Knowledge for Teaching and Teaching for Knowledge: How Much Is 'What to do in the Classroom?' Discipline-Specific?

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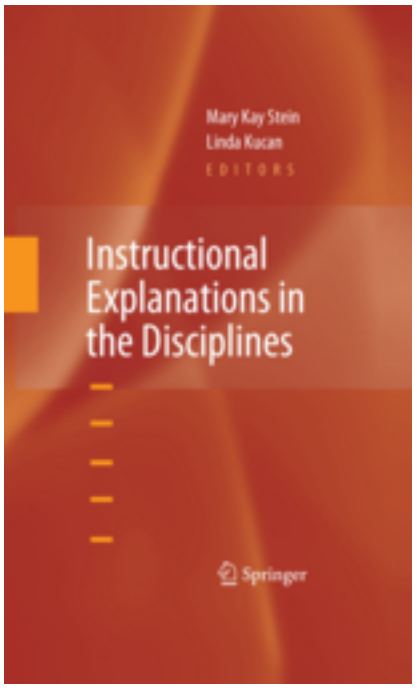
"…the field of research on teaching still lacks powerful ways of parsing teaching that provide us with the analytical tools to describe, analyze, and improve teaching"
(Grossman & McDonald, 2008).

Teaching is specific with respect to task, time, place, participants, content and the like and different subjects vary in those specifics

(Leinhardt, 2001)

Reflection on your own teaching practices



Instructional Explanation

-Designed to communicate some portion of the subject matter to the learner

-*Commonplace* of teaching

-Emphasis is on what is talked about and how, not on who is talking

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POGIL

Process Oriented Guided Inquiry Learning

Students use carefully designed materials that guide them to constructing new knowledge and develop higher-order thinking skills.

Provides shell for which discipline-specific details can be filled in.

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Common language?

inquiry

argumentation

mathematical/
scientific practice

problem solving

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Common Questions

How to support students in guided discovery?

How to orchestrate whole-class discussions?

How best to support groupwork?

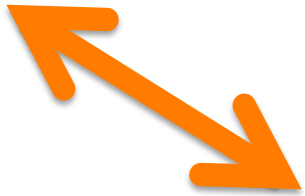
How can teachers support their students' learning in the classroom?

How to teach English Language Learners?

How to teach for understanding in a large lecture?

How can teachers support their students' learning in the classroom?

Valuing students' ideas



Moving student thinking forward

Examples from Science

Discursive resources to introduce authentic science to students (Hsu & Roth, 2008)

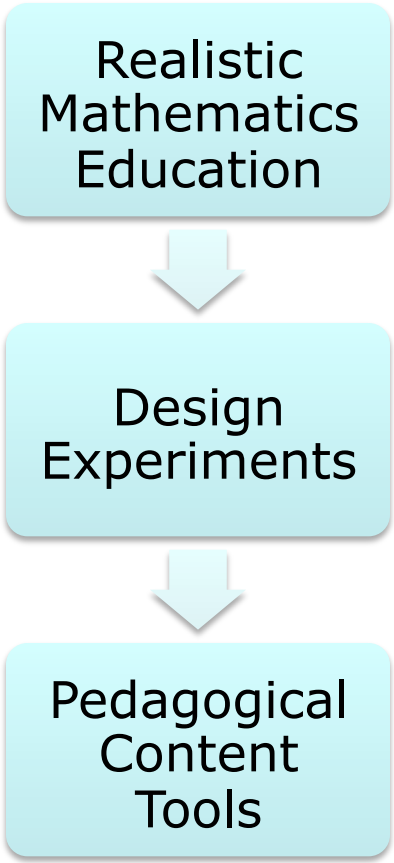
Open ended questions to support scientific argumentation (McNeill & Pimentel, 2009)

Teacher questioning, in particular the *reflective toss*, as a strategy to teach students physics (vanZee & Minstrell, 1997)

An Example from Differential Equations

Problem: If we view mathematics learning as participating in symbolizing and constructing arguments,

then we need constructs that organize and illuminate features of teaching that promote symbolizing and argumentation.



