

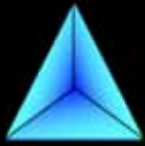


AAAS, Michigan State University, Northwestern University, University of Michigan
Center for Curriculum Materials in Science

Teachers and Curriculum Materials Plenary

Center For Curriculum Materials In Science

This research is funded by a CLT grant number #0227557 from the National Science Foundation. However, any opinions, findings, and conclusions or recommendations expressed here are those of the authors.



Why Teachers and Curriculum Materials?

- Why teachers and curriculum materials?
 - Teachers co-construct and enact the curriculum. They are the most critical factor in effective learning aside from SES.
 - Teachers bring knowledge, skills, beliefs to their interaction with curriculum materials. There is no such thing as teacher-proof curriculum materials.
 - Effective teaching requires much knowledge/many skills; teachers face challenges (ex: need SMK, PCK, PK, identity and efficacy, access to tools/curriculum, participation in community of practice)
 - Some teachers (e.g. elementary) receive little support for teaching science



Why Teachers and Curriculum Materials?

- Why teachers and curriculum materials?
 - CMs mediate what is taught (influence teachers' pedagogical decisions through content, voice, etc.) (Ball & Cohen, 1996; Grossman & Thompson, 2004; Brown & Edelson, 2003).
 - CMs are critical for teachers (especially **beginning teachers**) (Grossman & Thomson, 2004; Ball & Feiman-Nemser, 1988; Kauffman et al., 2002).
 - CMs have the potential to support teacher and **student learning** (Ball & Feiman-Nemser, 1998, Ball & Cohen, 1996; Davis & Krajcik, 2004).



Teachers & CM - Context

- Teacher knowledge, practices, & identities evolve over time within communities. Progress not necessarily towards reform-based practice.
- Teachers use curriculum materials differently across their careers. Specific challenges associated within these various stages.
 - PSTs unaware of CM importance & have own criteria for CM (e.g. practical & affective)
 - Beginning teachers often have insufficient knowledge and skills, and may lack productive orientations for effectively using/adapting curriculum materials.
 - Experienced teachers may not recognize affordances of materials and may make lethal mutations (Ball & Feiman-Nemser, 1988; Davis & Krajcik, 2004).



Teachers & CM - Context

- Teachers' effective use of CM can be fostered & supported throughout career stages with
 - Teacher education & professional development
 - Effective curriculum materials
 - Research
- Goal is to support productive teacher & CM interactions using reform-based approaches



Stop, Think, & Share

- What have been your challenges working with teachers and curriculum materials?
- What are your goals with respect to curriculum materials?



Cross-Cutting Issues

- Developing theory to improve our work, as researchers, curriculum developers, teacher educators, professional developers and teachers
- Exploring how teachers develop expertise across time, context, and roles
- Providing effective support for teacher learning



Session Plan

- Theme 1 - Analyzing and using curriculum materials in *teacher education* and *professional development*
- Theme 2 - Considerations in the design of teacher education with respect to curriculum materials (e.g. work with *collaborative teachers*)
- Theme 3 - Developing and researching *effective curriculum materials for teachers*



Theme 1 – Analyzing and Using Curriculum Materials in Teacher Education and Professional Development



CCMS Work in Teacher Education & Session Plan

- CASES work at UM
- ETCM work at MSU
 - Project background
 - Theoretical framing
 - in the spotlight: Kristin Gunckel
- Contributions from CCMS to field



CASES

- Focuses on preservice and new elementary teachers and how they learn to teach science
- Selected papers
 - Davis, E. A. (2006). Preservice elementary teachers' critique of instructional materials for science. *Science Education*.
 - Davis, E. A., Petish, D., & Smithey, J. (2006). Challenges new science teachers face. *Review of Educational Research*.
 - Beyer, C., & Davis, E. A. (2006). Characterizing the quality of second-graders' observations and explanations to inform the design of educative curriculum materials. In *The Proceedings of the 7th International Conference of the Learning Sciences*. Mahwah, NJ: Erlbaum.
 - Forbes, C., & Davis, E. A. (in press). Exploring preservice elementary teachers' critique and adaptation of socioscientific curriculum materials. *Science and Education*.



ETCM Background

People: myself, Ed Smith, Jim Gallagher, Beth Covitt, Kristin Gunckel, Minjung Bae, several alums and undergrads.

Selected Work

- Schwarz, C., Gunckel, K., Smith, E., Covitt, B., Bae, M., Enfield, M., & Tsurusaki, B. (under review). Helping elementary pre-service teachers learn to use science curriculum materials for effective science teaching.
- Gunckel, K., Bae, M., & Smith, E. (2007). Using instructional models to promote effective use of curriculum materials among preservice elementary teachers.
- Covitt, B., Schwarz, C., Bae, M., Mikeska, J., & Paluta, L (in progress). Facilitating pre-service teachers' development of professional practices through science methods course boundary spanning activities.



Teachers and CMs

- **Beginning teachers rely on curriculum materials** (Grossman & Thomson, 2004; Ball & Feiman-Nemser, 1988; Kauffman et al., 2002).
- **Most materials are of poor quality** (Kesidou & Roseman, 2002).
- **Teachers just beginning to develop their knowledge and practices around teaching - don't yet have the expertise yet to make strong adaptations** (Ball & Feiman-Nemser, 1988).
- **Materials can be a source of learning**



