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**Teaching High School and Middle School Students to Speak the Language of Math (Part One)**

Denise Thornton and Mary Davis
Professional Learning Facilitators, K-12 Education Strategy, Policy, and Services

July 18, 2018, CAMT Conference

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**About the Dana Center**

– Equity — Access — Excellence –

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## Dana Center by the Numbers

We supported 60,500 K-12 students attending school on U.S. military bases through our work with the **U.S. Department of Defense Education Activity**.

**60,500**

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## Dana Center by the Numbers

By the close of 2017, the Dana Center had contributed to the **implementation of math pathways** in higher education systems, institutions, and campuses in 29 states.

**29**

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## Dana Center by the Numbers

We engaged with
118 districts in 23 states
to provide middle and high school
math courses of the **highest quality**,
as recognized by rigorous national
and state reviews, including
EdReports.org, Louisiana
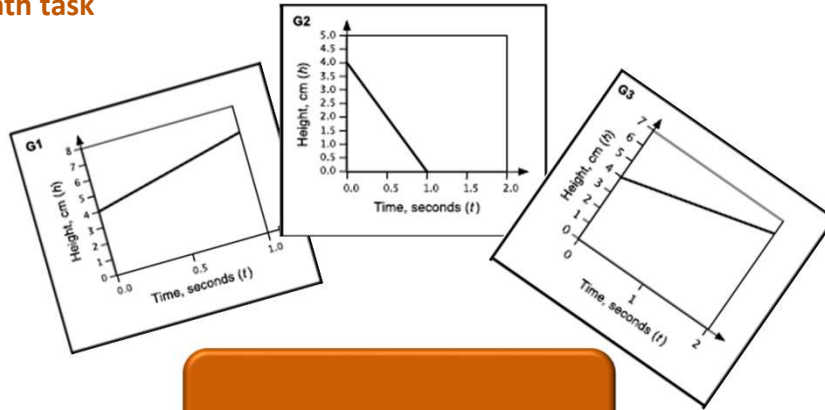Department of Education, and
Texas Education
Agency panels

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**Teaching High School Students to Speak the Language of Math**

**Agenda**

- **Math Task: Flowing Liquid**

- **5 Practices of Orchestrating Productive Discourse**

  - Chasing the Goal

  - Anticipating Student Responses

- **Seeing it Action: www.insidemathematics.org**

- **Closing**

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**Math task**



Flowing Liquid

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http://map.mathshell.org/download.php?fileid=1682

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**Flowing Liquid**



Projector resources     Comparing Lines and Linear Equations     P-1

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## Flowing Liquid



Projector resources      Comparing Lines and Linear Equations      P-2

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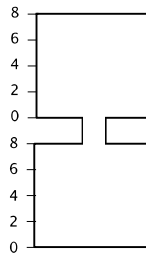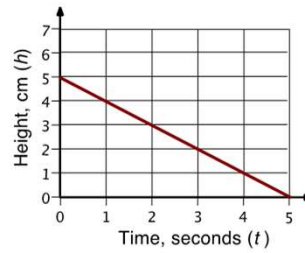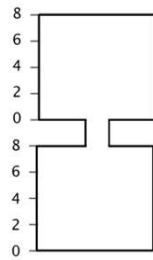
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## Liquid flowing out of the top prism 1



Projector resources      Comparing Lines and Linear Equations      P-3

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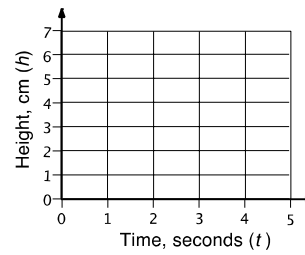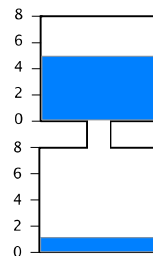
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## Liquid flowing out of the top prism 2