Rasmussen, C. L., & Marrongelle, K. A. (2006). Pedagogical content tools: Integrating student reasoning and mathematics in instruction. *Journal for Research in Mathematics Education 37*(5), 388-420.

Realistic Mathematics Education
Instructional Design Heuristics

Guided Reinvention

Outlines a route by which students develop mathematics for themselves

Emergent Models

Model of informal activity→ Model for more formal mathematical reasoning

Transformational Record

Teacher uses notations, diagrams, or other graphical representations initially to record student thinking. Students later use the teacher's record to solve new problems.

Sketch a population vs. time graph for a:

-Single species

-Continuous reproduction

-Unlimited resources

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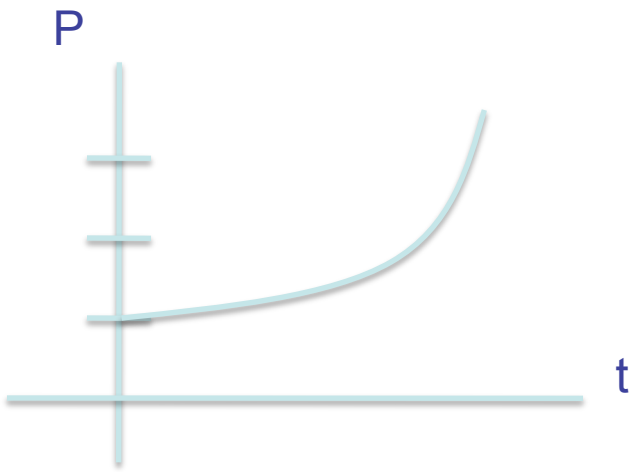

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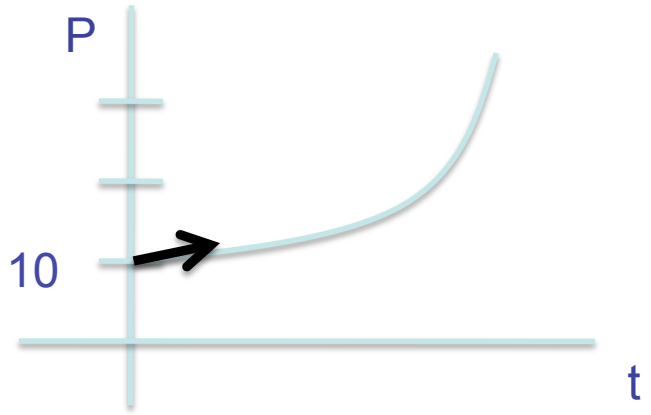

