Connecting Teaching Beliefs and Practices in Post-Secondary Geoscience Classrooms

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Why study teaching practices and beliefs in concert?

- •Reformed, active-learning techniques are well connected to student learning in science education research¹⁻³.
- •However, reformed teaching practices are not consistently translated to the classroom⁴.
- •Adoption of reformed, inquiry-based materials is done at the discretion of college geoscience instructors, and is often controlled by teaching beliefs⁵⁻⁷.
- •Teaching beliefs have been identified as one of the driving forces behind instructors' pedagogical decisions⁸⁻¹¹.

What we say is not always what we do



What we say is not always what we do

"Interested candidates should submit a CV, a statement of teaching philosophy, and a research statement."

"I teach the Thursday after GSA."

Beliefs: telling half the story

- •Linked to the use of inquiry, national reforms, and constructivist practice in the classroom¹⁻⁴
- Professional development experiences that support meaningful change take into account and address teachers' beliefs⁵
- •Many studies make claim about teaching practice based on what teachers say about their beliefs⁶
- •What is the relationship between teachers' beliefs (espoused theories of action) and teachers' practices (theories in use)⁶?



Characteristics of beliefs





•General or group consensus regarding the validity and appropriateness of a belief

Internal consistency within a belief system

What is meant by 'teaching beliefs'?

- Information a teacher holds about a person, group of people, a behavior or an event¹
- •Guide instructional decisions, influence classroom management, perceptions and judgments, which in term affect behavior in the

classroom and provide a lens for understanding classroom events^{2-4; 6-10}

- Generally comprise two orientations: subject matter vs student³⁻⁵
- Influence how we conceptualize tasks and learn from experience¹¹



¹ Fishbein & Ajzen, 1975; ²⁻⁴ Jones & Carter, 2007; Pajares, 1992; Richardson, 1996; ³⁻⁵ Meirink et al, 2009; Van Driel et al., 2007; ⁶⁻¹⁰ Ashton, 1990; Ashton & Webb, 1986; Brookhart & Freeman, 1992; Buchmann, 1984; Clark, 1988; ¹¹Nespor, 1987

Instruments to measure beliefs

•Most often assessed as *espoused beliefs* through semi-structured interviews¹⁻² and surveys questionnaires³

Instrument	ent Grade level Outcome(s)		Guiding principles		
Views on the Nature of Science (B) survey and interview (VNOSS) ³	Post- secondary	Factors affective preservice teacher conceptions of NOS on classroom instruction	Abd-EI-Khalick and Lederman's Nature of Science		
Level of Understanding (LoU) interview ⁴	K-16	Extent of mastery of an innovation, such as reformed teaching	Innovation adoption		
Pedagogical Discontentment Survey (PDS) ⁵	K-12	Science teachers' 'affective states' as they enter PD activities	Models of conceptual change		

Instruments to measure beliefs

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Instrument	Grade level	Outcome(s)	Guiding principles
Teacher Beliefs Interview (TBI) ³	Secondary	Science teachers' beliefs	Epistemological understanding of beliefs
Science Teaching Efficacy Beliefs Instrument (STEBI) ⁴	Pre-service elementary	Preservice teachers' science teaching efficacy beliefs	Bandura's social learning theory
Beliefs about Reformed Science Teaching and Learning (BARSTL) ⁵	Elementary	Alignment of teaching beliefs and practices with the reform movement in science education	Von Glasersfeld's Constructivism

What is known at the postsecondary level?

- •Few studies have examined teacher and collective efficacy of college-level instructors¹
- •Most work done with Graduate Teaching Assistants²⁻³
- •Relationship between teacher efficacy and motivation to improve teaching⁴
- •Efficacy in university faculty varies by gender⁵⁻⁷; professional rank⁸; and age, experience, and gender make-up of academic departments⁶.
- •University teacher efficacy is more dependent on individual than collective traits (compared to K-12 teachers)⁹

Questions asked with the STEBI

- 1. How does pre-service elementary teachers' science teaching efficacy change over a semester and why?
- 2. What do students perceive has changed about their efficacy, and to what do they attribute those changes?



