BUILDING BRIDGES BETWEEN MATHEMATICAL TASKS AND DIGITAL RESOURCES

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SESSION OVERVIEW

- Types of Mathematical Tasks
- Choosing an Instructional Medium
- Four Levels of Tasks

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 Supporting Teachers in Selecting Digital Mathematical Tasks

LEARNING TASKS

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- "All tasks are not created equal different tasks require different levels and kinds of student thinking." (Stein, Smith, Henningsen, & Silver, 2009)
- "Mathematical tasks are a set of problems or a single complex problem the purpose of which is to focus students' attention on a particular mathematical idea." (Briars, 2011)
- Mathematical tasks are essential to students' opportunities to learn mathematics – what it is and how to do it – and influence learning by directing attention to aspects of content and ways to process the information (Briars, 2011).

Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.

Principles to Action, 2014, p. l_47

The mathematics we need for learning is different than the mathematics we need for doing math.

Keith Devlin, NCSM 2016 Opening Session

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WHAT'S THE DIFFERENCE?

MATH FOR LEARNING

• Visual models

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- Multiple representations
- Communication

MATH FOR DOING

- Symbols
- Algorithms



Keith Devlin, NCSM 2016 Opening Session

SAMR MODEL (RUBEN PUEDENTURA)

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Mathematics Education in the Digital Age Teaching and Learning in Digital

Redefinition

Modification

Augmentation

Substitution

NCSM PLC App, A Helpful Lens: The SAMR Model

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TECHNOLOGY AS A LEARNING TOOL

Are we really doing more with technology? Or are we just substituting a medium?



CHARACTERISTICS OF MATHEMATICAL TASKS

Lower-level demands (Memorization)

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- Reproducing previously learned facts, formulas, or material
- Procedures are not used because they either do not exist or there is not enough time allocated
- Exact reproduction of previouslyseen material
- No connection to concepts or underlying meaning

Lower-level demands (Procedures without Connections)

- Algorithmic
- Little ambiguity about what needs to be done
- No connection to concepts or underlying meaning
- Focused on producing correct answers
- Explanations are not required or focus solely on describing procedures

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Summarized from Smith and Stein (1998) as presented in Principles to Action (NCTM, 2014)

CHARACTERISTICS OF MATHEMATICAL TASKS

Higher-level demands (Procedures with Connections)

- Procedures are used for developing deeper understanding
- Suggested pathways are broad and closely connected to underlying conceptual ideas
- Multiple representations

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 Procedures cannot be mindlessly followed Higher-level demands (Doing Mathematics)

- Complex and non-algorithmic thinking
- Explore nature of concepts, processes, or relationships
- Require self-monitoring or selfregulation
- Access relevant knowledge and experiences
- Analyze the task and actively examine contraints
- Some level of anxiety may emerge from unpredictable nature of problem solving

Summarized from Smith and Stein (1998) as presented in *Principles to Action* (NCTM, 2014)

SAMPLE TASKS

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TASK: MEMORIZATION

PAPER AND PENCIL

 Exit Ticket: How do you multiply decimals?

DIGITAL

 Blog or video entry: How do you multiply decimals?

Which approach to technology integration does this represent?

TASK: PROCEDURES WITHOUT CONNECTIONS

PAPER AND PENCIL

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- Independent Practice
- Simplify: $$1.30 \times 2.5$

DIGITAL

• Multiply \$1.30

Which approach to technology integration does this represent?

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TASK: PROCEDURES WITH CONNECTIONS

PAPER AND PENCIL

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Mrs. Motogbe purchased
 2.5 pounds of apples at
 \$1.30 per pound. Use a
 decimal grid to show how
 much money Mrs.
 Motogbe spent.

Which approach to technology integration does this represent?

DIGITAL

 Use a Geogebra sketch to generate a visual model. If the numbers were different, how would the model change?

http://tube.geogebra.org/material/ simple/id/13571

TASK: PROCEDURES WITH CONNECTIONS

PAPER AND PENCIL

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What does the intersection
 of y = 2x - 3 and
 y = 0.5x + 1 represent?

DIGITAL

 Use a Geogebra sketch to explore graphs. If the values of m and b were different, how would the model change?

http://tube.geogebra.org/material/ simple/id/937513

Which approach to technology integration does this represent?

TASK: DOING MATHEMATICS

PAPER AND PENCIL

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San Francisco Gym charges

 a \$75 startup fee and \$20
 each month. Oakland Gym
 charges no startup fee and
 \$25 each month. Which is
 the better deal?

DIGITAL

 Use graphing technology (calculator, app, etc.) to create graphs and tables to show the relationship.
 Explain your solution.

Which approach to technology integration does this represent?

HOW MATH LEADERS CAN HELP

To ensure that instructional materials create excitement and motivation, are developmentally appropriate, and support high-quality lessons:

- Provide access to rich instructional resources;
- Guide the selection of instructional resources;
- Involve teachers in the selection of instructional resources

It's TIME: A Leadership Framework for Common Core Mathematics, 2014, p. 33

OPEN EDUCATION RESOURCES

<u>http://tube.geogebra.org</u>

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Interactive sketches for geometry and pictorial models

<u>http://texasgateway.org</u>

Standard-specific (Texas TEKS) aligned instructional resources

http://nlvm.usu.edu/en/nav/vli brary.html

Library of interactive, Java-based virtual manipulatives

http://maine.edc.org/file.ph
 p/1/oer/math OERforMath.
 html

Clearinghouse for OER

 http://phet.colorado.edu/en /simulations/category/math

Interactive simulations

http://illuminations.nctm.org
 Mobile-based and Java-based
 interactives by topic and grade
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BREAKING THE SYMBOL BARRIER

- 5E lesson design
 - Engage

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- Explore
- Explain
- Elaborate
- Evaluate

- Three-Act Tasks
- Inquiry Lesson Design
- Other experience-based lesson framework

Do the thinking before generalizing symbolically. Explore \rightarrow Explain

POSSIBLE LESSON FRAMEWORK

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Lesson Stage	Student/Teacher Activity	Resources
Introduction		
Content Exploration		
Content Formalization		
Application		

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REFERENCES

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Stein, M. K., et al. (2009). Implementing standards-based mathematics instruction: A casebook for professional development. 2nd ed. New York: Teachers College Press.

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Devln, K. (2016). Game-Based Learning: The Hype is Starting to Give Way to Some Surprising Substance. Symposium conducted at the 48th Annual NCSM ²² Meeting, Oakland, CA. **QUESTIONS, COMMENTS, OR SUCCESS STORIES?**

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(Events and Conferences section)