Frameworks for Analyzing Curriculum Materials and Planning and Teaching Science Lessons to All Students

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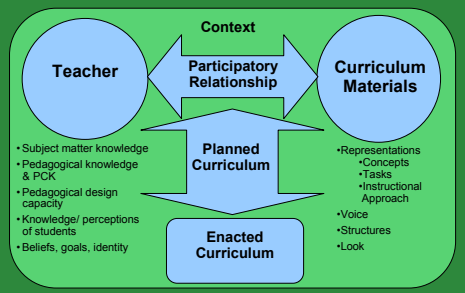
The Problem

CCMS curriculum designers are making important strides in improving the quality of curriculum materials. How do we prepare teachers to take advantage of these materials for their own students?

At the same time, not all teachers have access to the high quality materials CCMS designers are making available. How do we prepare teachers to teach science well even if they do not have access to high quality materials?

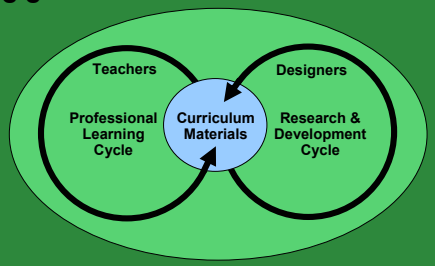
Teacher-Curriculum Materials Framework

When planning lessons, teachers participate with curriculum materials in a dynamic interrelationship that shapes the planned and enacted curricula and guides student learning. How teachers interact with curriculum materials depends on what both the teachers and the materials bring. (Remillard, 2005)



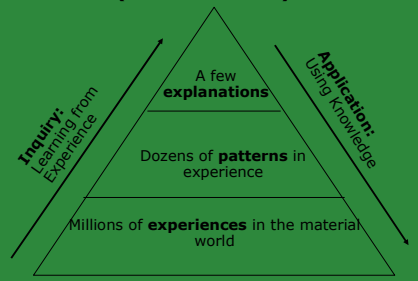
Curriculum Materials as Boundary Objects

Curriculum materials function as boundary objects (Wenger, 1998) around which teachers and curriculum designers develop professional knowledge and practices for teaching specified learning goals.



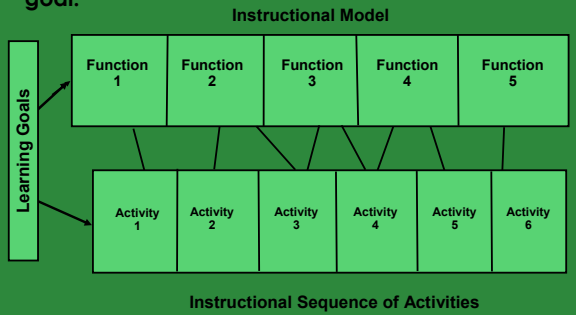
Inquiry & Application

Experiences, Patterns, Explanations (EPE) (Anderson 2003)



Using Instructional Models for Strategic Planning

Each activity within an instructional sequence serves a specific function in moving students toward the learning goal.



Inquiry –Application Instructional Model (I-AIM)

Instructional model for Inquiry-Application cycles. Also incorporates conceptual change and cognitive apprenticeship principles (Smith, 1991).

EPE		Model Stage	Function Activity
Inquiry		Engage	Establish a problem
			Elicit student ideas about the problem
		Explore & Investigate	Explore phenomena & look for patterns
			Explore student ideas about patterns
	Application	Explain	Explain patterns
			Introduce scientific ideas
			Compare to & revise student ideas
		Apply	Practice applying to new phenomena (model, coach fade)

Example Sequence: Compasses

Learning Goal: Describe patterns of interaction of magnetic materials with other magnetic and non-magnetic materials.

Activity	Description	Model Stage	Activity Functions
#2 Why do compasses point North?	Students explore small compasses and magnets. Another question is posed.	Engage	Establish a problem Elicit student ideas
		Explore/ Investigate	Explore phenomena Explore student ideas
#3 How do magnets interact?	Students investigate how magnets interact & form a rule.	Explore/ Investigate	Explore phenomena, Identify patterns Explore student ideas
#4 Label an unlabled magnet.	Students practice using rule	Apply	Coach students in using rule (pattern)
#5 Describe forces exerted by magnets	Concept of force is introduced. Students draw sketches showing magnetic forces using arrows.	Explain	Introduce scientific ideas Connect to magnet rule
		Apply	Model & coach use of arrows.
Continues…			

Critical Analysis & Planning Framework

Integrates Project 2061 Criteria into I-AIM. Emphasizes consideration of own students sociocultural background.

Use knowledge of students as a lens for analyzing curriculum materials ⇄ Use curriculum materials as a lens for thinking about students

Model Stage	Activity Function	CM Analysis Questions	Knowing My Students Questions	Planning Questions
Engage	Establish a problem	Is there a relevant, interesting, motivating, understandable problem that addresses the learning goal?	What problems are relevant and interesting to my students? How can I connect to my students' lived experiences?	What relevant, interesting, motivating, understandable problem will I use? How is this problem related to my students' lived experiences?

Related Work

Gunckel, K. L., Bae, M. J., & Smith, E. L. (2007). *Using instructional models to promote effective use of curriculum materials among preservice elementary teachers.* Paper presented at the National Association of Research in Science Teaching, New Orleans, LA.

Bae, M. J. (2007). A case study of using an instructional model to promote preserivce teachers' practices in using curriculum materials Paper presented at the Knowledge Sharing Institute, Washington, D.C.

Calabrese Barton, A., Gunckel, K. L., & McLaughlin, D. (2007). Considering students' strengths: Helping elementary preservice teachers take account of students' resources in planning and teaching science lessons. Paper presented at the Knowledge Sharing Institute, Washington D.C.

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Anderson, C. W. (2003). *Teaching science for motivation and understanding. Unpublished* manuscript, East Lansing, MI: Michigan State University.
Remillard, J. T. (2005). Examining key concepts in research on teachers' use of mathematics curricula. *Review of Educational Research, 75*(2).
Smith, E. L. (1991). A conceptual change model of learning science. In S. M. Glynn, R. H. Yeany & B. K. Britton (Eds.), *The psychology of learning science.* Hillsdale, NJ: Eribaum.
Smith, E. L. (2001). *Strategic approaches to achieving science learning goals.* Paper presented at the Improving Science Curriculum Materials Through Research-Based Evaluation, Washington, DC.
Wenger, E. (1998). *Communities in practice.*

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