Projector resources       Comparing Lines and Linear Equations       P–4

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11
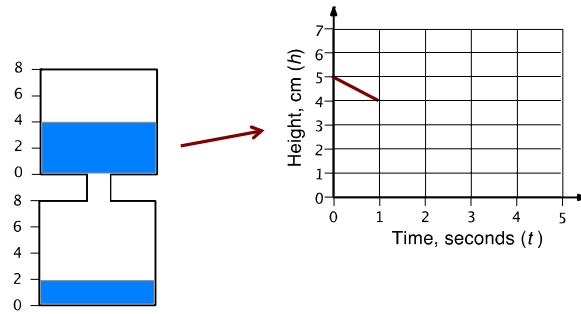
**Teaching High School Students to Speak the Language of Math**

## Liquid flowing out of the top prism 3



Projector resources       Comparing Lines and Linear Equations       P–5

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12
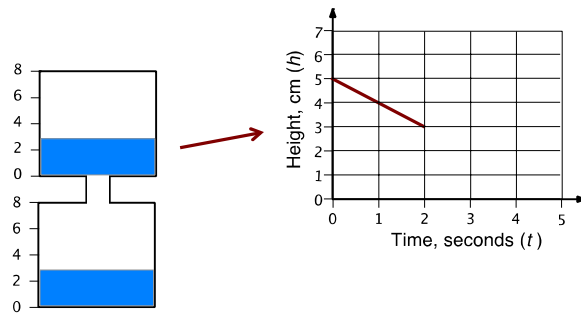
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**Liquid flowing out of the top prism 4**

Projector resources — Comparing Lines and Linear Equations — P-6

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13
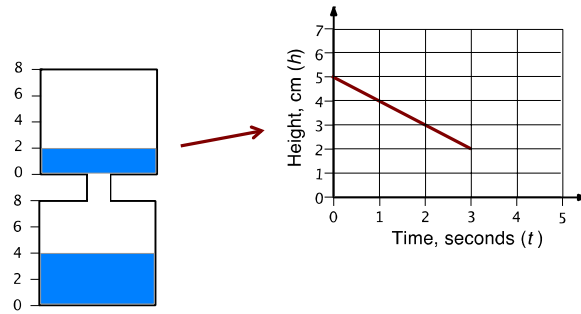


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**Liquid flowing out of the top prism 5**

Projector resources — Comparing Lines and Linear Equations — P-7

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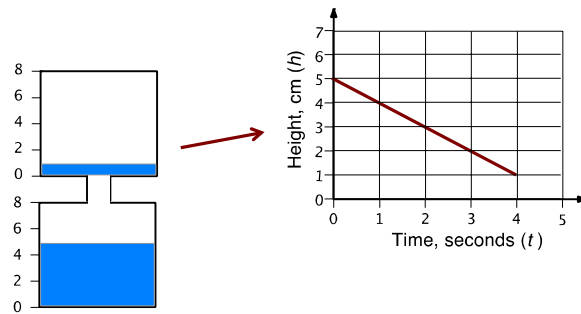
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### Liquid flowing out of the top prism 6



Projector resources — Comparing Lines and Linear Equations — P–8

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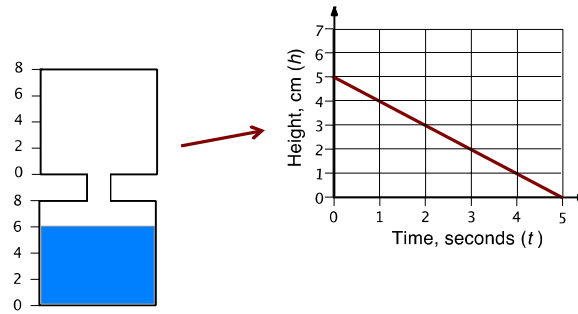
## Teaching High School Students to Speak the Language of Math
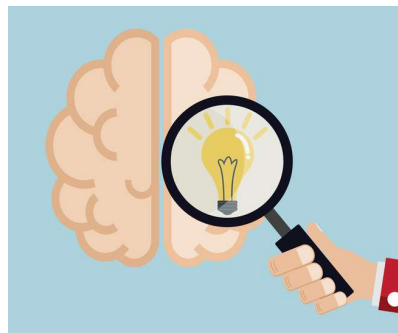
### Graphs



How did you decide which graphs matched?