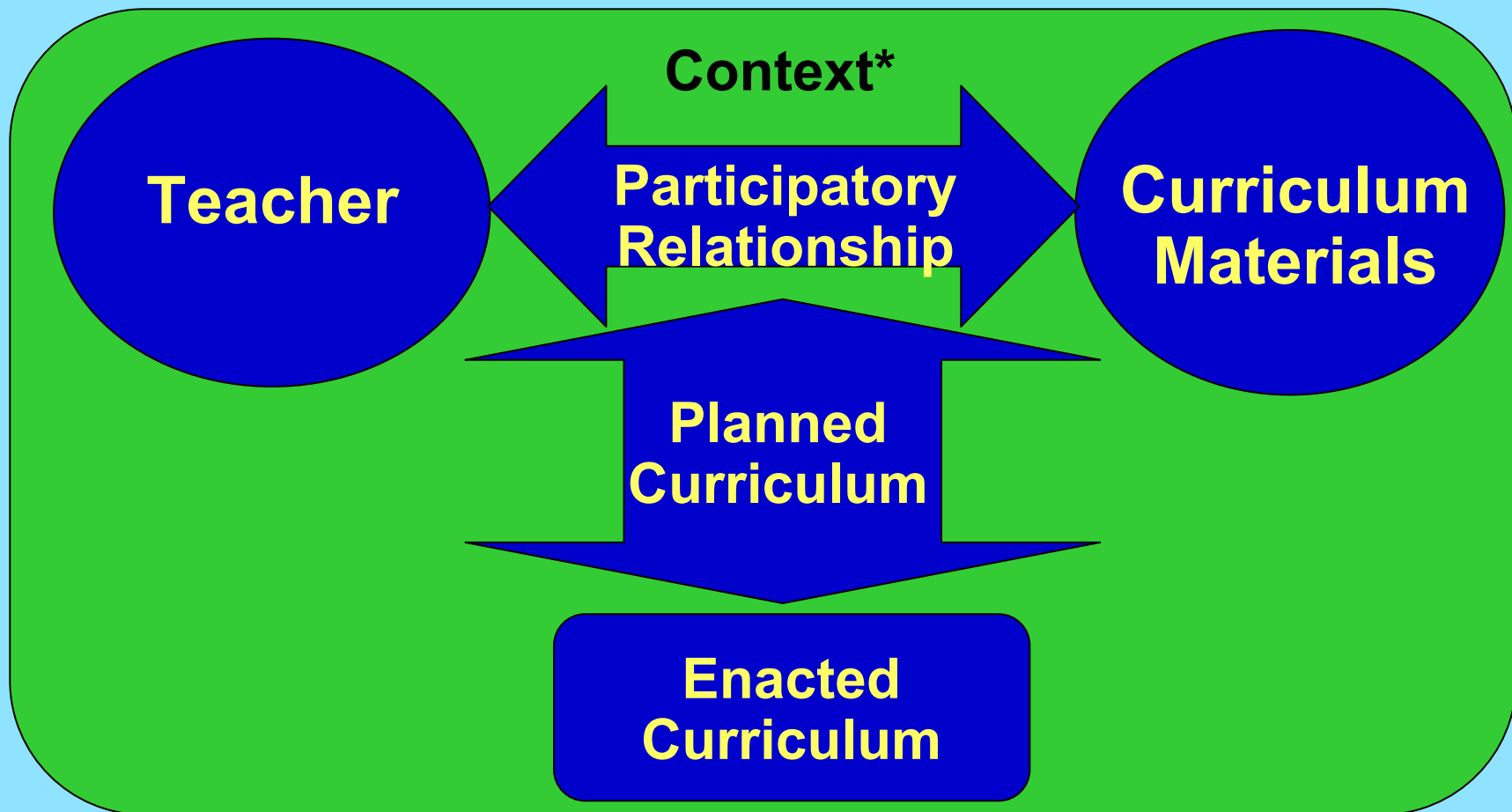
ETCM Goals and Research Approach

- Help pre-service teachers learn how to use curriculum materials for effective science teaching
- **Design-based research** (Barab & Squire, 2004; A. Brown, 1992; M. Brown & Edelson, 2003)



Teacher-Curriculum Materials Framework

(Remillard, 2005)



*Context includes the communities of practice in which teachers, students, and curriculum materials are participating.



Design Cycle 1 Goals & Research Questions

- Help PSTs recognize strengths and weaknesses of materials
- Use AAAS Project 2061 Curriculum Materials Analysis Criteria (Kesidou & Roseman, 2002)
- Did PSTs accurately apply and use P2061 criteria in analyzing and planning with materials? What were their attitudes towards curriculum materials analysis and the criteria?



Cycle 1 Methods

- Empirical study with 3 sections of elementary science methods sections at MSU
- Example P2061 criteria: establish sense of purpose, engage students with scientific phenomena, etc.



Design Cycle 1 - Outcomes

- PSTs had mixed/moderate success in understanding intent and accurately applying many P2061 Criteria.
 - + ‘learning goal’; ‘experiences with phenomena’
 - - ‘sense of purpose’; ‘application and practice’
- PSTs made little spontaneous use of criteria in CM analysis and planning
- Most success in appropriating and applying those most congruent with their own criteria or were appropriated and used in multiple contexts (e.g. through instructional models)
- Had different primary goals and concerns
 - *hands-on activities, lessons that are fun, engaging, connected to the real world, grade appropriate, easy to manage, clear explanations, clear up misconceptions*



Design Cycle 1 Interpretations

- Did not find curriculum materials analysis central to their current or future practice; Different views of authentic practice – A good teacher ‘just knows’ what are good curriculum materials.

“Umm, but I think a lot of it is just going to come from your knowledge of what you want to do rather than looking or filling out each of those things [evaluation criteria forms] for every lesson you want to teach.”

- Navigation among different communities of practice (methods, school placement, science courses)
- Curriculum materials analysis potentially destabilizing



Revised Project Goals

Helping PSTs

- Develop a clearer, synthesized image of reform-based teaching
- Expand and revise their vision and intentions towards curriculum materials - motivate to see CM use as central to their practice, & take an active and critical stance towards that use
- Work on resolving own goals with those of reform-based efforts
- Find ways of bridging communities of practice



Design Cycle 2: Three Coordinated Components

- Inquiry and Application Instructional Model (I-AIM) (Gunckel, Bae, & Smith, 2007)
- Curriculum Materials Analysis Tasks (CMAT) (Schwarz, Covitt, Bae, Mikeska, & Paluta, 2007)
- Work with cooperating teachers
- Use of each component in multiple methods sections during 2006



Inquiry-Application Instructional Model (I-AIM)

		Model Stage	Activity Function
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)	



I-AIM Findings

- Lesson plans
 - followed steps of I-AIM
 - but, included many steps in one lesson plan
- CM analysis, PSTs paid attention to
 - learning goal match
 - functions of activities within a sequence
 - students' resources and needs



Curriculum Materials Analysis Tasks

CMAT - Light & Shadows

- Scenario - given 5 lessons/activities to determine whether they meet district learning goals
- Discuss strengths and weaknesses
- Which lessons meet learning goal & why



Design Cycle 2 Findings: CMAT

- PSTs substantially engaged in curriculum materials analysis; Not much off-task behavior.
- Some extensive dialogue around particular activities.
- CMAT a boundary spanning task, creating a space for overlapping Discourses (preservice teachers and reform-based)



Spanning PSTs and Reform Discourses

PST Discourse in red and reform science Discourse in teal.

"I don't like this activity as much. I mean, it's not set up a well as the other one."

"If this is 2nd grade, this is pretty difficult stuff to talk about...."

"I think this would be fun to do like at the end. I mean some of this stuff."

"It will show that a shadow can happen like if light can't pass through something."

"That shows one of the big ideas about needing light to be blocked. That's almost like what we were saying needs to be done before the other one. We're talking about how shadows are formed."

"But I would never do this in a classroom to try to teach them about how shadows are made."

"I mean it does address the learning goal."



Work With Cooperating Teachers

Efforts: Meetings with CTs and seniors to analyze learning goals and fit with instructional model. Make CM use more explicit, visible, and aligned with methods.

