

UW-Madison, College of Engineering:  
Academic Program Assessment Annual Report for 2009-2010  
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## Overview

In concert with the University of Wisconsin-Madison's strategic framework promoting an exemplary undergraduate education, the College of Engineering's strategic goals focus on:

- *Educational excellence and leadership*
- *Research leadership*
- *Technology innovation and entrepreneurship*
- *Recognition of the quality of our education and research*
- *Effective business model, infrastructure and administrative support to accomplish the mission, vision and objectives*

The assessment plan for the College of Engineering (CoE) reflects the education innovations underway to transform how engineering education is designed and delivered to students today to meet their needs as future engineers in a multidisciplinary global economy. With an increasing awareness and focus on the need to educate engineering students with the necessary discipline specific skills, as well as with the knowledge and ability to engage as a global citizen, the CoE has revised its strategic priorities over the past few years and has refined its mission and vision statements accordingly:

**Mission:** *To educate and prepare people of all backgrounds to contribute as engineers and citizens through the creation, integration, application, and transfer of engineering knowledge*

**Vision:** *To be, and be recognized as, a world-class college of engineering that provides an excellent learning experience and education in a culture of scholarly innovation, collaboration and discovery*

## CoE Academic Assessment

In the spring of 2009, the Engineering Beyond Boundaries (EBB) Round Table reviewed a sampling of the 2008-2009 projects to determine what the attributes of the successful projects were. As a result of these discussions the request for proposal themes, criteria and activities to be funded were revised to encourage flexibility in designing curriculum and support of sustainable and scalable projects. The following criteria were incorporated into the request for proposals:

1. Modularize and restructure similar core courses currently offered in different departments to enable interdisciplinary teaching of common content with separate modules of discipline-specific content.

2. As appropriate and feasible to the course, move toward online content using standardized tools to enable implementation of innovative teaching methods in the classroom.
3. As appropriate and feasible to the course, proposals are encouraged that enable students to take one or more modules of a course while studying abroad or participating in an internship off campus

The EBB Task group recommended a vetting process to change the name of the *2010 and Beyond Round Table* and to focus on transforming engineering education by incorporating recommendations from the American Society for Engineering Education (ASEE), the National Academy of Engineering (NAE) and other relevant engineering education research literature. Organizational changes within CoE were advocated based upon an identified need to provide coordinated support to faculty in their use of effective technology enhanced learning (TEL) tools and assessment strategies. Coordination of resources from across CoE functional units within Academic Affairs, CAE and Wendt Library was proposed to more effectively address the strategic priorities of the TEL project and other identified instructional and curriculum innovation efforts.

Specific performance criteria for each project are aligned with the EBB goals and each project is asked to provide an assessment plan along with an outcome report at the end of the project. The specific assessment methods are determined by the project objectives and outcomes, and focus on assessing the impact on student learning resulting from the design of a course or module. A particular focus of the Wendt Commons Teaching and Learning Services group (formed in July 2010), will be to provide proposal development and assessment planning consultation to support the assessment efforts of similar projects in the future.

### **CoE Assessment Committee**

The purpose of the committee is to engage around accreditation and assessment activities that help to identifying program strengths, and to use assessment data to improve program content and the learning environment in support of achievement of broad-based and disciplinary specific student learning outcomes. The CoE Assessment Committee meets monthly during the Academic calendar year to discuss assessment strategies related to the accreditation process and for program and instructional improvement. During the 2009-2010 academic year a series of assessment webinars developed by ABET were scheduled on the following topics:

- Accreditation Update
- How to Develop a Survey
- Choosing Assessment Methods
- Defining Learning Outcomes
- Developing Rubrics, and
- Developing and Assessing Program Educational Objectives

Electronic copies of these webinars are available.