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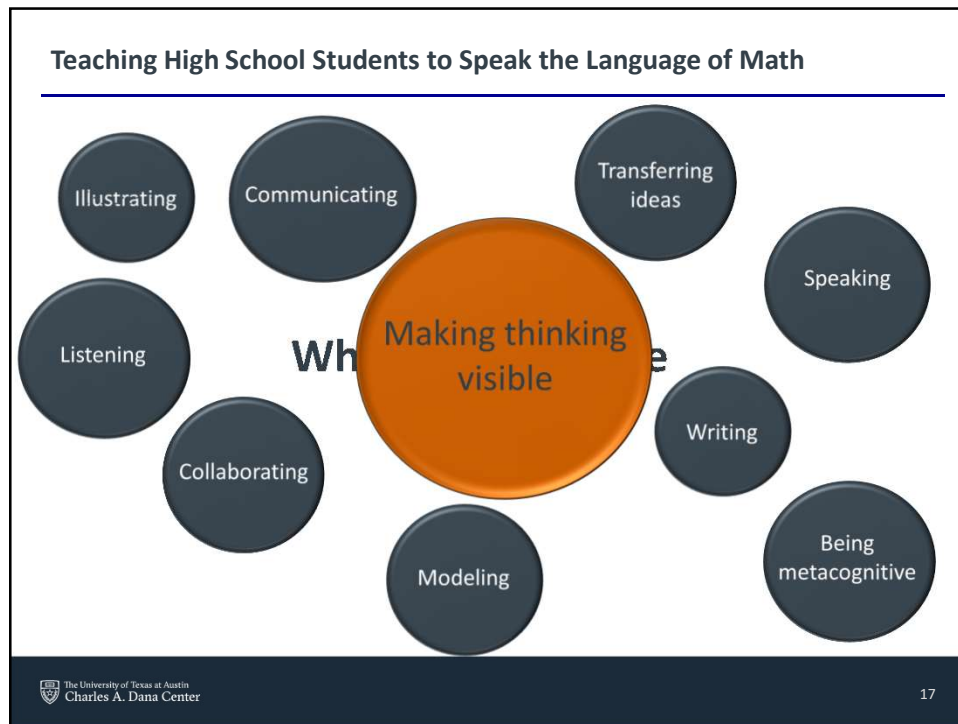
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"Discourse is the mathematical communication that occurs in a classroom. Effective discourse happens when students articulate their own ideas and seriously consider their peers' mathematical perspectives as a way to construct mathematical understandings."

— National Council of Teachers of Mathematics (2010). Call for manuscripts: Discourse. Mathematics Teaching in the Middle School. From http://www.nctm.org/Publications/mathematics-teaching-in-middle-school/2010/Vol16/Issue2/Call-for-Manuscripts_-Discourse---September-2010

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## Why promote student discourse?



Deepen student understanding

Encourage students to build on and construct new ideas

Make student thinking visible

Foster practices of mathematicians, scientists, and engineers

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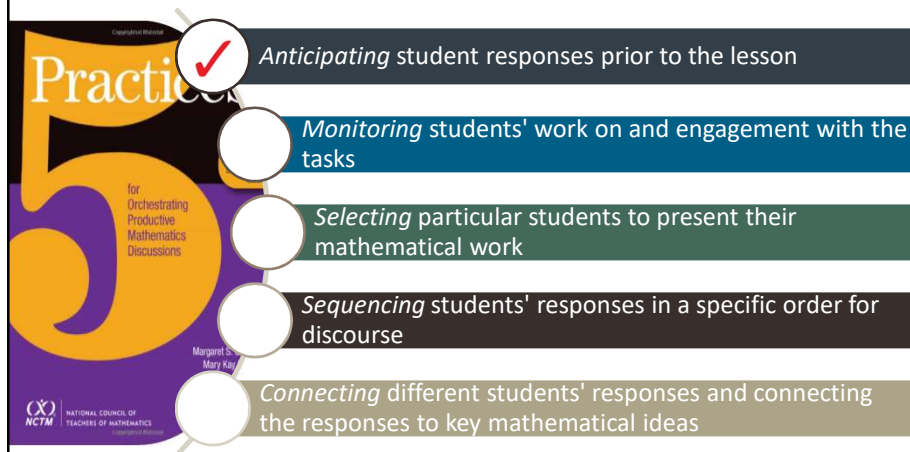# What is a pitfall that teachers encounter in preparing students to talk about math?

