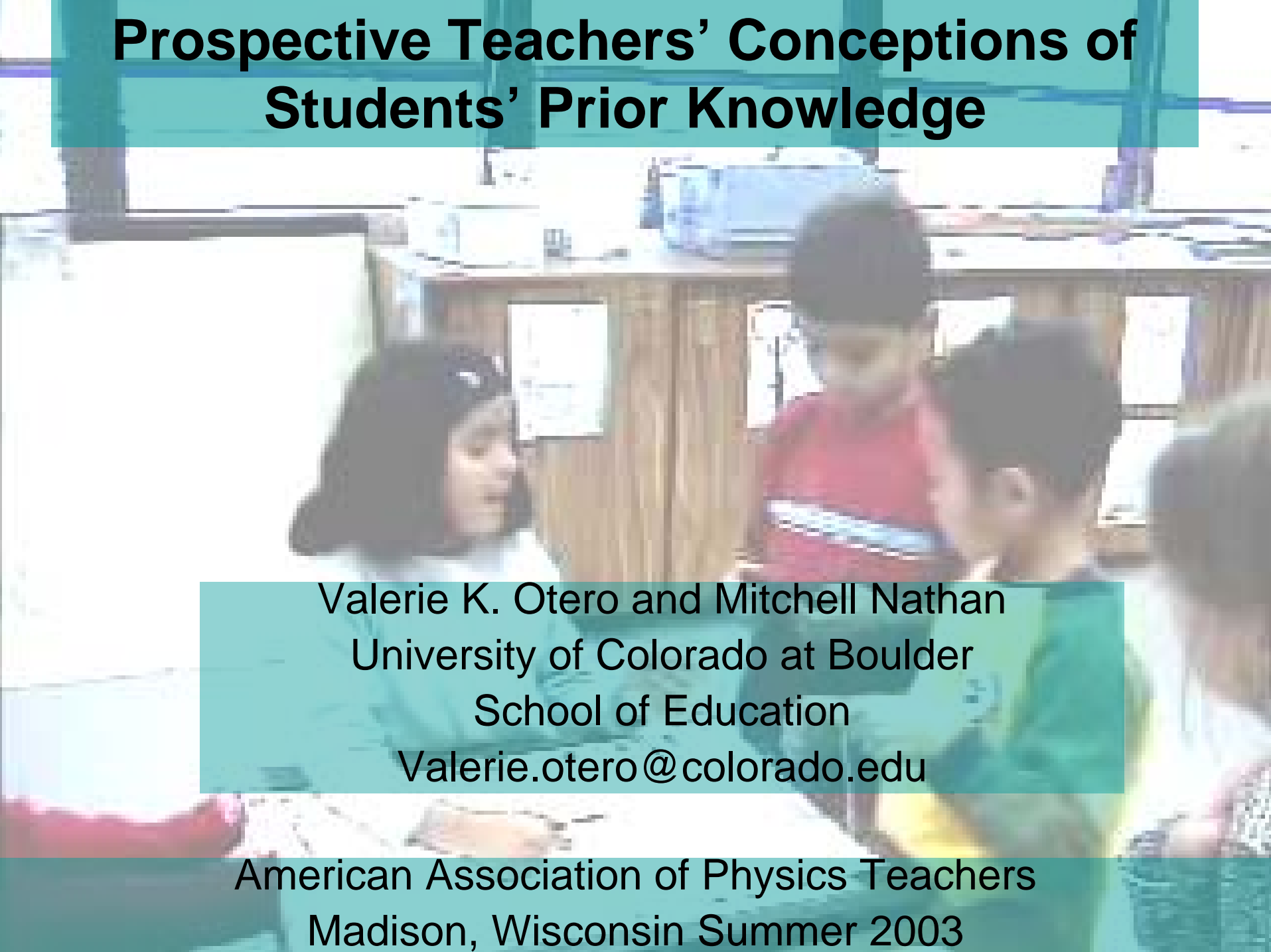


Prospective Teachers' Conceptions of Students' Prior Knowledge



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Physics Education Research-Based Instruction

Reform teaching, Active learning, Student-centered instruction

- **Students have prior ideas based on experience**
- **These ideas influence learning they can be problematic and/or can serve as resources for learning.**
- **Learning evolves over time. Students may have a partial understanding of a particular concept at a given time.**
- **Learning is the process of sense making where learners try to bring their understandings into coordination with their experiences**
- **Learning is a social process (articulation, hearing ideas of others, group discourse, consensus, tools)**

***“After I gave students their
prior knowledge...***

I began the lesson.”

(Prospective teacher, 2001)

What was the problem?