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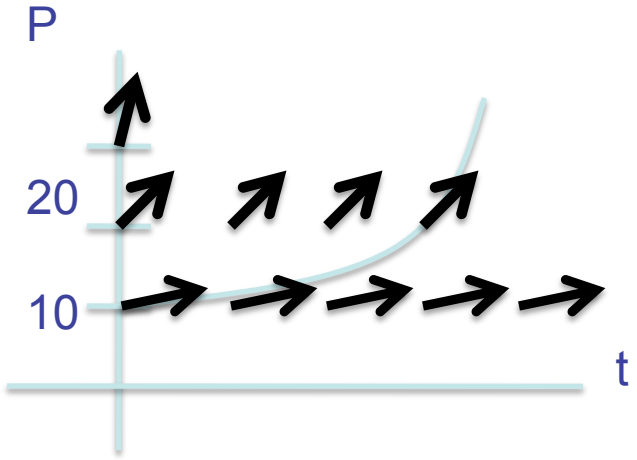
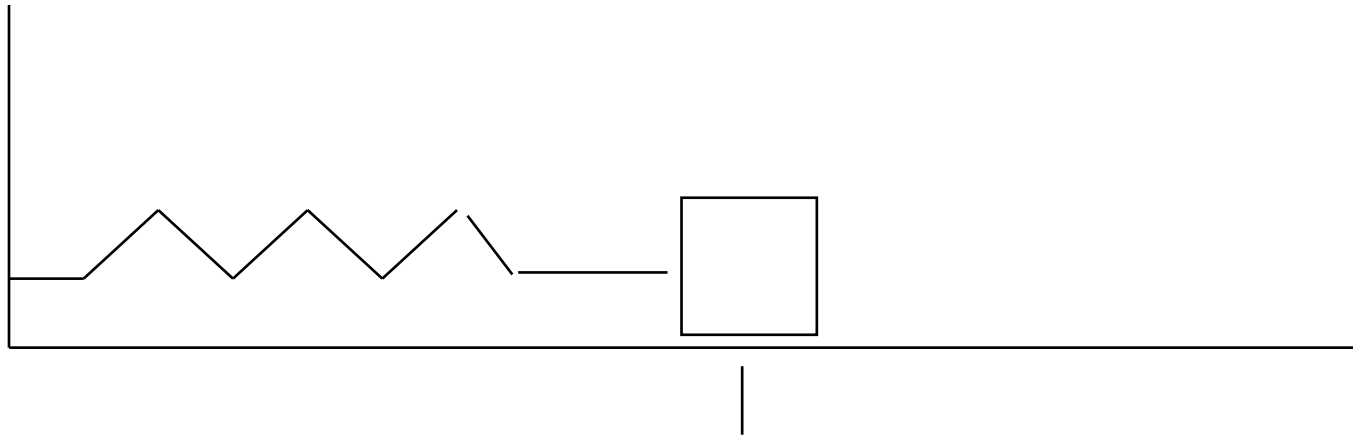


Generative Alternative

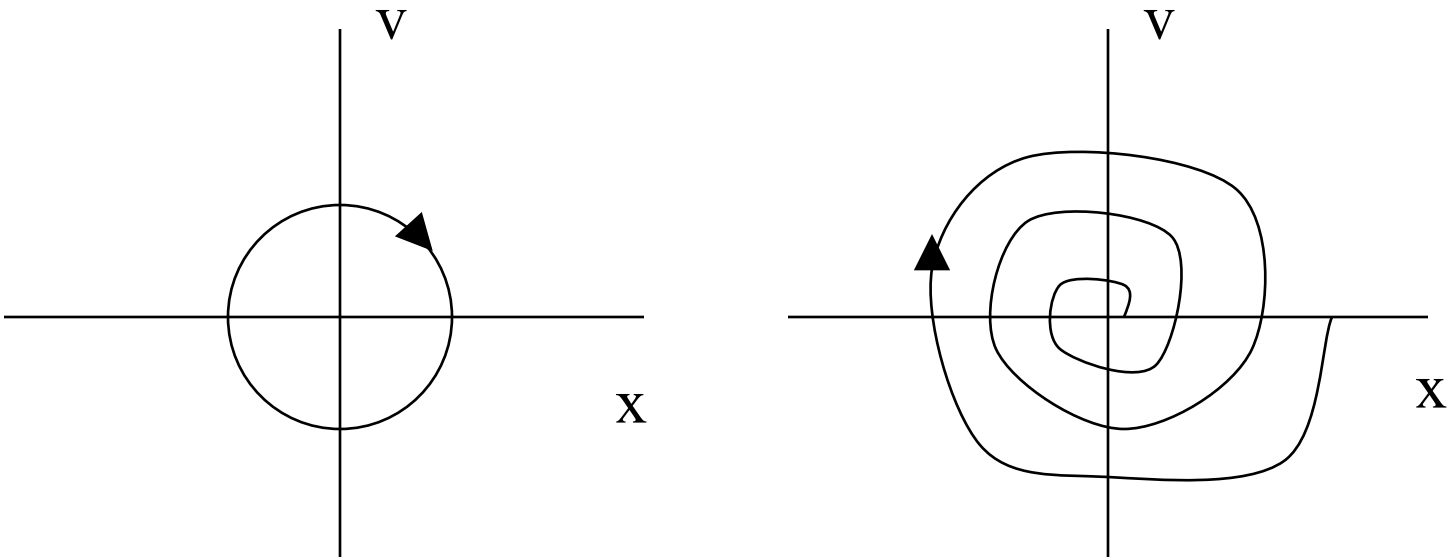
The alternative representation(s) offered by the teacher to generates students' explanations and justifications and allow for progress to be made through logical reasoning.