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**5 practices for orchestrating productive discussions**
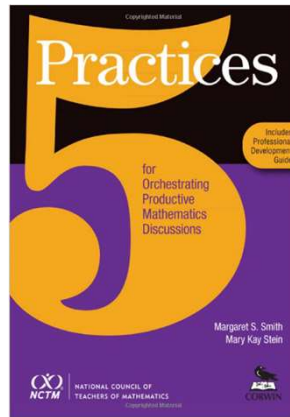


Stein, M.K., & Smith, M.S. (2011). *5 practices for orchestrating productive mathematics discussions.* Reston, VA: National Council of Teachers of Mathematics. http://www.nctm.org/Store/Products/5--Practices-for-Orchestrating-Productive-Mathematics-Discussions/

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**5 Practices for Orchestrating Productive Mathematics Discussions**



✓ *Anticipating* student responses prior to the lesson

*Monitoring* students' work on and engagement with the tasks

*Selecting* particular students to present their mathematical work

*Sequencing* students' responses in a specific order for discourse

*Connecting* different students' responses and connecting the responses to key mathematical ideas

Stein, M.K., & Smith, M.S. (2011). *5 practices for orchestrating productive mathematics discussions.* Reston, VA: National Council of Teachers of Mathematics. http://www.nctm.org/Store/Products/5--Practices-for-Orchestrating-Productive-Mathematics-Discussions/

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**Goal statements**

**Goal Statement 1**
Students will learn slope of a linear graph.

**Goal Statement 2**
Students will identify speed as the slope of a linear graph and explain how it relates to the equation of a line and its graphical representation.

**Goal Statement 3**
Students will interpret speed as the slope of a linear graph and translate between the equation of a line and its graphical representation. Students will describe and justify to their peers how the graphical representation and equation of a line are related.

*Which learning goal statement would be most useful when planning for student discourse?*

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**The need for explicit learning goals**

"Without explicit learning goals, it is difficult to know what counts as evidence of students' learning, how students' learning can be linked to particular instructional activities, and how to revise instruction to facilitate students' learning more effectively. Formulating clear, explicit learning goals sets the stage for everything else."

Cartier, J. L., Smith, M. S., Stein, M. K., & Ross, D. K. (2013). *5 practices for orchestrating productive task-based discussions in science*. Reston, VA: National Council of Teachers of Mathematics, p. 8.

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## Orchestrating productive mathematics discussions

### *Anticipating* student responses prior to the lesson

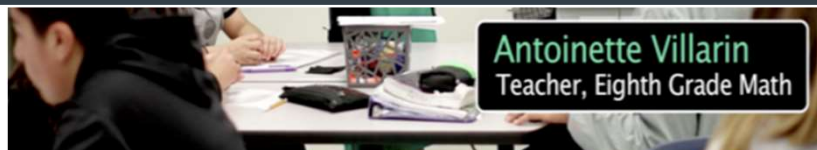| What should you consider? | How is this supported? |
|---|---|
| • The strategies that students might use to approach or solve a challenging mathematical task<br><br>• How to respond to what students produce<br><br>• Which strategies are most useful in addressing the mathematics to be learned | • Solving the problem in as many ways as possible<br><br>• Solving the problem with other teachers<br><br>• Drawing on relevant research when possible<br><br>• Documenting student responses year to year |

— Adapted from Mary Kay Stein and Margaret Schwan Smith. (2011). *5 Practices for Orchestrating Productive Mathematics Discussions.* | Reston, VA: National Council of Teacher of Mathematics.

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**Inside Mathematics**



How did collaborative conversations with colleagues help this teacher plan for productive discourse?

Antoinette Villarin
Teacher, Eighth Grade Math

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## Engage With the Dana Center



facebook.com/utdanacenter



@UTDanaCenter

Conference Hashtag: #gotmath

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## Contact Information

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