Results: Positive feedback about utility of meetings

Interpretations:

- Supported mutual understanding and coordination
- Enabled work in methods to be more meaningful and authentic
- Learning goal and instructional model important focus in navigating between theory & practice



ETCM Current Directions

- Learning progressions/trajectories for teacher's use of curriculum materials
 - **Continue to work towards better understanding pre-service teachers with respect to multiple dimensions (knowledge, practices, identity) as they begin their teaching careers**
 - Reformulating goals for movement along the progression (e.g. expanding PSTs vision of practice and role in practice)
- Continue to design supports for helping teachers move productively along this trajectory
 - **Effective tools and strategies**
 - Resources (example activity sequences and analyses)
 - Boundary spanning activities & design heuristics for activities
 - Ways of bridging multiple communities of practice



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**In the spotlight
Kristin Gunckel
Michigan State University**



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Preservice Elementary Teachers Learning to Use Curriculum Materials to Plan and Teach Science Lessons

Kristin L. Gunckel

Michigan State University



AAAS, Michigan State University, Northwestern University, University of Michigan

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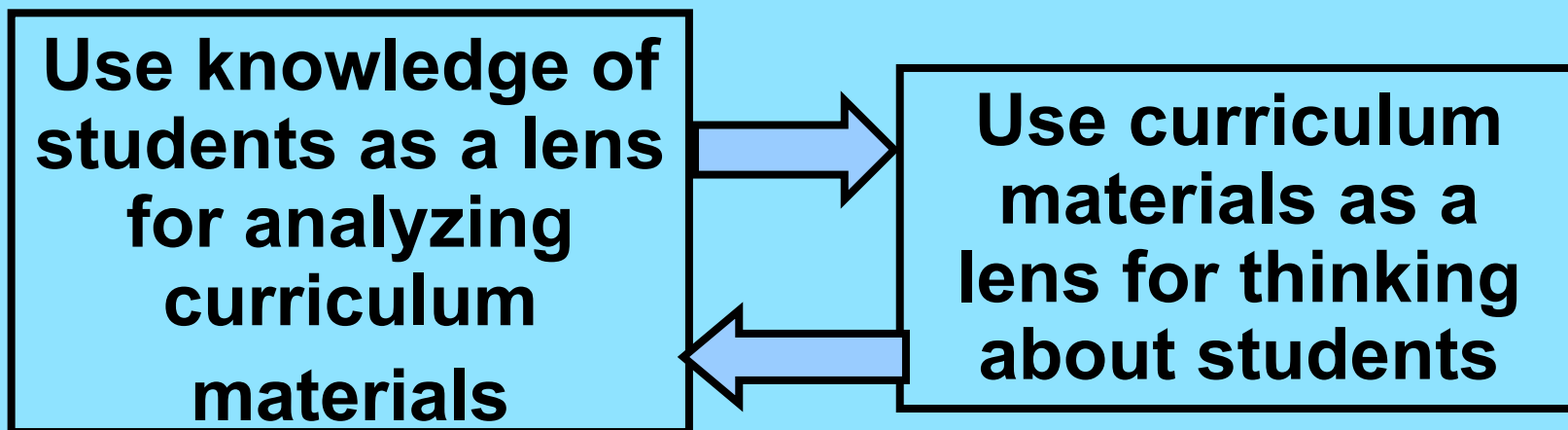
- **How do we prepare teachers to take advantage of the new, high quality curriculum materials for their own students?**



- **How do we prepare teachers to take advantage of the new, high quality curriculum materials for their own students?**
- **How do we prepare teachers to teach science well even if they do not have access to high quality materials?**



Critical Analysis for Planning





Teachers need to be able to understand

- Science (content & pedagogy)
 - learning goals
 - strengths & weaknesses of an instructional approach
- Students'
 - cultural (i.e. funds of knowledge) and intellectual resources for learning science
 - ways of being in and knowing the world



Inquiry-Application Instructional Model (I-AIM)

EPE	Model Stage	Activity Function	
Inquiry	Engage	Establish a problem	
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		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)	



I-AIM Critical Analysis & Planning Table

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?



Current Research

How do the interns think about and use curriculum materials when they are planning and enacting their science lessons?

How do the interns think about and account for who their students are when they are planning and enacting their science lessons?



Curriculum Materials

Nicole – 2nd-grade unit on sound

Did not use district-provided materials. Relied on internet resources and worksheets available from cooperating teacher

Dana – 6th-grade unit on light & color

Sampled from available textbook and used activities from university content courses

Leslie – 5th-grade unit on carbon cycle

Used internet and university sources. Also relied on suggestions from cooperating teacher



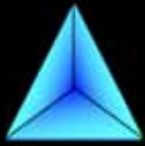
Preliminary Results

- Nicole –
 - Focused on using patterns about vibrations to explain sounds
 - Leveraged some student funds of knowledge (families, popular culture)
- Dana –
 - Focused on explaining colors of objects using a “logical” progression of topics
 - Little recognition of student resources
- Leslie –
 - Activities on photosynthesis
 - Missed opportunities to take advantage of student resources



Nicole: Curriculum Materials Analysis

- **Analysis Question:** Is there a relevant, interesting, motivating, understandable **problem/question** that addresses the learning goal?
- **Rating:** 3
- **Rationale/examples:** Each of the activities used in *Primary Physics* has a key question included, however; several are **not grade-level appropriate** and/or not placed in a context that directly **connects it to the students' lives**.
- **Modifications:** We plan to make the questions/problems ... **relevant to our students' lives**... The content and activities cover sound waves, disturbances in materials, and how sound travels through solids, liquids, and gases. We want to center the material on the idea that **when one thing vibrates, it causes another thing to vibrate**.



Nicole: Focus on Patterns & Students

Many examples of key patterns

- things vibrate when they make a noise
- one thing vibrating makes another thing vibrate
- high and low pitch

Incorporated examples that students

- brought from home (playing musical instruments)
- brought from playground (bouncing balls)
- invented in the classroom (popcorn in a cup)

Reflected that next time will draw more from student knowledge of popular music



Preliminary Findings

- Successful use of I-AIM and leveraging student resources requires understanding of key experiences and patterns that support explanations
- Strategic planning is different from “logical” planning
- Interns’ meanings of some of the stages of I-AIM were different from intended meanings
- Consideration of students and what/how to teach science at the same time is demanding



Interpretations

- Teachers bring many experiences & perspectives that mediate how they use curriculum materials.
- Teachers' use of materials is heavily influenced by the practices of the communities in which they are members.
- Critical analysis for planning entails practices whose meanings that may not be readily accessible to preservice teachers.



Implications

- Teacher education needs to
 - clarify practices of critical analysis and planning
 - scaffold development of these practices and identities in ways that align with reform-based, culturally responsive science teaching.



