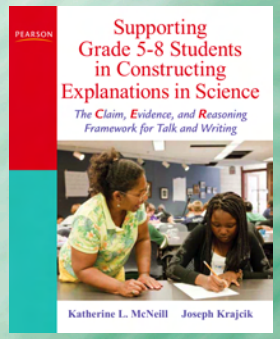
Supporting Grade 5-8 Students in Writing Scientific Explanations

Katherine L. McNeill, Boston College

Book Development

- The book describes lessons learned from previous research including how to: design learning tasks and scaffolds, incorporate different teaching strategies into science lessons, and develop and use assessment tasks and rubrics to inform instruction (McNeill, 2009; McNeill & Krajcik, 2008; McNeill & Krajcik, 2009).
- The book includes multiple examples of student writing and approximately 40 minutes of video clips from grade 5-8 science classrooms.
- The book will be published by Pearson Allyn & Bacon in January 2011.



Research Question

- How do teachers' pedagogical content knowledge, beliefs and classroom practices for scientific explanation and argumentation change after reading the book and participating in professional development?

Framework for Scientific Explanation

- We developed an instructional framework for scientific explanation (McNeill & Krajcik, 2007; McNeill, Lizotte, Krajcik & Marx, 2006).

- **CLAIM**
  - An assertion or conclusion that answers the original question
- **EVIDENCE**
  - Scientific data that supports the claim
  - The data needs to be appropriate and sufficient to support the claim
- **REASONING**
  - A justification that links the claim and evidence
  - Shows why the data counts as evidence by using appropriate scientific principles
- **REBUTTAL**
  - Recognizes and describes alternative explanations
  - Provides counter evidence and reasoning for why the alternative explanations are not appropriate

Description of Professional Development

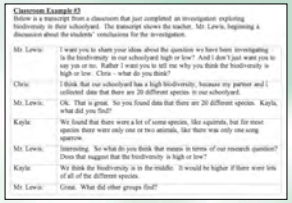
- A series of three professional development workshops were offered.
- **WORKSHOP 1** (8 hours)
  - Topics included an introduction to the CER instructional framework, common student difficulties, designing learning tasks, and scaffolds
  - Assignment: Read Chapters 1-3; bring in student work from a learning task applied in the classroom
- **WORKSHOP 2** (3.5 hours)
  - Topics included teaching strategies, designing learning tasks with integrated teaching strategies, and application to discourse
  - Assignment: Read Chapters 4-6; bring in student work from a learning task applied in the classroom
- **WORKSHOP 3** (3.5 hours)
  - Topics included discourse, developing assessment tasks, rubrics, and formative versus summative feedback.

Method

- This study took place during the 2009-2010 school year with seventy grade 1-12 teachers in a large urban district in New England.

Primary Subject Taught			Years Experience* Range	Years Experience* No. of Teachers	Highest Degree Level	Highest Degree Subject: Education	Highest Degree Subject: Science
Science Specialist	Elementary	14	0 to 5	25	None	2	37
	Middle	12					
	High	19	6 to 10	15	Bachelors	2	25
General Classroom Teacher		14					
English/Language Arts		2	11 to 20	15	Masters	65	6
Special Education		4					
Other Resource Position		5	> 20	14	Doctoral	1	2

- Multiple data sources were collected for all participants:
  - Pre and post teacher surveys
  - Videotapes of the professional development workshops
  - Artifacts produced by the teachers at the workshops
  - Samples of strong and weak student writing that the teachers brought to the workshops
- Additional data was collected for five case study teachers:
  - Videotape of three science lessons
  - Student writing from all students in the lesson
  - Teacher Interviews
- The teacher survey asked teachers to analyze samples of student writing and classroom discourse:



Results

Four themes emerged from the analysis of the multiple data sources:

- Theme #1: In terms of student writing, teachers' understanding of claim and evidence was strong and their understanding of reasoning improved, but the application of reasoning to classroom practice continued to be challenging.

Code	Elementary (n=22) Pre	Elementary (n=22) Post	Grade 5-8 (n=23) Pre	Grade 5-8 (n=23) Post	High (n=17) Pre	High (n=17) Post
Claim	59.10%	77.30%	73.90%	82.60%	71.40%	81.00%
Evidence	90.90%	90.90%	87.00%	95.70%	85.70%	95.20%
Reasoning	45.50%	81.80%	39.10%	91.30%	42.90%	90.50%
Conceptual	72.70%	50.00%	87.00%	73.90%	85.70%	76.20%
Personal	22.70%	27.30%	34.80%	34.80%	38.10%	33.30%
Literary	45.50%	13.60%	52.20%	21.70%	47.60%	23.80%
Questioning	4.50%	13.60%	30.40%	4.30%	33.30%	4.80%
Vague	18.20%	31.80%	39.10%	13.00%	38.10%	14.30%

- Theme #2: In terms of classroom discussion, teachers exhibited a limited understanding of how to apply argumentation in terms of both the framework and dialogic interactions.

Code	Elementary (n=22) Pre	Elementary (n=22) Post	Grade 5-8 (n=23) Pre	Grade 5-8 (n=23) Post	High (n=17) Pre	High (n=17) Post
Claim	27.30%	36.40%	17.40%	30.40%	11.80%	11.80%
Evidence	77.30%	72.70%	73.90%	52.20%	52.90%	70.60%
Reasoning	18.20%	18.20%	30.40%	26.10%	29.40%	23.50%
Conceptual	63.60%	50.00%	78.30%	73.90%	94.10%	76.50%
Personal	0.00%	0.00%	0.00%	0.00%	0.00%	5.90%
Teacher Directed	18.20%	0.00%	13.00%	30.40%	11.80%	58.80%
Student Interaction	22.70%	31.80%	43.50%	47.80%	41.20%	70.60%
Student Participation	36.40%	36.40%	26.10%	17.40%	29.40%	17.60%
Teacher Moves	68.20%	77.30%	73.90%	73.90%	58.80%	52.90%
Vague	81.80%	45.50%	43.50%	34.80%	52.90%	47.10%

- Theme #3: Teachers found designing the question to be challenging, but also important for providing students with the opportunity to justify their claims with evidence and reasoning.
- Theme #4: Elementary teachers framed argumentation in terms of connections to other disciplines while high school teachers framed argumentation by discussing the science content or laboratory investigations.

Implications and Future Directions

- The themes from the data analysis informed both the revision of the book and the facilitators guide to support future professional development.
- We will run two additional workshop series in spring 2011 with approximately 50 teachers and collect data to examine the impact of the revisions.
- Currently, I am working with Carla Zembal-Saul from the Pennsylvania State University on writing a similar book specifically for elementary teachers to address their needs.

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