I had not based my methods instruction on the very tenets I believed in for learning and understanding in physics

I paid little attention to my prospective teachers conceptions of the very concepts I was trying to teach—*the role of prior knowledge in learning and teaching*

The Study: Methodology

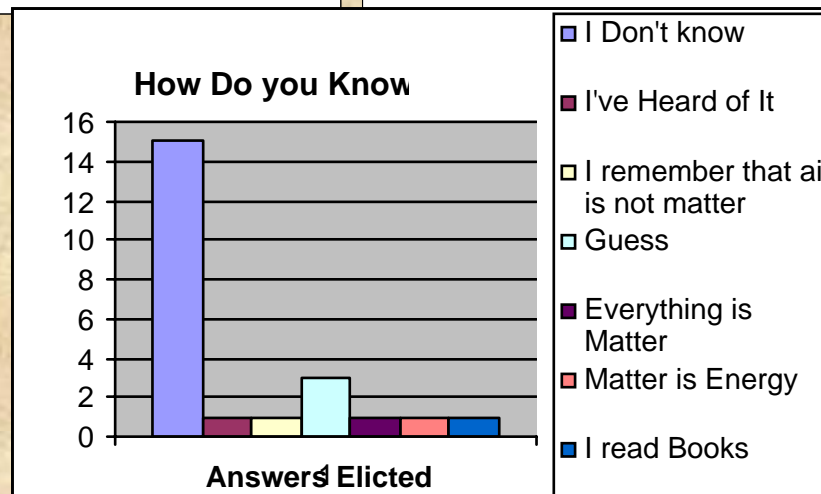
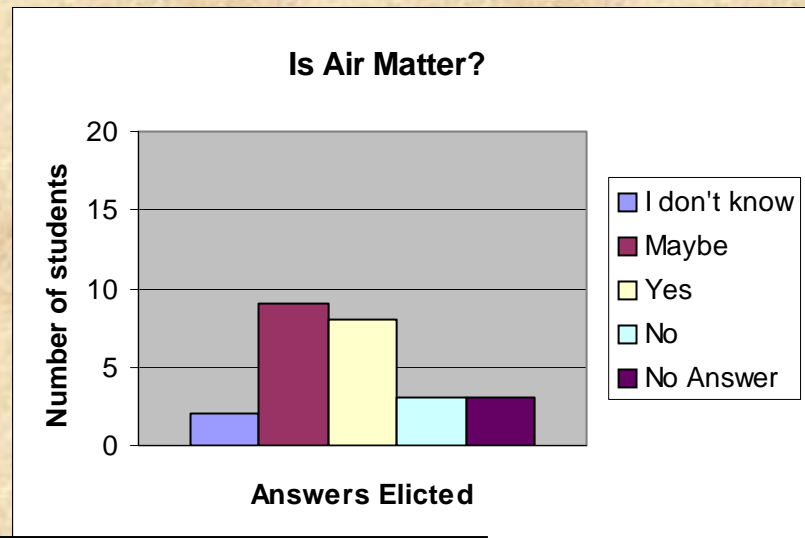
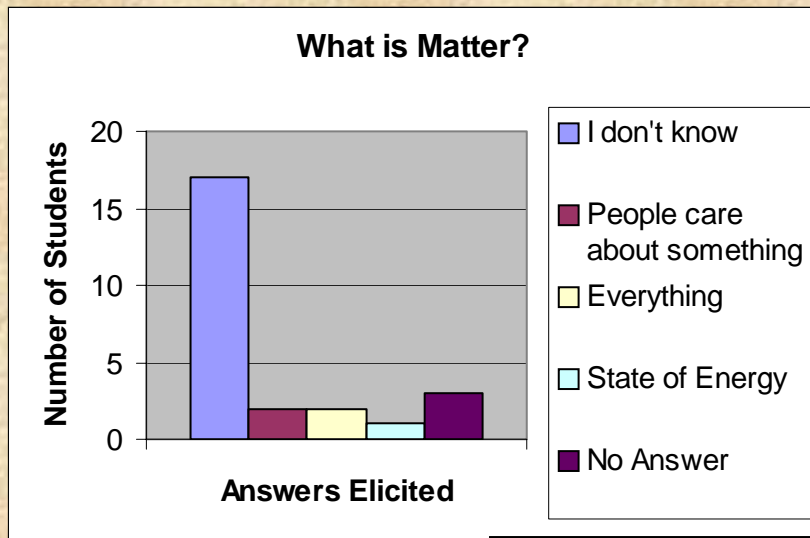
Question: What are prospective teachers' conceptions of students' prior knowledge and collaboration

- Masters level students in a program to earn Masters Degree plus licensure (n=23)
- Data collected over a 16 week period during students final semester before student teaching
- Data source: Cumulative assignment to meet the requirements for two courses: *Elementary Science Theory and Methods* and *Theories of Learning and Development*
- Assignment required: topic, learning objectives, unit plan, pre and post assessment, modified unit plan based on pre-assessment data analysis, implementation of modified lesson, final revised unit and reflection.
- Coding Scheme: Codes were generated from the data in two parts: initial and final states

Example from the Data (4th grade unit on matter)

Pre-assessment Questions:

What is matter? Is air matter? How do you know?