Theme 1 – Analyzing and Using Curriculum Materials in Teacher Education and Professional Development



Theme 1: *Professional Development and Curriculum Materials*

- On-going PD work at UM, Northwestern, MSU, and others
- In the spotlight: Jay Fogleman (UM)



The Role of Professional Development in Educational Reform

- Professional development is a fundamental component of recent reform efforts in science education (National Research Council, 1996; AAAS, 1993).
- Effective professional development should be sustained, be grounded in teachers' practice, focused on subject matter knowledge, foster collegiality and collaboration, and provide time to enact new knowledge and reflect on these experiences (Loucks-Horsley & Matsumoto, 1999; Garet et al, 2001).



The Role of Professional Development in the Implementation of Curriculum Materials

- In order to use new CMs effectively, teachers must understand their intent and features.
- PD focused on new curriculum materials provides an important setting for teacher learning (Borko, 2004).
- Current PD efforts seek to support teachers' adaptations in ways that maintain connections between their enactments and the written curriculum (Lin & Fishman, 2004; Squire et al, 2003).
- Sustained PD around reform-rich curriculum materials can result in teachers changing their classroom practices and student learning (Kubitskey, 2006).



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In the spotlight
Jay Fogleman
University of Michigan



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Scaling and Sustaining Reform:

Professional Development to Support the
Institutionalization of Learning Goals-Driven Science
Curriculum Materials

Jay Fogleman
University of Michigan



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3 Studies of How Teachers and Districts Use CMs

- Comparing Teachers' Adaptations of a Middle School Science Inquiry-Oriented Curriculum Unit with Student Learning
- Sustaining Innovations Through Lead Teacher Learning: A Learning Sciences Perspective on Supporting Professional Development →
- Enhancing Local Capacity to Sustain Reform: What Do Teachers Need to Know First?



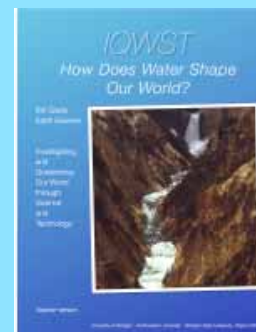
Acknowledgements

- **IQWST/LeTUS PD Groups**
 - Barry Fishman, Hsien-Ta Lin, Beth Kubitskey, Lou-Ellen Finn, Ayelet Weizmann, Jeff Rozelle, LeeAnn Sutherland, and Yael Schwarz
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 - Joseph Krajcik, Barry Fishman, Phyllis Blumenfeld
- **Funding Agencies**
 - Center for Curriculum Materials in Science
 - National Science Foundation



Research Contexts

Investigating Our World Through Science and Technology* (IQWST)



Center for Learning and Technology in Urban Schools* (LeTUS)



**Collaborations Between the University of Michigan, Northwestern University, Michigan State University and Project 2061 to Improve the Teaching and Learning of Science at the Middle School Level*



IQWST Goal: Design the Next Generation of Curriculum Materials

- Utilizes a coordinated approach for 6th through 8th science curriculum materials
- Uses a learning goals driven design model
- Applies what we know about student learning in context of project based science
- Supports students in developing understandings of the big ideas of science (both content & scientific practices)
- Engages students in complex tasks



Introduction

- Curriculum materials and professional development are often used to foster reform in science education.
- A Persistent Challenge: How to implement, sustain, and scale up high-quality enactment of these materials?



Sustaining Reform within District-University Partnerships

- Partnerships between researchers and school districts provide a rich context to develop and use reform - based materials.
- A Partnership Challenge: How to support the district's efforts to sustain effective materials and programs as researchers begin to develop new innovations?



LeTUS Professional Development

- Links student and teacher learning
- Provides regular opportunities to grow classroom expertise around each unit
- CERA (Collaboration, *Enactment*, *Reflection*, *Adaptation*)
- Initially conducted by CM developers, led by DPS lead teachers since 2002



A Challenge in Providing Sustained PD around Reform-Rich CMs:

Since systemic pressures influence teachers to negatively adapt reform-rich materials (Tyack & Cuban, 1996; Pinto et al, 2005):

- How should the *district* support teachers' enactments of CMs that are congruent with their original character?
- How can *CM developers* enhance the district's capacity to support teachers' use of CMs beyond an initial implementation cycle?



A learning sciences approach to enhancing district capacity

- Teachers' knowledge is *situated* physically and culturally (Putman & Borko, 1997)
- A *cognitive apprenticeship* approach allows experts to share their knowledge by moving in and out of the center of a learning community. (Brown et al, 1989)
- *Communities of practitioners* develop shared understandings and expertise (Lave & Wenger, 1991)