Measuring Self-Efficacy

STEBI: Science Teaching Efficacy Belief Instrument

Two subscales

- Outcome expectancy: student learning can be influenced by effective teaching
- Personal science teaching efficacy: confidence in their own ability to teach¹

	1.	When a student does better than usual in science, it is often because the teacher exerted a little extra effort.	SA	A	UN	D	SD
×	2.	I will continually find better ways to teach science.	(SA)	A	UN	D	SD
~	3.	Even if I try very hard, I will not teach science as well as I might other subjects.	(SA)	Α	UN	D	SD
	4.	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	SA	A	UN	D	SD
	5.	I know the steps necessary to teach science concepts effectively.	SA	(A)	UN	D	SD
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Quantitative STEBI survey results

- •No significant differences in STEBI subscales, gains, or overall score based on area of study
- •Science and math teachers outperformed two of their counterparts on lecture exams (p < 0.005; g = 0.66), but not on labs or overall course grade (p > 0.05)



Average Exam Grade (Out of 100)

Quantitative STEBI survey results

- •No significant differences in STEBI or learning (lab scores, exam average, course grade) based on EMU GPA or credit hours taken
- •Males had significantly higher gains than females on the Outcome subscale, leading to overall higher scores (p < 0.05; g = 1.07)
- •No significant difference between males and females on labs, exams, or overall course performance(p > 0.05)





Pick <u>five</u> statements that you feel have changed the most for you over the semester and write 2-3 sentences describing how and why they've changed.

Note: There are no wrong answers here, so long as they honestly reflect your beliefs! Statement How do you think your beliefs about this statement have changed over this semester and why? What number (1-25) caused them to change?

12 I feel that I have the concepts of science down. I know that I will be effective at teaching science even the It doesn't appear that way in looking at my grade.

- Item 2: I will continually find better ways to teach science. (Personal)
- "I think originally when I read this question, I thought it was my obligation as a teacher to put that I agree, but after this semester I am excited to find better ways to teach science. I know many more resources than I did and I want to use them to help me find the best teaching method for my students."

Four principal sources of efficacy expectation

Vicarious Information **Enactive Information** "I saw a fellow classmate "I got an A on my test." succeed." **Emotive Information Persuasory Information** "I was anxious before the "Dr. Ryker told me I could test, but exhilarated succeed." afterward."

SE model: Bandura, 1977 Image source: https://wikispaces.psu.edu

Thematic content analysis

759 individual responses			
Each response read 3+ times			
 110 initial codes developed from student responses, e.g. I have a deeper understanding of the content I will teach 	Performance n = 74	Vicarious n = 19	
 Seeing an enthusiastic/excited teacher Talking to Dr. Ryker one-on-one Science has always been hard for me 	Verbal	Physiological	
Sorted into one of four themes	(Social) n – 2	(Emotional) n = 15	
Iterative coding process reduced number to 32 codes			

Intra-rater reliability¹: K = 0.94

Coding themes for STEBI subscales



Questions asked with the TBI

- 1. Do Graduate Teaching Assistants (GTAs) change their teaching beliefs over time as a result of teaching inquiry-based labs?
- 2. What is the relationship between teaching practices and beliefs for geoscience instructors?





Teacher Beliefs Interview



Total score is referred to as the TIBI score.



Relationship between teaching practices and beliefs for geoscience instructors



Considerations for studying the connection between beliefs and practices

- Make theoretical framework explicit
- •Use instruments that align with theoretical framework
- •Clarify 'espoused theories' from 'theories in practice'
- Have participants explain why there is (or isn't) a relationship between their beliefs and practices
- •Replication or longitudinal studies important to see how beliefs change over time

Questions? Want to get involved? Katherine Ryker, <u>kryker@emich.edu</u>

