

Differences in Engineering Students' Beliefs About Knowledge Across Educational Levels



Bethany A. King, Ph.D.
Susan Magun-Jackson, Ph.D.
July 20, 2011

Presentation Outline

- Introduction
- What is epistemology?
- Theoretical Framework
- Research Question
- Method
- Results
- Discussion
- Questions



Introduction

• **U.S. competitive edge in Science, Technology, Engineering, and Math (STEM)**
(Committee on Science, Engineering, and Public Policy, 2007)

• **Engineering Education Reform**
(National Academy of Engineering, 2005)

• **Accreditation Board for Engineering and Technology Criteria** (ABET, 2009)

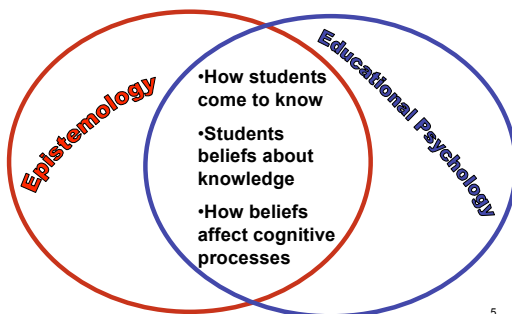
• **Engineering Epistemologies**
("The Research Agenda", 2006)

What is Epistemology?

The branch of philosophy that studies the origin, nature, methods, and limits of human knowledge (Hofer & Pintrich, 1997).

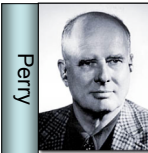
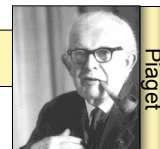


Link between Epistemology & Educational Psychology



Educational Psychology Theorists

Jean Piaget's genetic epistemology
(Hofer & Pintrich, 1997)




William Perry (1970) pioneered epistemological development studies with college students.

Educational Psychology Theorists

Dr. Marlene Schommer-Aikins

- Influenced by Perry's (1970) research.
- Independent dimensions

Dimension	Naïve vs. Sophisticated
-Structure	-Simple vs. Complex
-Certainty	-Absolute vs. Changing
-Control	-Fixed vs. Can Improve
-Speed	-Quick vs. Gradual



ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Literature Review: Perry

Most applied to engineering education.
(Marra, Palmer & Litzinger, 2000; Pavelich & Moore, 1996; Wise et al., 2004)

Literature Review: Schommer-Aikins

- Used to compare engineering students to other majors.**
(Schommer, 1993; Trautwein & Ludtke, 2007)
- Used to compare educational levels.**
(Jehng, Johnson & Anderson, 1993; Schommer, 1993; Paulsen & Wells, 1998)

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Literature Review: Critical to Engineering Education


Impact learning, thinking, and problem-solving.
(Schommer-Aikins, 2004)

- Certainty** - draw absolute conclusions.
(Schommer, 1990)
- Fixed** - less likely to value school.
(Schommer & Walker, 1997)
- Quickly Acquired** - Poor comprehension.
(Schommer, 1990)
- Simple** - Settle for memorization.
(Hofer & Pintrich, 1997)

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Gap in Literature

No quantitative studies to examine epistemological beliefs of engineering students across educational levels.




Research Question

Do epistemological belief dimensions (certainty, structure, control, and speed) of engineering students differ across educational levels (underclassmen, upperclassmen, graduate)?

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Method



- Participants**
- Materials**
 - Schommer Epistemological Questionnaire (SEQ) (Schommer, 1990, 1998)
 - Background Information Form (Barker, 1998)
- Procedure**
- Analysis**
 - Inter-item reliability analysis
 - One-way ANOVA

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Results - Background Information

Gender		Ethnicity	
421 males; 91 females		African American	146
		Alaskan/Pacific	2
		Asian American	26
		Euro American	278
		Hispanic	11
		Multi-ethnic	11
		Native American	2
		Other	35


Educational Level	
Freshman	130
Sophomore	98
Junior	104
Senior	150
Master	29
Doctoral	5

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

Results

Reliability - 4 Factors

- Fixed: $\alpha = .65$
- Simple: $\alpha = .61$
- Quick: $\alpha = .64$
- Certain: $\alpha = .59$



Schommer (1993) found $\alpha = .63$ to $.85$


One-Way ANOVA

•One belief dimension differed across educational levels

- Quickly acquired: $F(2, 513) = 9.98, p < .001$.
- Underclassmen ($M = 2.42, SD = .48$)
- Upperclassmen ($M = 2.23, SD = .45$)

Summary

- Educational level differences:
 - Quickly acquired
 - No difference: undergraduates vs. graduates
- Supports other research (progression).



Suggestions for Best Practices


- Study strategies for freshmen and sophomores.
- Beliefs assessment as an ABET quality tool.

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

14


Limitations & Future Research

- Generalizability
- Cross-sectional
- Self-reported background information



ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

15



Questions?

ASQ Advancing the STEM Agenda in Education, the Workplace and Society Conference
University of Wisconsin-Stout July 19-20, 2011

16