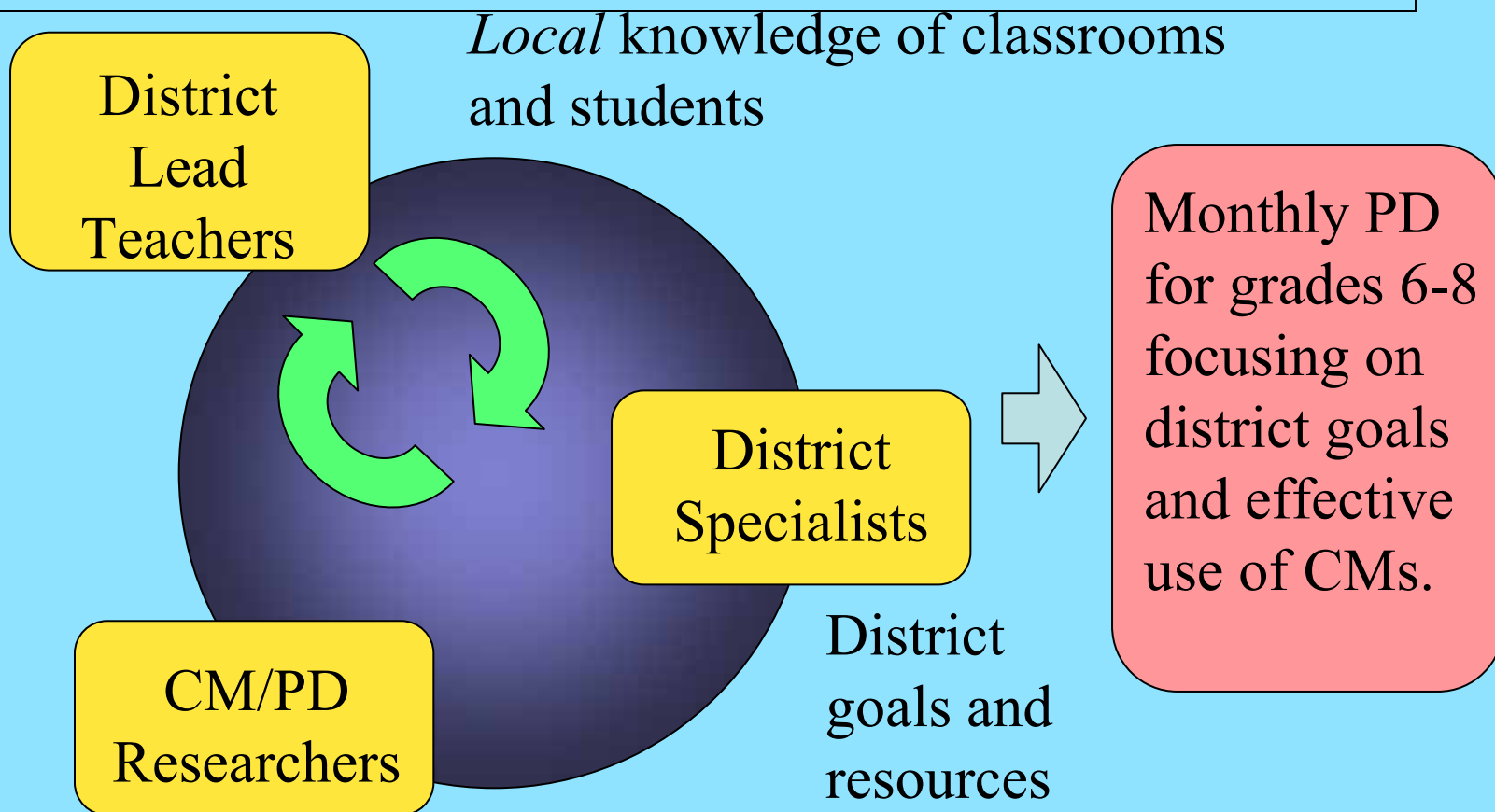


A Professional Development Workcircle

- Participants include pairs of district Lead Teachers identified to lead PD for each unit, CM developers and researchers, and district instructional specialists and resource personnel.
- Monthly planning meetings help prior to each PD workshop.
- Each meeting includes time for PD discussions across and within grade levels.



The Work of the PD Workcircle



District-wide feedback on student learning
Research-based knowledge of effective PD, etc.



Capacity Building Example: Improving Students' Scientific Explanations (SEs)

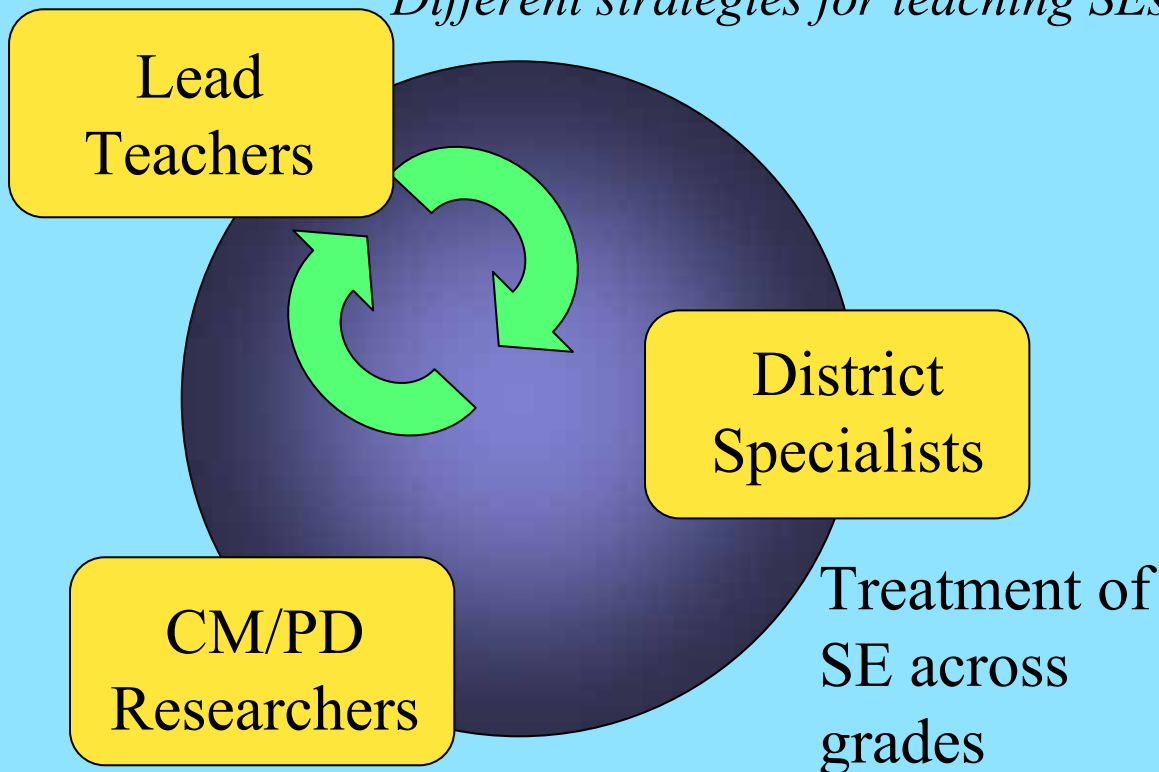
- Lead Teacher Observation:

The requirement in some units that students construct scientific explanations highlighted students' writing difficulties.



