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The Foundation Coalition Newsletter

....an agent of change

http://www.foundationcoalition.org

From Jeff Froyd, Project Director

The seven key ideas (http://foundationcoalition.org/home/foundationcoalition/corecompetencies.html) on which Foundation Coalition (FC) partner institutions based their curricular renewal projects continue to provide the foundation for many current curricular renewal efforts:

Active/Cooperative Learning
Recruitment, Retention, and Graduation of Women and Underrepresented Minorities
Technology-enabled Learning
Curriculum Integration and Learning Communities
Student Teams in Engineering
Assessment and Evaluation
Curricular Change, Resistance, and Leadership

FC has made and will continue to make valuable contributions to conversations about each of these key ideas. One-page introductions and minidocuments on topics related to these key ideas can be found at http://www.foundationcoalition.org/publications/brochures/index.html.

In assessment and evaluation, work on concept inventory assessment instruments (http://www.foundationcoalition.org/home/keycomponents/concept/index.html) continues to be an active and exciting area of progress. As shown on the second page, faculty members have authored five FIE 2003 (http://fie.engrng.pitt.edu/fie2003/) papers on concept inventories. FC work, together with work of other faculty members, will be presented at a panel session at the conference. Results from students taking the instrument illustrate the challenge of improving the conceptual understanding of our students in important disciplines in engineering science. More significantly, faculty members who have worked to develop, administer, revise, and interpret results from the instruments realize the challenges that they face in improving their teaching.

In curricular change, resistance, and leadership, Carolyn Clark, Prudence Merton, Jim Richardson, and Jeff Froyd have written a paper on evolving models of curricular change that has been accepted for publication in the *Journal of Engineering Education*. It should appear early in 2004. The paper describes how models for curricular change evolved during the ten years of FC activities and supports these models with references to curricular change processes at various partner institutions.

In active/cooperative learning, Susan Ledlow at Arizona State University has been assembling information on active/cooperative learning (ACL), interviewing faculty members across the nation who are using ACL in their classes, and updating the FC Web site on ACL (site http://clte.asu.edu/active/main.htm). Also, she has published the third edition of the ACL CD. Copies of the ACL CD may be obtained by contacting Brenda Bridges (bridges@tamu.edu). At INFORMS 2003 (http://www.informs.org/conf/Atlanta2003/) César Malavé (TAMU), Jorge Leon, (TAMU) Rene Villalobos (ASU), Rick Wysk (Penn State), and Paul Griffin (Georgia Tech) will be presenting papers on using ACL and student teams in teaching various industrial engineering topics. The modules that they developed are being posted to the FC Web site. At FIE 2003, Karl Smith, Susan Ledlow, Jim Morgan, and others will present a description of a project to publish five minidocuments on various initiatives related to ACL. These minidocuments should begin appear on the FC Web site in the next few months.

Upcoming Event

Nov 5–8 **Frontiers in Education Conference,** Boulder CO

Foundation Coalition Papers
to be presented at the 2003 Frontiers in Education Conference

Software Engineering Baccalaureate Programs in the United States: An Overview

Donald J. Bagert and Mark A. Ardis

There are over 20 B.S. in Software Engineering degree programs in the U.S. The first accredited ones are likely in the 2002–03 cycle; the total number of such programs should grow for years. The authors compared programs to determine emerging trends that will benefit software engineering undergraduate programs and institutions that may create new degrees of this type. The programs' curriculum (by subject area) is compared with curriculum models and accreditation criteria. Results of a survey of undergraduate software engineering programs worldwide provide additional data about the U.S. programs and compare them as a group to their counterparts in other countries.

Progress on Concept Inventory Assessment Tools

D. L. Evans, moderator; Gary Gray, Stephen Krause, Jay Martin, Clark Midkiff, Branisla Notaros, Michael Pavelich, David Rancour, Teri Reed-Rhoads, Paul Steif, Ruth Streveler, Kathleen Wage

The Foundation Coalition and others have developed concept inventory (CI) assessment instruments patterned after the Force Concept Inventory instrument of Halloun and Hestenes. Such assessment inventories can relate teaching techniques to student learning. Work started two years ago on CIs for thermodynamics, solid mechanics, signals and processing, and electromagnetics. Last year work began on CIs for circuits, fluid mechanics, engineering materials, transport processes, and statistics. This year work began on chemistry, computer engineering, dynamics, electronics, and heat transfer. This panel will discuss progress on the CIs and early student data emerging from the continuous improvement of the CIs. Results will be compared to data collected by Hake that are segregated by how the content was managed and delivered (traditional lecture compared to interactive engagement). Effective practices for developing CIs will also be discussed.

