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

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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)

Research Method and Instruments

- Quantitative
  - Reform Teaching Observation Protocol
  - Science Teaching Efficacy Belief Instrument
  - Constructivist Learning Environment Survey
  - Measure of conceptual understanding
- Qualitative
  - Written extended-response questions
  - Focus Groups
  - Teacher Interviews
Levels of Scientific Concepts

- Descriptive
- Hypothetical
- Theoretical

Concepts:
- Mass, Magnets
- Astronomical observations
- Atoms, Curl of a vector

Assessing Meaningful Understanding by Concept Mapping

- Descriptive
- Hypothetical
- Theoretical

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

Waltner et. al (2007)
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

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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.

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Thank You

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Picasso