## **Department/ Program Academic Assessment**

A variety of assessment methods and activities are used at the department and program levels within CoE to collect meaningful data on the impact of curricular changes on student achievement of learning outcomes. All departments participate in the Engineering Benchmarking, Inc. (EBI) survey, administered to graduating seniors, that uses a number of factors to measure students' perceptions about their engineering educational experience. The survey results of specific department data are shared in hard copy and also available electronically for further analysis. A few interesting findings were that students ranked the quality of teaching in engineering courses compared to non-engineering courses on this campus as higher compared to 2009. Furthermore, students rated their understanding of contemporary issues and ability to communicate using oral progress reports higher than the previous year's ratings. On the downside, students were less satisfied with the number and quality of companies recruiting on campus than in 2009. Unfortunately the satisfaction with career services took a hit due to the drop in the number of companies recruiting on campus in 2008-09, and reduced opportunities for permanent job placement. Despite these lower ratings, the CoE ranked higher in this area overall compared to all other 69 institutions participating in the survey.

### **Biomedical Engineering**

The UW Biomedical Engineering (BME) department's Assessment Committee is charged with assessing its program outcomes in order to better evaluate, revise and refine their curriculum.

#### 2009 Recommendations and Actions Taken:

*Recommendation:* The committee should explore strategies for improving consistency in outcome assessment (i.e., scoring) from year to year.

*Action:* An assessment rubric was created and used this year, which should improve consistency in outcome assessment from year to year.

*Recommendation:* Design advisors should keep overall educational outcomes in mind when suggesting directions for projects. For example, advisors should advise teams to consider how mathematics and statistics could be used to improve their project designs.

*Action 1:* A version of the assessment rubric is being prepared for students and faculty for use during the BME design course, which should help advisors and students work toward the educational outcomes more effectively.

*Corollary:* All course instructors should keep departmental educational outcomes in mind when creating assignments.

*Action 2:* Lab reports for BME 601 Tissue Engineering Laboratory now require a statistical analysis including the Q-test.

*Action 3:* A technical writing assignment has been added into BME 510, Tissue Engineering.

*Recommendation:* Students should be made more aware of BME departmental educational outcomes by putting a link on our design course syllabus to the department's mission web page.

*Action:* Educational outcomes have been posted on the BME design website; educational outcomes have been incorporated into the evaluation forms that students (and faculty) refer to when preparing (grading) student work. As noted above, a version of the assessment rubric is being prepared for students.

*Recommendation:* Design advisors and other faculty should make students aware of professional codes of ethics and other resources related to professional and ethical responsibilities of engineers.

*Action 1:* Resources have been added to the BME design website. For example, these links have been provided:

<http://www.nspe.org/Ethics/CodeofEthics/index.html>

<http://www.nspe.org/Ethics/CodeofEthics/Creed/creed.html>

*Action 2:* Active learning ethics modules have been developed and incorporated into BME 510 and 601 (Tissue Engineering Laboratory) under the direction of Prof. Pamela Kreeger and Faculty Associate John Puccinelli

#### 2010 Recommendations:

*Recommendation:* Provide a best-practices checklist for BME Design deliverables, which should help advisors and students work toward the educational outcomes more effectively.

*Recommendation:* Continue the assessment exercise for several years to evaluate the impact of past changes in the BME Design curriculum on student attainment of educational outcomes.

*Recommendation:* Continue revising other required and elective courses in the BME curriculum to address the persistent weaknesses in student outcomes (2 and 7) noted above.

### **Chemical and Biological Engineering**

Chemical and Biological Engineering (CBE) continues to use an array of activities to assess the program and implement improvements. The triennial Alumni Survey was revised in spring 2010 for application in fall 2010. The Visiting Committee met in spring 2010 and provided input on several topics. Most notably, they collected student comments on advising and highlighted particular weaknesses; these will guide an ongoing initiative to revamp CBE's undergraduate advising system. In spring 2010 faculty meeting discussions of Diverse Opportunities (study abroad, student organizations, independent study and research program involvement, etc.) began to evaluate the positive influence of activities outside the specific degree requirements on our student body excellence. The department revised the Mission Statement in spring 2010 and is developing written committee guidelines to clarify processes. Evaluation of course effectiveness and coordination between courses continues to be aided by periodic review of Instructor Course Evaluation forms through the departmental Assessment web pages.

## **Electrical and Computer Engineering**

The ECE is in the early stages of implementing a curriculum revision plan. A desired outcome of these changes would be to attract, and thereby enroll more students into ECE by increasing student awareness that electronic or digital technology is in everything that is engineered. The revised curriculum plan will foster opportunities to blend learning activities with other engineering disciplines to give students global competencies and cross disciplinary skills acquisition.

