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USING THE CONTEXT OF PHYSICS PROBLEM SOLVING TO EVALUATE THE COHERENCE OF STUDENT KNOWLEDGE.

Mel Stephan Sabella, Doctor of Philosophy, 1999

Dissertation directed by: Professor Edward F. Redish
Department of Physics

ABSTRACT

We use the context of problem solving to show that students exhibit a local coherence but not a global coherence in their physics knowledge. When presented with a problem-solving task, students often activate a coherent set of knowledge called a schema to solve the problem. This schema consists of strongly related knowledge and procedures. Although the schemas students develop in the physics course are usually sufficient for success in the class, they are often insufficient for solving complex problems. Complex problems require that students have a deep understanding where they have integrated their qualitative knowledge with their quantitative knowledge and have integrated related physics topics. We show that our students activate schemas consisting of small amounts of knowledge and these schemas are often isolated from other schemas.

Physics Education Research (PER) has shown that students in introductory physics lack a deep understanding of physics principles and concepts. Through research-based curricula, conceptual understanding can be improved. In addition PER has shown that students can be taught problem solving skills through a modified curriculum. Despite these improvements, students still have difficulty developing a coherent knowledge of physics. In particular, students often have difficulty connecting related physics concepts. In addition, they view quantitative problems and qualitative questions as distinct types of tasks, possessing different types of knowledge and different sets of rules for responding.

We discuss some possible methods that physics instructors and physics education researchers can use to examine coherence in student knowledge. Using these methods, we provide evidence for the local coherence in student physics knowledge by identifying distinct schemas for different physics topics and concepts, as well as distinct schemas for qualitative and quantitative knowledge. After identifying some of these difficulties in student understanding, we look at how students are connecting qualitative knowledge to quantitative knowledge after going through concept-based curriculum. The research identifies benefits as well as shortcomings in the concept-based curriculum and talk about possible modifications that may foster coherence. In addition, we compare performance on quantitative questions between a physics class using the traditional problem-solving recitation and a class using *Tutorials in Introductory Physics* on quantitative problems.

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by

Mel Stephan Sabella

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Advisory Committee:

Professor Edward F. Redish, Chair/Advisor
Professor Sarah C. Eno
Professor S. James Gates
Professor David Hammer
Professor Daniel P. Lathrop
Professor Emily van Zee

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