Student Examples of Written Communication

Design Principles for an Educative Curricula

Principle 4: Adaptations for a Particular Student Audience

- **Alternatives for Varying Time and Pacing Conditions**
- **Built-In "Just in Time" Review**
- **Distributed Practice**
- **Remediation Options for "Below Mastery" Performance**

Beyond the Curriculum

The Difference between High- and Low-Knowledge Teachers

- **High-Content and Pedagogy-Knowledge Teachers Are Generally:**
  - Better able to give clear, consistent explanations
  - Adapt to student differences in a mixed-ability class
  - Conduct probing classroom discussions

Davis, Palincsar, Smith, Arias, & Kademian (2017). Educative Curriculum Materials: Uptake, Impact, and Implications for Research and Design. *Educational Researcher.*

The Difference between High- and Low-Knowledge Teachers

- **Low-Content and Pedagogy-Knowledge Teachers Are Generally:**
  - Less likely to negotiate multiple solutions to problems or tasks
  - Less likely to build connections to other key concepts
  - More likely to move through the curriculum in a routine fashion or substitute with their own materials
  - Provide too much assistance on challenging tasks

Davis, Palincsar, Smith, Arias, & Kademian (2017). Educative Curriculum Materials: Uptake, Impact, and Implications for Research and Design. *Educational Researcher.*

Implications for PD

Building Out from the Curriculum

- **Focus PD on the Big Ideas in a Domain**
- **Concentrate on Teaching "High-Level Tasks"**
- **Devote Attention to Classroom Talk**
- **Consider Systematic Development of Performance Assessments**

2018 WEBINAR SERIES

Q&A

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WEBINAR SERIES 2018

Tuesday, May 15 | 4:00 p.m. ET

Let's Talk: Nurturing Social Emotional Learning

Presented by Lucy Hart Paulson, Ed.D., CCC-SLP and Judi Dodson, M.A.

voyagersopris.com/webinar-series/paulson-dodson-register

Wednesday, May 23 | 3:00 p.m. ET

Teaching Reading: The Connection Between Student Literacy and Professional Development

Presented by Dr. Mary Dahlgren and Michelle Elia

voyagersopris.com/webinar-series/dahlgren-elia-register

Wednesday, May 30 | 3:00 p.m. ET

Strategies for Building Proficient K–12 Writers

Presented by Jenny Hamilton, M.Ed.

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