INTEGRATING PROBLEM-SOLVING SKILLS ACROSS AN ENGINEERING CURRICULUM: A WEB RESOURCE

Ashley Ater Kranov[1], J. Angell[2], A. DuBuisson[3], S. Ruzich[4], R. E. Smelser[5], Donald F. Elger[6]

Abstract — *Many engineering students do not develop the problem-solving skills necessary to function effectively in upper-division design courses and in professional practice. Instead, they demonstrate "dead-end" strategies that work well in solving textbook problems and passing course exams. To address this issue, our cross-disciplinary team at the University of Idaho is developing an across-the-curriculum program that promotes teaching engineering problem solving and content knowledge simultaneously. A component of this project is the Idaho Strategy for Engineering Thinking (Iset), a web-based resource that mirrors effective engineering practice by describing an iterative, non-linear approach to problem solving that can be applied to straightforward textbook problems as well as to open-ended design projects. The Iset resource emphasizes powerful methods and procedures that can help students develop the ability to apply appropriate engineering concepts and principles in a wide range of contexts.*

Index Terms— problem-solving skills, Iset, web-based resource

INTRODUCTION

Development of problem-solving skills is a primary goal of engineering education. Over the course of a typical four-year degree program, students observe professors work 1000 or more example problems, and the students themselves solve more than 3000 problems. In spite of intensive modeling and practice, Woods reported that the students showed "negligible improvement" in problem solving skills, meaning that "if they were given a related but different problem situation, they were not able to bring any new thinking or process skills to bear" [1].

Traditional engineering education encourages covering content over fostering skills and, ironically, reinforces the following dead-end strategies frequently used by students: "a) using example problems as templates, b) plugging numbers into formulas, c) little understanding or consideration of underlying concepts; and d) working backwards from known answers"[2].

A component of our cross-disciplinary project is the Idaho Strategy for Engineering Thinking (Iset), a web-based resource that mirrors effective engineering practice by describing a non-linear, iterative approach to problem solving that can be applied to straightforward textbook problems as well as to complex, open-ended design projects. In efforts to help instructors shift the focus from "problem specific procedures and mathematical manipulations to help students" [3] get the right answers, the Iset resource will emphasize powerful methods and procedures that can help students develop the ability to apply appropriate engineering concepts and principles in a wide range of contexts.

DISCUSSION

Elger et al. [4] have reported success with integrating the engineering problem-solving process into the engineering science classroom. Their data confirms that practice of the process increases student problem-solving skills and empowers students with professional methods and strategies for dealing with complex engineering situations.

Conventional engineering education obscures the global nature of engineering. With an emphasis on covering encyclopedic amounts of content, students obtain superficial and often erroneous knowledge of important concepts and principles, without any understanding their relationships or interdependence. By focusing on student mastery of engineering concepts through the development of higher-level thinking skills, we believe that students will evolve into professional problem solvers. And by developing an inductive and active environment, we can provide our students with the rich experiences necessary to foster higher-level thinking skills. When our students graduate they will no longer use a shotgun approach to engineering with little understanding of the profession, instead they will become self-sufficient engineers devoted to serving the public.

REFERENCES

[1] Woods, D.R " How might I teach problem solving?" in Stice, J.E., ed., *Developing critical thinking and problem-solving abilities*, No. 30 Jossey-Bass, 1987.

[2,4] Elger, D., Armstrong, T., Beyerlein, S., Felicione, C., Fulcher, K., & Rousseau, P. "A structured problem solving model for developing high-level skills", *Proceedings of 2001 Annual Meeting of American Society for Engineering Education*

[3] Mestre, J.P. "Cognitive aspects of learning and teaching science", *Teacher enhancement for elementary and secondary science and mathematics*, Washington, D.C.: NSF, 1994, pp. 3-1 - 3-53

[1] Ashley Ater Kranov, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902 ashleya@uidaho.edu
[2] J. Angell, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902
[3] A. Dubuisson, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902
[4] S. Ruzich, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902
[5] R. E. Smelser, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902 rsmelser@uidaho.edu
[6] Donald F. Elger, University of Idaho, Mechanical Engineering, Moscow, Idaho 83843-0902 delger@uidaho.edu

0-7803-7444-4/02/$17.00 © 2002 IEEE **November 6 - 9, 2002, Boston, MA**
32nd ASEE/IEEE Frontiers in Education Conference