Building District Capacity: Improving Students' Scientific Explanations

Their students' struggles with SEs
Different strategies for teaching SEs



Effective strategies for teaching SEs

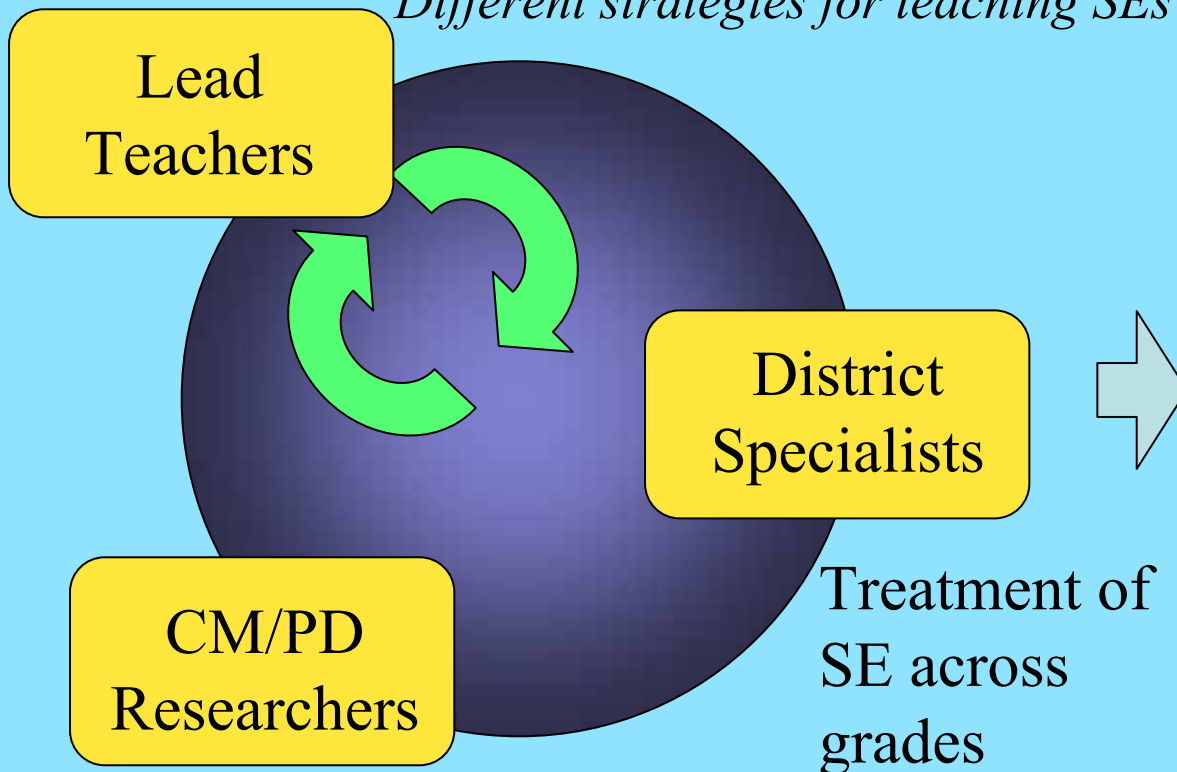
Analysis of a district-wide sample of student SEs

A cognitive apprenticeship approach to building new knowledge



Building District Capacity: Improving Students' Scientific Explanations

Their students' struggles with SEs
Different strategies for teaching SEs



- Shared language around SEs
- Aligned PD across grades including strategies for providing teacher feedback
- Need to align supports for SEs in CMs
- Refined SE supports in CMs

Effective strategies for teaching SEs

Analysis of a district-wide sample of student SEs

Fostering a community of practice around professional development



Conclusions

- Sustaining and scaling the use of reform-based materials requires districts to develop the capacity for sustained PD.
- Current theories about knowledge and learning, such as the situated nature of knowledge, learning from cognitive apprenticeships, and the benefits of communities of practice can guide our efforts to enhance a district's capacity to sustain innovative CMs longterm.
- COPs around PD can provide support for Lead Teacher Learning.



How CCMS informs the Field

- Analyzing and using CM in TE
 - Revised goals & approaches
 - Revised theoretical frameworks
 - Tools and materials for supporting curriculum materials analysis and effective use
- Practice and curriculum-based PD:
 - Models of effective PD
 - Approaches for sustaining and scaling PD



Stop, Think, and Share

- How does what you've heard in this theme help you think about your goals and challenges related to teachers and curriculum materials?



Theme 2 - Considerations in the design of teacher education with respect to curriculum materials (e.g. work with *collaborative teachers*)



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Mentoring Mentors & their Interns

James Gallagher

Christopher Wilson

Michigan State University



Teaching Science is Underrated in Its Complexity

Common myth:

Science teaching as an easy task!

- Teaching is telling (information transfer)
- Learning is memorizing
- Assessment is summative



This is a problem for us, as teacher educators because . . .

It is widely believed by

- Practicing science teachers
- Prospective science teachers
- Administrators
- Parents
- And too many who teach teachers!



Popular models of science teaching reinforce this

- The 5 E model, and even early conceptual change models, are formulaic and result in an oversimplified view of the complex task of teaching science.
- Common university and high school lecture modes also give a distorted image of the task of teaching.



Magnusson, Krajcik & Borko (1999) give a different view

- Their model of science teacher knowledge shows 19 different knowledge components
- SMK, PK, & PCK each represent complex, integrated knowledge that comprise a part of a science teacher's professional base
 - Implies the eclectic, complex nature the science teaching



Project 2061 Criteria for Textbook Evaluation

Also implies the complexity of
science teaching

- 7 broad categories,
- >20 high level criteria
- Dozens of specific indicators



Broad in Scope Depth in Component Levels

- I. Providing a Sense of Purpose
- II. Taking Account of Student Ideas
- III. Engaging Students w/ Relevant Phenomena
- IV. **Developing and Using Scientific Ideas**
- V. Promoting Students' Thinking about
Phenomena, Experiences, & Knowledge
- VI. Assessing Progress
- VII. Enhancing the Science Learning
Environment



Category IV

Criteria

Developing & using Scientific ideas

- A. Providing evidence for learning goals**
- B. Introducing terms and procedures meaningfully**
- C. Representing ideas effectively**
- D. Connecting & synthesizing ideas**
- E. Demonstrating skills & use of Knowledge**
- F. Providing Practice**



There is HOPE!

When we introduced a modified listing of Project 2061 Categories & Criteria to Mentors & Interns

- Reactions were highly positive
 - o A clear description of a master teacher
 - o A guide to the complexity of their work
 - o A roadmap of how to improve
 - o A stepwise procedure of how to become a more effective teacher



However, teachers need support in addressing the complexity of their work

- Without support, they are likely to take the “easy road”
- Support must come through multiple channels
 - High quality materials
 - Staff development
 - Assistance from leaders & peers
 - Administrators



Importance of materials that support teachers in supporting learning

- Making goals clear to teachers and students
- Accessing information on student's ideas & reasoning throughout instruction (Continuous Assessment)
- Guiding students' learning
 - Engaging students with phenomena
 - Developing and using scientific ideas
 - Promoting students' thinking about experiences & knowledge



Staff development that leads to growth & self-reliance

- Educative materials
- Recurring staff development activities over a long duration
- Time in daily schedules for interaction with peers & leaders
- Overt administrative support & knowledgeable supervision



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Mentoring Mentors

Spotlighting Chris Wilson



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A Staff Development Workshop Series for Mentors & Interns

