

AC 2008-1687: ENVIRONMENTS FOR FOSTERING EFFECTIVE CRITICAL THINKING (EFFECTS).

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DR. Joseph R.V. Flora is an Associate Professor in the Department of Civil and Environmental Engineering at the University of South Carolina – Columbia. He received a B.S. in Civil Engineering from the University of the Philippines, a M.S. in Environmental Engineering from the University of Illinois at Urbana-Champaign and a Ph.D. in Environmental Engineering from the University of Cincinnati. His research interests are in the areas of environmental process modeling, quantum modeling, electrochemically-mediated biological degradation, and water, wastewater, and hazardous waste treatment. He is a licensed professional engineer in the State of South Carolina.

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Briana Timmerman is a Research Associate Faculty member in the Department of Biological Sciences and an Assistant Dean in the SC Honors College. She has several NSF science education research projects, but this is her first opportunity to work in the area of engineering education. Her research focuses on the area of curriculum design to develop critical thinking and research skills, as well as conceptual change. In addition, she has developed a Universal Rubric for Laboratory Reports which measures students' scientific reasoning and science writing skills and has been demonstrated to be reliable regardless of biological course content area.

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Environments For Fostering Effective Critical Thinking (EFFECTS).

Abstract

The ability to make decisions based on solid engineering judgment is directly related to the success of professional engineering careers. Engineering judgment results from acquisition of core knowledge and technical skills, application of critical thinking, and reliance on previous engineering experiences. Traditional lectures can be effective in the transfer of core knowledge, technical skills but leave the development and application of critical thinking to the student. The Environments For Fostering Effective Critical Thinking (EFFECTS) are modular inquiry based tools specifically designed to develop critical thinking skills, collaborative teamwork skills and improving the transfer of core knowledge in engineering classes. This paper describes current activities to develop EFFECTS in the Civil Engineering undergraduate curricula. The overarching goal of the EFFECTS is to facilitate students' critical thinking skills in a manner that will encourage the eventual development of engineering judgment.

Six disciplines of civil engineering are used to provide the appropriate context for the EFFECTS: Environmental, Geotechnical, Structural, Surveying, Transportation, and Water Resources. The structure of each EFFECT is as follows: individual, group discussion of, and classroom of responses to a driving question in the discipline during the first meeting; hands-on activities during the succeeding meetings; and a final meeting where students discuss within their group what was learned and determine to determine the best approach to address the driving question. The answer to the driving question is documented in an individual report. Throughout each EFFECT, students are asked specific questions in the discipline that will be studied during the next several sessions and are required to document their response in an online journal.

Four major data sources are being used in a mixed methods approach synthesizing multiple perspectives over time to capture the development of students' abilities. These include: i) a pre-post written test of both core knowledge and fundamental skills, ii) open-ended, written decisions responding to each EFFECT's driving question, iii) journal entries, and iv) evaluation of capstone design projects by members of a professional review panel during their senior year. Preliminary data suggest that the combination of group discussion and hands-on investigation within a specific engineering context stimulate reflection and development critical thinking.

The EFFECTS are currently being implemented this Fall 2007 in a new Introduction of Civil Engineering freshman course at the University of South Carolina, in a similar course at Marshall University, and in sections of existing courses at Midlands Technical College. Details of the activities will be documented in the paper and during the conference presentation.