Future Elementary Teachers' Epistemological Beliefs & Views About Nature of Science Before & After a 'Reformed' Conceptual Physics Course

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Research Questions

What are future elementary teacher's epistemic beliefs about the physical sciences?
- How do these epistemic beliefs change after they complete a 'reformed' physical science course?

What are these views about the nature of science?
- How do these views change after they complete a 'reformed' physical science course?

Research Participants

- Elementary Education Majors
  - N = 108
  - 95% Women
- Enrolled in a Conceptual Physics Course
  - Almost no students have High School Physics

Course Pedagogy

- Learning Cycle
  1. **Exploration**
     - Lecture on Wednesday.
     - Address Exploration
     - Use peer instruction
     - Introduce concepts
  2. **Concept Introduction**
     - Monday-Wednesday
     - Stations in Activity Center
     - Hands-on with guiding questions on worksheet.
  3. **Application**
     - Wednesday-Friday
     - Hands-on experiment stations in Activity Center
     - Apply concepts learned in class on Wednesday

Data Sources

Pre-Post Comparisons of scores on...
- Epistemic Beliefs in Physical Sciences (EBAPS)
  - A 30-question multiple-choice questionnaire
- Views about Nature of Science (VNOS)
  - A seven-question open-ended questionnaire

EBAPS Dimensions

- Structure of Knowledge
  - Coherent vs. Pieces
- Nature of Learning
  - Propagated from authority vs. Self constructed
- Real-Life Applicability
  - Applicable vs. Non-applicable to the real world
- Evolving Knowledge
  - Knowledge changes with time
- Source of Ability to Learn
  - Innate vs. Acquired
**EBAPS Results**

- **Structure of Knowledge**
- **Nature of Learning**
- **Real-life Applicability**
- **Evolving Knowledge**
- **Source of Ability to Learn**

**VNOS Dimensions**

- **Empirical Nature of Scientific Knowledge**
  - Observations are used in making scientific claims.
- **Inference & Theoretical Entities in Science**
  - Scientific models are inferential in nature.
- **Nature of Scientific Theories & Laws**
  - Theories provide a framework for examining evidence.
  - Laws may change.
- **Creativity & Subjectivity in Science**
  - Creativity permeates science, no single scientific process.
  - Science is a mixture of objective & subjective components.
- **Social & Cultural Influences**
  - Science is a culture in itself and is influenced by society.

**VNOS Results**

- **Empirical Nature of Science**
- **Inferential Nature of Models**
- **Scientific Theories & Laws**
- **Creativity & Subjectivity**
- **Social & Cultural Influences**

**Conclusions**

Future elementary teachers’...

- Epistemic beliefs (as measured by EBAPS) do not change significantly after this course. Only change in “Real-Life Applicability” dimension
- Views of Nature of Science (as measured by VNOS) do not change significantly after this course. Only change in “Inferential Nature of Models” dimension

**Limitations of Study**

Inherent limitations in the instruments

- **EBAPS:**
  - Teasing Epistemology vs. Expectations
  - Teasing Beliefs vs. Goals
  - Inferring students’ sophistication
  - Inviting stock responses from students
- **VNOS:**
  - Validity of interpreting open-ended responses
  - Inter-rater reliability (low ~70%)}

**Implications**

A single reformed science course, even one that uses research-based pedagogy, may not significantly alter students’ views or epistemic beliefs about science.

These issues may need to be explicitly addressed over the longer term in a students’ educational experience.

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1 Elby & Hammer (2002)