

## Investigating Application of Concepts by Future K-6 Teachers in Traditional and Reformed Science Courses

Mojgan Matloob & Dean Zollman  
Kansas State University

Cynthia Sunal & Dennis Sunal  
University of Alabama

Cheryl Mason  
San Diego State University

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## Research Questions

- ❑ What are the essential characteristics of reformed undergraduate science courses?
- ❑ How do reform science course characteristics differ from traditional courses?
- ❑ How do reform and traditional courses differ in their long-term impacts on K-6 teachers?
- ❑ How do K-6 teachers apply science concepts in traditional and reform science courses?

## Research Participants

As part of the NOVA (NASA opportunities for Visionary Academics), 103 higher education institutions participated in the reforming science courses for future teachers.



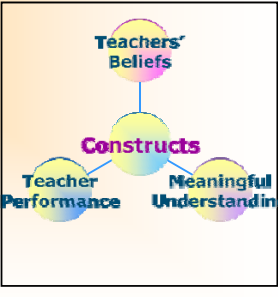
## Sampling

- ❑ 30 Reformed and 30 Traditional undergraduate science courses
- ❑ Randomly selected from the 103 diverse NOVA institutions, stratified by institution type
- ❑ 2 groups of science teachers randomly selected: Traditional & Reformed courses

## Research Constructs

Meaningful understanding is knowing ...

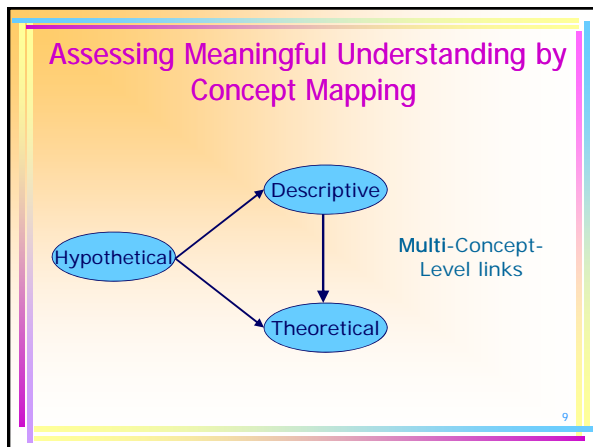
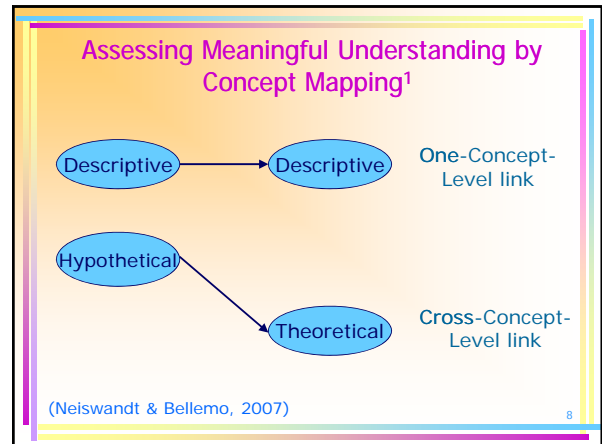
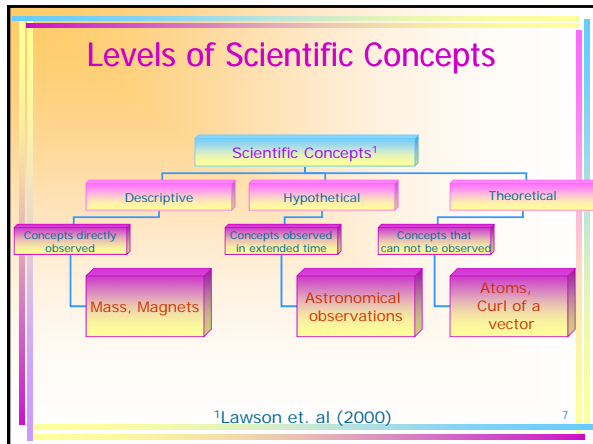
- ❑ single concepts (declarative knowledge)
- ❑ how to use algorithm and rules (procedural knowledge)
- ❑ why, where and when to apply the knowledge (strategic knowledge)



The diagram shows a central circle labeled 'Constructs' connected to three surrounding circles: 'Teachers' Beliefs' at the top, 'Teacher Performance' at the bottom left, and 'Meaningful Understanding' at the bottom right.

## Research Method and Instruments

- ❑ Quantitative
  - Reform Teaching Observation Protocol
    - Measures degree to which classroom is in accord with characteristics of Standard- and Inquiry-oriented teaching
  - Science Teaching Efficacy Belief Instrument
  - Constructivist Learning Environment Survey
  - Measure of conceptual understanding
    - Work reported in this talk
- ❑ Qualitative
  - Written extended-response questions
  - Focus Groups
  - Teacher Interviews



- ### Structure of Extended-Response Questions
- Students consider a situation or scenario that is rich in detail and contextualized
  - The questions to be designed will represent all three levels of concepts
  - Students need to combine and link different level of concepts to apply concepts in other scenarios or contexts into a complex system

### Physics in Context<sup>1</sup>

#### locomotion by oscillation

Start Stop Step

simulation speed

coronal movement  
whirl movement

sum positive = 1201  
total sum = +893  
sum negative = 399  
sum per periode = 959

sum positive = 1507  
total sum = +108  
sum negative = 1391  
sum per periode = 0

Waltner et. al (2007)

### locomotion by undulation

Start Stop Step

simulation speed

lateral components  
positive F = 298  
sum: F=0  
negative F = 198

propelling components  
positive F = 377  
sum F = 377 → propelling force  
negative F = 0

### Further Study

- ❑ Determining how characteristics of reform may change for different contexts, different level of courses with varying environments and limitations
- ❑ Developing cognitive strategies that support students to make multi-level links to understand complex theories
- ❑ Prepare teachers to apply cognitive strategies which promote multi-level thinking and provide their students' tools for answering written extended-response questions

13

*So how do you teach them something new?*

*By mixing what they know with what they don't know. Then, when they see vaguely in their fog something they recognize they think, "Ah I know that". And then one more step to "Ah I understand", and their mind thrust forward in to the unknown, and they begin to recognize what they didn't know before and they increase their power of understanding*

**— Picasso**

## Thank You

[mojgan@phys.ksu.edu](mailto:mojgan@phys.ksu.edu)

14