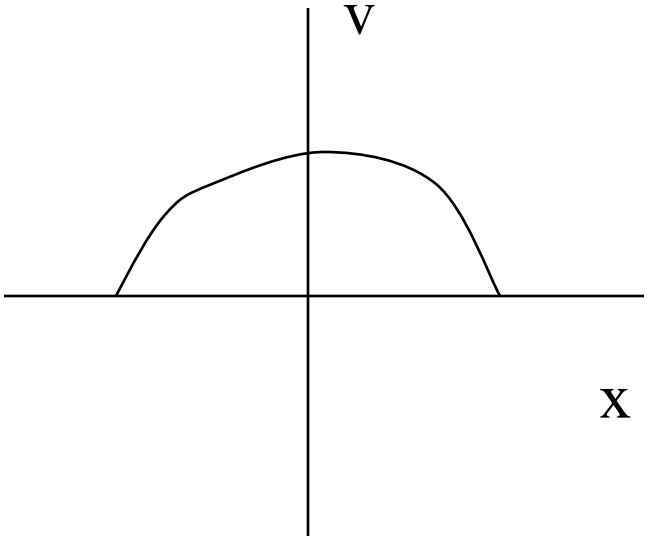
Spring-Mass Motion Investigation



Depending on the values for parameters like the stiffness of the spring, the weight of the object attached to the spring, and the amount of friction along the surface that the object travels, different motions of the mass may be possible. **Describe in words the different motions you might see or expect to see. For each different type of motion provide a rough sketch of what you think the position versus velocity graph would look like.**

Student Solutions

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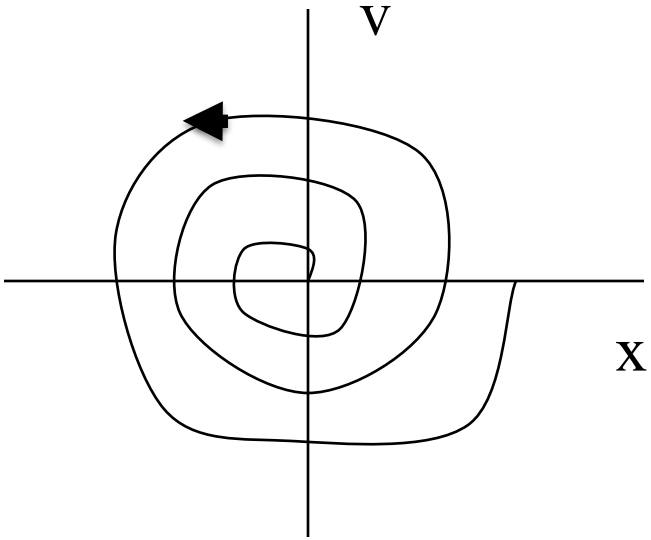
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Do either of the RME-inspired pedagogical tools – transformational record or generative alternative – have a place in the teaching of other scientific subjects (chemistry, physics, engineering, etc.)?

Are there “RME-like” theories in scientific disciplines that might be useful for the development of other pedagogical content tools (that could transcend the discipline in which they are developed)?

If any of these subject-specific constructs are to be helpful across the disciplines, they need to be studied in the context of different disciplines!

Thank you!