James Gallagher

Chris Wilson

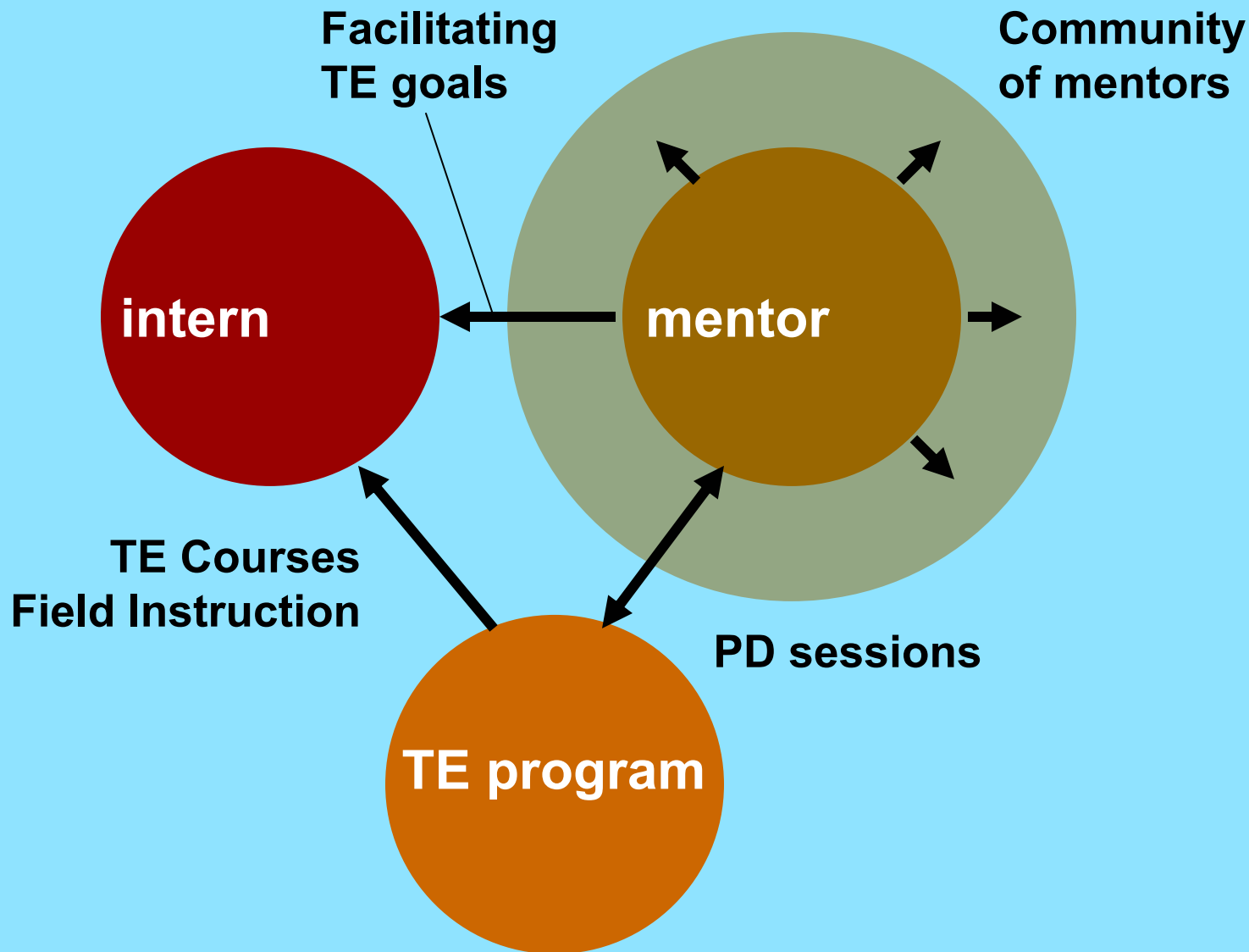
Dean Grosshandler

MSU



Motivation

- Recognition of the important role that mentor teachers play in the teacher education program.
- The need to provide support for the mentors.
- The need for greater communication with the mentors
- Findings from the previous year's sessions and program observations.





The Workshop Series

- Pilot sessions for Lansing area mentors in Year 1.
- A more structured series of sessions in Year 2.
- Sessions for Lansing and Detroit area mentors.
- Involvement of the interns.



Sessions Focused on . . .

selecting and adapting curriculum materials

use of instructional models

planning

assessment strategies



Some Findings

- Differences between the Detroit and Lansing mentors, and consequently, interns.

Coherence of courses, assignments, and the internship.

- The issue of communication.
- Practicing what we preach.



Some Quotes from Evaluations

“I felt better equipped to engage in conversations [with my intern] about MSU’s philosophy towards teacher education and how we look at curriculum development”

“It was encouraging to know that the struggles encountered were not unique to me or my intern. The workshops helped me keep clear and open communication with my intern.”

“We were able to do a little networking on a professional level which is rare in the area of secondary education.”



Stop, Think, & Share

- How does what you've heard in this theme help you think about your goals and challenges related to teachers and curriculum materials?



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Theme 3 - Developing and researching *effective curriculum materials for teachers*



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Designing and Researching Educative Curriculum Materials that Promote Teacher Learning

Elizabeth A. Davis & Carrie Beyer

School of Education

University of Michigan

Center for Curriculum Materials in Science

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The Plan

- Designing educative curriculum materials (ECM)
 - What are educative curriculum materials?
 - What might educative curriculum materials accomplish?
 - What's hard about designing them?
- In the spotlight: Carrie Beyer
- How CCMS is informing the field



Curriculum Materials & Teacher Learning

- Reform-oriented teaching is challenging
- Teachers learn from their use of curriculum materials (in addition to learning to use them)
- Curriculum materials are inherently situated in teachers' daily practice
- *Educative curriculum materials* are intended to promote teacher learning





Existing Guidelines

- **Some high-level design guidelines for educative curriculum materials**
 - support development of PCK, especially anticipating learners' ideas
 - support development of subject matter knowledge
 - make rationales for decisions visible

(See Ball & Cohen, 1996)



More Detailed Recommendations

- Educative curriculum materials can...
 - Provide approaches for teachers to use
 - Explain **why** the recommendations are scientifically and pedagogically appropriate (rationale)
 - Explain **how** teachers can use these recommendations in their own teaching (implementation guidance)



(see Davis & Krajcik, 2005)



The Argument for Educative Curriculum Materials

- **Educative curriculum materials can help teachers...**
 - add new specific ideas
 - add new general principles (e.g., through rationales)
 - make links between general principles and specific instructional moves
 - eventually, promote teachers' pedagogical design capacity (see Brown & Edelson, 2003) and the transfer of ideas



Design Tensions

- Determining appropriate amount of guidance and prescription
 - How explicit in providing rationales? How often?
 - How prescriptive?
 - How many choices? What are the choices?
- Designing for different teachers
 - new versus experienced teachers?
 - elementary versus secondary teachers?
 - science versus other subject areas?



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In the spotlight
Carrie Beyer
University of Michigan



Textbook Review: Study Overview

- Reviewed 8 sets of high school biology curricula to determine their potential for promoting teacher learning.
- Adapted Davis and Krajcik's (2005) design heuristics to use as a guide for analysis and wrote descriptive narratives.



