

ENE 59500: Social Construction of Knowledge – Conceptual Change in
Engineering, *CRN 56057*, 1 credit
Wednesdays, 9:30-10:20am
ARMS 1028

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COURSE DESCRIPTION AND RATIONALE

What does “social construction of knowledge” mean in this course? Engaging deeply in theory is a central part of what it means to be and become an engineering education professional. Traversing these theories is a complex undertaking and making sense of existing and emergent theories requires dialogue (conversational exchange and debate), discourse (systematically constructing and legitimating the worlds of which we speak), and support (safe environments for learning and multiple mechanisms for engagement). This is what “social construction of knowledge” means for this course – engaging the epistemological, interpersonal and intrapersonal elements of learning.

The purpose of this course is to provide opportunities to socially construct knowledge around a shared topic of interest and for course participants to define and meet their own learning goals in relation to this topic. The topic for this term is **conceptual change in engineering**. Here, conceptual change can be deconstructed as a means to address four questions:

1. What concepts in engineering are difficult for students to learn?
2. *Why* are those concepts difficult?
3. How can one measure conceptual understanding?
4. What kind of learning environments can help students more easily understand these difficult concepts?

Activities will involve collectively reading, discussing, critiquing, synthesizing, and communicating ideas around this topic. The focus will be on co-constructing knowledge in terms of (1) the central ideas, (2) the use of these ideas in different contexts, and (3) the implications of these ideas for research and practice in engineering education. As such, the course explicitly links to the ENE PhD Competencies: synthesize knowledge, communicate knowledge, create knowledge, think critically and reflectively, engage in professional development, and participate actively in a professional community.

READINGS will draw primarily from the following sources:

- Carey, S. (2000). Science education as conceptual change. *Journal of Applied Developmental Psychology*, 21(1), 13-19.
- Chi, M. T. H., Roscoe, R. D., Slotta, J. D., Roy, M., & Chase, C. C. (2012) Misconceived causal explanations for emergent processes. *Cognitive Science*, 36(1), 1-61.
- Limón, M. & Mason, L. (Eds.) (2002). *Reconsidering conceptual change: Issues in theory and practice*. New York: Kluwer Academic Publishers.
- Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: toward a theory of conceptual change. *Science Education*, 66(2), 211-227.
- Schnotz, W, Vosniadou, S., & Carretaro, M. (Eds.). (1999). *New perspectives on conceptual change*. Advances in Learning and Instruction Series. Oxford: Pergamon.
- Slotta, J. D., & Chi, M. T. H. (2006). Helping students understand challenging topics in science through ontology training. *Cognition and Instruction*, 24(2), 261-289.
- Streveler, R.A., Brown, S., Herman, G.L., & Montfort, D. (in press). Conceptual change and misconceptions in engineering education: Curricular-, measurement-, and theoretically-focused approaches. In A. Johri and B. Olds (Eds.), *Cambridge handbook of engineering education research (CHEER)*. New York: Cambridge University Press.
- Streveler, R.A., Litzinger, T. A., Miller, R.L., & Steif, P. S. (2008). Learning conceptual knowledge in engineering: Overview and future research directions. *Journal of Engineering Education*, 97 (3), 279-294.
- Vosniadou, S. (Ed.) (2008). *International handbook of research on conceptual change*. New York: Routledge.

LEARNING OBJECTIVES

By the end of this course you should be able to:

- Synthesize knowledge, think critically and reflectively, and communicate knowledge around this topic
- Collaborate with others to translate central ideas of this topic into practical and theoretical implications
- Identify quality resources (journals, communities, individuals) for investigating this topic further
- Articulate your own view of the topic and become more confident as an engineering education researcher

COURSE ACTIVITIES AND GRADING

This is a 1 credit course that meets weekly for an hour. We will spend the first half of the term discussing a shared set of readings and the second half discussing readings participants identify on the topic. Each course meeting will involve (1) revisiting conversations from the last meeting, (2) critical discussion related to readings, (3) meaning-making activities to synthesize and translate ideas into practice, and (4) individual reflection.

There are five course tasks:

| Tasks | Weight | Process |
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| <i>Discussions</i> | 20% | <p>Weekly - participate actively and contribute to discussion.</p> <p>The goals are to engage in collaborative learning and enable reflective practice. If you miss more than two classes you must make up your absence. <i>All readings will be made available on Blackboard.</i></p> |
| <i>Reflection essays</i> | 20% | <p>Weekly - to Blackboard 5pm the day before class.</p> <p>Submit a brief (400 words or less) reflection on the readings (e.g., a statement of what you feel is important or provocative, something you “took away”, a sentence that really stood out for you as a central idea). The collection of reflections will be posted on Blackboard for sharing. Grading will be based on completion - there are no right or wrong essays.</p> |
| <i>Lead a discussion</i> | 20% | <p>Once over term - select a reading and lead a group discussion</p> <p>Sign up during the sixth week of class to lead a discussion (including learning objectives and activities) during weeks 10-13. This requires identifying a reading related to conceptual change in engineering and making this available to your peers two weeks before the discussion. Grading will be based on completion and self-assessment*</p> |
| <i>Engage with a broader audience</i> | 20% | <p>Twice over the term (iterative) - share your thoughts with a broader audience by contributing your insights to the “conceptual change research blog.” Grading will be based on completion and self-assessment*</p> |
| <i>Build your own conceptual change research framework</i> | 20% | <p>At the end of the term (Week 14) - create a concept map or other graphic that depicts the connections you see between the various readings discussed over the term. Grading will be based on completion and self-assessment*</p> <p>Share your concept map with classmates and consider posting and discussing on the conceptual change blog. We will build a class concept map in Week 15.</p> <p><i>*Self-assessment will take the form of a one-two page double-spaced reflection completed one week after the respective assignment is due that discusses (1) what you learned during the assignment, and (2) what questions about still remain for you.</i></p> |