Prospective Teacher's Pre-Assessment Analysis

I asked the students: "What is matter?," "Is air Matter?," and "How do you know that?" I was ... curious as to how they knew what they did because I know that they did not study matter or its states in the particular school system up to the present.

I was not really surprised at the results of the pre-assessment. Because I know that they did not previously study matter or its states their lack of knowledge on the subject was not a shock.

According to the graphs and data collected, it is evident that the majority of the students do not know what matter is. As I was expecting the students to be unfamiliar with matter or air as a state of matter when I created my lesson, I am not going to change or modify my lesson.

Coding Scheme: Prior Knowledge

Conceptions of Prior Knowledge Initial Codes	Reform-Based Ideas Final Codes
(P1) Blank slate model of cognition	(P-a) Attempts to elicit what students do know instead of what students do not know
(P2) Little connection between prior knowledge and lesson objectives or planned activities	(P-b) Use of prior knowledge as resources for learning in lesson plan
(P3) Fragmented, isolated terms-view of science; difficulty distinguishing between science concept and vocabulary term; you either know it or you don't	(P-c) Lesson design that allows for the gradual construction of concepts
(P4) Instruction leads to learning/prior knowledge comes from prior instruction	<i>This was final-coded as (P-c) but as a conception it differs slightly from Fragmented, isolated terms.</i>

Results: Conceptions of Student Prior Knowledge

- The *Blank slate model* and *science as fragmented, isolated terms* were the most common conceptions appearing an average of 1.4 times per PST in the initial unit plan, decreasing to an average of 0.39 per PST in the final unit plan, statistically significant drop, $t(22)=5.0$, $p<.001$.
- PSTs conceptions of *student knowledge as resources for learning* and *science as connected concepts* increased from an average of 0.9 per PST in the initial unit plan to 1.9 per student in the final unit plan, statistically significant, $t(22)=5.0$, $p<.001$.
- **Although we measured changes, PSTs still had difficulty using *prior knowledge as resources for learning* and designing a unit or lesson that allowed for the *gradual construction of science knowledge*.**

Conclusions

- PSTs continued to believe that the purpose of eliciting student prior knowledge was to determine whether their students already knew what was about to be taught.
- The (a) blank slate model, (b) conceptions of science as fragmented, isolated terms, and (c) the notion that prior knowledge comes from prior instruction were difficult to distinguish.
- The problem appears to go beyond a one-semester methods course---**pedagogical-content knowledge** needs to be developed over time and throughout science courses **and** education courses.



Physics for Elementary Teachers (PET) Curriculum

(Fred Goldberg, Steve Robinson, Valerie Otero)

PET Course Goals:

- 1. Content*** Mechanical interactions, magnetism, electromagnetism, fields, electric circuits, light, heat, and conservation of energy are learned through an energy theme
- 2. Nature of Science (implicit):** Students use consensus, discussion, laboratory and simulator observations, models
Nature of Science (explicit): History of science is explicitly taught to help students see that scientists also struggled and argued as they constructed and modified ideas; skills for explanation are explicitly scaffolded throughout the unit
- 3. Metacognitive:** Learning commentaries—written self-analysis explaining how the student thinks she moved from one model to a model with greater explanatory power
- 4. Motivation and Attitude: Elementary Students' Ideas Activities**



Elementary Students' Ideas Activities (ESI)

- PET students analyze video of elementary students doing physics.
- The activities guide students through the analysis and help them recognize the good (often partial) physics understandings that elementary students have.
- The elementary students in the video are doing activities that cover content that is similar to the content that PET students are learning in their PET physics course



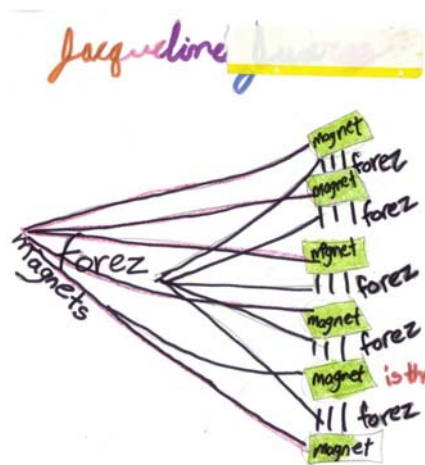
PET: Connecting one's own learning process with the learning of elementary students

PET Curriculum

- Content (selected if it has strands in K-5)
- Scientific Inquiry and explanations
- Metacognitive/Learning Commentary
- Nature of Science/History of Science

Elementary Students Ideas Homework

- Explicit connections between their own learning process and the learning of elementary students
- Explicitly addresses the role of prior knowledge and partial knowledge in the process of learning



I think what is happening to the magnets is that it has a forez that is sticking to the material and that it makes the magnet more stronger.

I think everything in here works together and makes a magnet I also think it pushes it's not work when it's not work anymore



I think it matters about which way the atoms are pointing.