Types of Support Examined

- Support for 3 teacher knowledge domains
 - Subject matter knowledge
 - PCK for science topics
 - PCK for scientific inquiry
- Support for rationales & implementation guidance



Example of Rationale

“Studying composting can lead to understanding the relationship between biology and energy transfer in the environment. This activity also provides a solid example of how individuals can have a positive effect on the environment while decreasing the amount of water.”

(Program 1, p. 48)



Example of Implementation Guidance

“Finding creatures in the compost can be aided in several ways. Putting the compost in a white enamel pan and then separating the material is one way to make it easy to see the larger animals. An old technique for separating the organisms from the compost is a funnel with a heat source above and a container below it...” (Program 1, p. 135)



Frequency of Rationales vs. Implementation Guidance

- Implementation guidance supports (how) were far more common than rationales for instructional decisions (why).



Frequency of Support for Teacher Knowledge Domains

- Abundant support for subject matter knowledge and some aspects of PCK for science topics (i.e., attending to students' ideas).
- Little support for PCK for scientific inquiry and some aspects of PCK for science topics, (i.e., engaging students in scientific phenomena and instructional representations).



Quality of Educative Supports

The quality of support differed in its degree of:

- Relevance
- Pedagogical helpfulness
- Depth



Limited Support

“The following statement is often heard from students. ‘Humans evolved from apes.’ Advise students that evolutionary evidence supports the theory that humans and apes evolved from a common early ancestor.”
(Program 2, p. 605)



Stronger Support

“Revealing Misconceptions. ‘If humans evolved from apes, why are there still apes alive today?’ is a question often posed by students. The question represents a common misconception that students have about human evolution.

Uncover the Misconception. Explain that humans evolved from ancestors of apes, which were neither humans nor apes, and the common ancestor probably lived during the Miocene.

Demonstrate the Concept. Use an example from the previous chapter to explain the concept of common ancestry. You might use an example from the Galapagos Islands, or divergent evolution of the honeycreepers in Hawaii.

Assess New Knowledge. Ask students to suggest other examples of species that are closely related and what their common ancestor may have been. Have them suggest how they might explain this to a friend.” (Program 3, p. 431)



Implications

- Need to consistently provide both rationales and implementation guidance.
- Need more support for teachers' PCK for scientific inquiry and PCK for using specific phenomena and representations
- Need stronger examples of support that are relevant, pedagogically useful, and sufficiently in depth.



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Wrap Up Theme 3



Other ECM Work in CCMS

- The Project 2061 analysis criteria include some criteria to check for how educative the materials are for teachers.
- Danny Edelson's *Investigations in Environmental Science* includes design rationales relating activities to the Learning for Use framework, to aid teachers in understanding the implications of changes they make.
- The IQWST curriculum materials include educative elements to support teachers in developing subject matter knowledge and PCK, building in part on Becky Schneider's earlier work with LeTUS.
- Nonye Alozie's study using a genetics unit explores how ECM can support productive dialogue in high school classrooms.
- David Kanter's work explores new and innovative ways of delivering ECM, in part to work around the design tensions.
- The CASES curriculum materials provide a range of educative supports for preservice and beginning elementary teachers.



How CCMS Informs the Field

- CCMS is contributing some of the initial research on ECM in science education. For example, we have...
 - developed design heuristics to guide the design of ECM.
 - made recommendations for what curriculum materials and textbooks need to include.
 - identified examples in existing textbooks and curriculum materials that illustrate how we might productively incorporate supports, and developing our own examples.
 - found that educative curriculum materials allow preservice teachers to think more deeply about the curriculum materials.
 - illustrated that since current curriculum materials may lack adequate support for teacher learning, we need to work with teachers on using existing curriculum materials.



Stop, Think, and Share

- How does what you've heard in this theme help you think about your goals and challenges related to teachers and curriculum materials?



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Synthesis



The Themes We Explored

- Theme 1: Preservice and inservice teachers' analysis and use of curriculum materials
- Theme 2: Issues in the design of teacher education: Mentoring mentors and their interns
- Theme 3: Educative curriculum materials



Cross-Cutting Issues

- Developing theory to improve our work, as researchers, curriculum developers, teacher educators, professional developers, and teachers
- Exploring how teachers develop expertise across time, context, and roles
- Providing effective support for teacher learning



Developing Theory to Improve Our Work

- Developing theoretical frameworks and constructs that describe or explain the relationships between teachers and curriculum materials. For example, CCMS works on...
 - elaborating and refining Remillard's (2005) framework
 - exploring curricular role identity
 - unpacking pedagogical design capacity
 - understanding teacher learning, development, knowledge, beliefs



Exploring How Teachers Develop Expertise: Time, Context, & Roles

- Developing learning progressions, describing learning trajectories, working across roles. For example, CCMS works with...
 - preservice, beginning, and experienced teachers
 - new and experienced users of curriculum materials
 - elementary, middle school, and high school teachers
 - cooperating teachers and mentor teachers
- How do these teachers develop expertise?



Providing Effective Support for Teacher Learning

- Supporting teacher learning across different paths and within different roles. For example, CCMS designs supports within...
 - teacher education
 - professional development
 - educative curriculum materials
- How do specific forms of support promote teacher learning and development?
 - Not just what learning and development is promoted.



Accomplishments Since 2003 KSI

- helping preservice and classroom teachers learn to analyze, adapt, and use curriculum materials effectively
- systematically designing educative curriculum materials
 - exploring a range of types and forms of support
 - supporting specific teacher learning goals
 - analyzing teachers' use of those supports
- characterizing teachers' knowledge, beliefs, and identities vis-à-vis the use of curriculum materials (and the effects of those knowledge, beliefs, and identities)



There's Still Room for Progress

- How can curriculum materials support teachers in dealing with all the complexities of teaching? How can TE and PD support teachers in dealing with that complexity, including the complexity of using curriculum materials?
- What is the cost/benefit analysis for providing support through curriculum materials, TE, or PD? What support is best provided how?
- What are the most important teacher learning goals to work toward? How can we measure attainment of goals?
- What are the implications of this work for policy in teacher education, school administration, & curriculum adoption?



Learning More at the KSI

- Follow-up to this plenary, Monday 3:00
 - includes plenary participants and Jen Cartier, Heather Johnson, & Felicia Moore
- Teachers and curriculum materials paper session, Tuesday 10:30
 - includes David Grueber, Michelle Luna, & Ann Rivet
- Beginning elementary teachers & curriculum materials poster session, Wednesday 10:30
 - includes Minjung Bae, Angie Barton, Carrie Beyer, Jen Cartier, Beth Covitt, Betsy Davis, Cory Forbes, Kristin Gunckel, David McLaughlin, Jamie Mikeska, Christina Schwarz, Ed Smith, & Shawn Stevens
- Teacher support (Monday morning—done)
 - included Jay Fogleman, Kathleen Morris, Aaron Rogat, & Linda Wilson