WHAT I EXPECT FROM YOU

While much effort has gone into the design of this course, ultimately it is your responsibility to *learn*. I encourage you to: (1) identify your own learning goals and ways to determine the extent to which you are meeting these goals, (2) think critically, challenge your own beliefs, and work towards synthesizing ideas, (3) engage in class discussions, explain your insights and ask others to explain theirs, and work towards making persuasive and grounded arguments, (4) attend all classes, complete assignments on time, and come prepared for class, and (5) abide by Purdue's policy on scholastic conduct (http://www.purdue.edu/univregs/pages/stu_conduct/stu_regulations.html).

If you are a person with special circumstances (e.g., visual, hearing or learning disabilities or language differences) that you believe will affect your class learning or performance please let me know if I can make appropriate accommodations. The Adaptive Services website is located at: <http://www.purdue.edu/odos/adpro/>.

In the event of a major campus emergency (e.g., the A H1N1 virus or weather), course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Changes in the course will be disseminated on the course blog, on Blackboard Vista, and when appropriate as an e-mail.

WHAT I EXPECT FROM MYSELF

My goal is to create a safe and engaging environment for learning. My responsibility is to take into account students' prior learning and perspectives, make learning visible and push on prior conceptions, provide opportunities for students to achieve learning goals, and facilitate life long learning habits of mind. This inherently involves active listening, being respectful and reliable, asking for and using course feedback, and encouraging a community of practice.

COURSE STRUCTURE (TENTATIVE)

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| Week 1 Jan 9 | Starting the conversation..."What is this class about?" Introductions and overview; Identifying individual learning goals; Making previous knowledge about conceptual change explicit. Generate a list of learning goals to guide selection of readings for weeks 6, 7 and 8. |
| Week 2 Jan 16 | An introduction to conceptual change research <ul style="list-style-type: none">• Vosniadou, S. (Ed.) (2008). <i>International handbook of research on conceptual change</i>. New York: Routledge. Pages xiii-xxviii.• Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: toward a theory of conceptual change. <i>Science Education</i>, 66(2), 211-227.• Carey, S. (2000). Science education as conceptual change. <i>Journal of Applied Developmental Psychology</i>, 21(1), 13-19. |
| Week 3 Jan 23 | An introduction to conceptual change research in engineering <ul style="list-style-type: none">• Streveler, R.A., Litzinger, T. A., Miller, R.L., & Steif, P. S. (2008). Learning conceptual knowledge in engineering: Overview and future research directions. <i>Journal of Engineering Education</i>, 97 (3), 279-294.• Streveler, R.A., Brown, S., Herman, G.L., & Montfort, D. (in press). Conceptual change and misconceptions in engineering education: Curricular-, measurement-, and theoretically-focused approaches. In A. Johri and B. Olds (Eds.), <i>Cambridge handbook of engineering education research (CHEER)</i>. New York: Cambridge University Press. |
| Week 4 Jan 30 | Major theories in conceptual change (Chi, diSessa, Vosniadou) <ul style="list-style-type: none">• Vosniadou, S. (Ed.) (2008). <i>International handbook of research on conceptual change</i>. New York: Routledge. [Chapters 1, 2, 3] |
| Week 5 Feb 6 | Ontological approach to conceptual change <ul style="list-style-type: none">• Chi, M. T. H., Roscoe, R. D., Slotta, J. D., Roy, M., & Chase, C. C. (2012) Misconceived causal explanations for emergent processes. <i>Cognitive Science</i>, 36(1), 1-61.• Slotta, J. D., & Chi, M. T. H. (2006). Helping students understand challenging topics in science through ontology training. <i>Cognition and Instruction</i>, 24(2), 261-289. |

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| Week 6 Feb 13 | Based on class interest – selected chapters from.... <ul style="list-style-type: none"> • Limón, M. & Mason, L. (Eds.) (2002). <i>Reconsidering conceptual change: Issues in theory and practice</i>. New York: Kluwer Academic Publishers. • Students sign up to lead a discussion during weeks 10-13. |
| Week 7 Feb 20 | Based on class interest – selected chapters from.... <ul style="list-style-type: none"> • Vosniadou, S. (Ed.) (2008). <i>International handbook of research on conceptual change</i>. New York: Routledge. |
| Week 8 March 6 | Based on class interest – selected chapters from.... <ul style="list-style-type: none"> • Schnotz, W, Vosniadou, S., & Carretaro, M. (Eds.). (1999). <i>New perspectives on conceptual change</i>. Advances in Learning and Instruction Series. Oxford: Pergamon. |
| Week 9 Mar 13 | Spring Break |
| Week 10 Mar 20 | Participant-led discussions Facilitators: Self-assess own learning |
| Week 11 Mar 27 | Participant-led discussions Facilitators: Self-assess own learning |
| Week 12 April 3 | Participant-led discussions Facilitators: Self-assess own learning |
| Week 13 April 10 | Participant-led discussions Facilitators: Self-assess own learning |
| Week 14 April 17 | Share individual concept maps |
| Week 15 April 24 | Build a group concept map |