A Concept Inventory for Heat Transfer

Anthony Jacobi, Jay Martin, John Mitchell, Ty Newell

Students enter engineering courses with intuitions about physical phenomena. Through coursework they build on their intuition to develop a set of beliefs about the subject. Often their understanding of basic concepts is incomplete and their explanations are incorrect. Concept inventories (CIs) are assessment tools that determine the degree to which students understand concepts of a subject and identify the bases for misunderstandings. A cooperative effort between faculty at the Universities of Wisconsin and Illinois worked to develop a CI for heat transfer. The process initiated with student identification of the conceptual problems rather than with faculty perceptions of student misunderstandings. Students explored areas of conceptual difficulty and phrased questions that test understanding of concepts. Students working with faculty developed a CI for heat transfer. The presentation will report the experience with using student groups and the resulting CI.

Using a Materials Concept Inventory to Assess Conceptual Gain in Introductory Materials Engineering Courses

Stephen Krause, J. Chris Decker, Richard Griffin

A materials concept inventory (MCI) was created to measure conceptual knowledge gain in introductory materials engineering courses. The 30-question, multiple-choice MCI test was administered as a pre- and post-test at Arizona State University (ASU) and Texas A&M University (TAMU) to classes ranging in size from 16 to 90 students. Results on the entering class showed both "prior misconceptions" and knowledge gaps that resulted from earlier coursework in chemistry and, to a lesser extent, geometry. The exiting class showed that some "prior misconceptions" persisted and also that new "spontaneous misconceptions" had been created during the course of the class. Most classes showed a limited, 15% to 20%, gain in knowledge between pre- and post-test scores, but one class, which used active learning, showed a gain of 38%.

Development of a Concept Inventory for Fluid Mechanics

Jay Martin, John Mitchell, Ty Newell

Concept inventories are assessment tools designed to determine the degree to which students understand concepts of a subject and to identify their misconceptions. Results of a concept inventory can be used to change methods of instruction to overcome misconceptions. A cooperative effort between mechanical engineering faculty at the Universities of Wisconsin Madison and Illinois Champaign-Urbana was directed toward developing a fluid mechanics concept inventory (FMCI). Fluid mechanics typically follows thermodynamics in the courses sequence in thermal sciences, involves both the mechanics and dynamics of fluids, and builds on basic physics and Newtonian mechanics. This paper describes the process used to develop the FMCI, details of how content was determined, and examples of actual content of the instrument itself.

Development of a Concept Inventory for Strength of Materials

Jim Richardson, Paul Steif, Jim Morgan, John Dantzler

With the success of David Hestenes's Force Concept Inventory, many educators are developing concept inventories for other subjects, like math, biology, and engineering science. Development of a useful concept inventory is not easy. This paper describes development of two concept inventories for strength of materials, the first of which was a failure. Psychometric testing of this concept inventory indicated serious deficiencies. A larger project team was assembled to develop a better inventory. Results of the psychometric analysis of the first inventory, which showed its shortcomings, are presented, followed by the improved development procedure for the second inventory, along with lessons learned.

A Novel Approach to Integrating Design into Manufacturing and Materials Education through the Fabrication of a Scale Model Cannon

Jeremy Weinstein and Richard Griffin

Prior to 2002 materials and manufacturing laboratories were independent initiatives. Recently these courses were combined. It was proposed that, if these two courses integrated fully under one project, students would better understand the place of materials and manufacturing in design. The proposed project was a 1/8th-scale replica of a 12-pound Civil War Napoleon in a field mount. Labs were modified so each topic contributed to the production of the cannon. Lab assessment utilized three student surveys and two open-ended qualitative essays graded using analytic rubrics. Results indicate students are highly enthused by the new class and feel they have improved in the subjects. Analysis of the essays shows that students in cannon class better understand the role and application of materials selection and manufacturing in design.