WHY ARE SOME SCIENCE AND ENGINEERING CONCEPTS SO DIFFICULT TO LEARN? IDENTIFYING, ASSESSING, AND "REPAIRING" STUDENT MISUNDERSTANDING OF IMPORTANT CONCEPTS

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Abstract - This Special Session will provide an active learning environment where participants will (1) be introduced to the idea of difficult concepts in engineering and science, (2) learn how they might use concept inventories for assessing understanding, and (3) begin examining how they can help improve student understanding of these concepts.

Index terms – Difficult concepts, misconceptions, special session

INTRODUCTION

Many engineering faculty are frustrated when their students can correctly solve problems but cannot explain the fundamental concepts governing the problem solution. Some concepts, like heat, electricity and equilibrium, are very difficult for students to learn - even after they have been repeatedly "taught." Why is this so? Literally thousands of studies in the science and engineering education literature suggest that students bring to their classes pre-conceived ideas about how the world works - ideas that are largely based on everyday experiences and observations but which may be fundamentally incorrect though strongly held. Experienced professors may exacerbate the problem by having "expert blinds spots" that block them from understanding why these concepts, now second nature to the expert, are so difficult for their students to learn.

SESSION OUTLINE

This special session is designed to be highly interactive and will include discussion, think-pair-share, and investigation of participants' prior knowledge of the content. Participants will take home a tangible product (the beginnings of a plan for implementing these ideas in their instruction).

Specific Topics to be Included in the Session

- What science and engineering concepts seem to be most difficult for students to learn?
- Some ways to measure students' understanding of these concepts.
- Why are some concepts so difficult to learn?
- Some ideas for designing instruction to make these concepts easier to learn.

EXPECTED OUTCOMES (LEARNING OBJECTIVES)

- Participants will identify at least one difficult concept in their field of expertise.
- Participants will have the start of a plan for (a) measuring difficult concepts in courses they teach and/or (b) for modifying their instruction to enhance student learning of this concept.

DIRECTION FOR FUTURE RESEARCH BY PARTICIPANTS

- Participants will be familiar with the concept of mental models and will have a new way to think about and explain how their students learn.
- Participants will also have insight into how instruction could be designed to enhance learning of difficult concepts.
- We would expect that classroom research studies would be created as an outcome of this session.

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