The ECE continues to review the Engineering Benchmarking Inc. (EBI) survey data of graduating seniors and is currently working on a survey of recent alumni and current students to examine elements of the ECE programs and curriculum for improvement.

## **Industrial Systems Engineering**

The Industrial Systems Engineering (ISyE) department's assessment and continuous improvement process included the following activities:

- 1) Reconciled GPA by aligning the progression GPA to be consistent across the major GPA and the overall GPA.
- 2) Evaluated the use of teaching assistants and laboratory resources.

Three years ago ISyE hired a 25% lab support person to set up and organize the manufacturing laboratory experiences for students. Stimulated by budget constraints, they evaluated how TAs and lab/discussion sections in our undergraduate courses were being used. The IIE chapter sought input from students, the Academic Affairs Cluster, and from the entire faculty as part of this process. ISyE determined that the required undergraduate classes; ISyE 313, 315, 324, 349 and 415, should

- Give priority to TAs to run the discussion/lab sections,
- Continue the required courses as three credit classes with 150 minutes of lecture and 50 minutes of discussion/lab per week, and
- Provide flexibility and responsiveness in meeting student needs by assigning TAs based on total enrollment in the course rather than by a pre-set number of lab & discussion sections.

ISyE considered but rejected the plan to add a one-credit laboratory section to each of these undergraduate courses.

- 3) Considered expanding the number of biological science courses that are appropriate to meet the biological science 3-credit requirement. A plan to expand the number of biological science courses considered appropriate to meet this requirement is being discussed.
- 4) Planning is underway to conduct an ABET informative survey of ISyE graduates with the Student and Alumni Affairs Cluster in the spring 2011 semester.

## **Mechanical Engineering**

Mechanical Engineering initiated a number of continuous improvement activities in 2009-10. The Educational Objectives and Student Outcomes for the curriculum have been re-examined and re-affirmed by the faculty. The descriptive material, outcomes, and assessment procedures for the required courses in the curriculum are being reviewed and updated. The Advisory Board met and its members conducted small student focus groups with 30-40 students at the spring and fall meetings to evaluate recent changes that have been made in the curriculum. Student response to the recent shift from CS 310 as a requirement to CS 302 indicated that the programming skills learned in CS 302 are valuable and meeting a goal of the curriculum change. The increase from 3 to 4 credits for ME 368 Instrumentation Laboratory combined with more time spent on experimental analysis skills has been received positively. The Second Annual Professional Development Day was modified to reflect student input from the first PDD, and an extensive survey was taken to further improve the event.

## **Engineering Professional Development: Technical Communications**

The Technical Communications (TC) program within Engineering Professional Development (EPD) has been working to integrate appropriate technical communication into the undergraduate engineering curriculum. An ongoing initiative to define and measure effective engineering communication learning outcomes is underway within the CoE. A preliminary survey of faculty was conducted in early 2009 to begin the process of identifying critical communication skills and knowledge valued by engineering faculty, industry, and collaborative partners. The results of this initiative have been used to identify specific performance criteria and to develop a systematic approach to support effective teaching and learning of engineering communication and information literacy. Faculty focus groups in Spring 2010 indicated strong interest in development of further modules on using effective graphics, writing in teams, and understanding engineering ethics. With support from the College EBB grant program, the TC program developed these new modules this fall with a plan to pilot them in spring 2011. The pre- and post-surveys, quizzes, and rubrics that are part of these modules will be used to assess student learning.

The TC Program is working to align faculty expectations and industry expectations by holding meetings with their Industrial Advisory board to analyzing student portfolios. A similar portfolio assessment workshop is planned with CoE faculty for January 2011.

While we are working toward more consistent expectations across the College, we are also carefully assessing our own required courses. For example, we are analyzing data on the numbers of students who take EPD 275 (Technical Presentations) before EPD 397 (Technical Communication), and finding that the data clearly show a benefit for students who take these courses in sequence.

In preparation for ABET 2012, the TC program has been revising our program mission statement, our course homepages, and the learning objectives for our core courses, particularly EPD 155 and EPD 397, which are required of most engineering undergraduates. We noticed during this process that the end-of-semester course evaluations – which we have used for many years – do not directly address some of our objectives. To address this weakness and gather more useful data about the effectiveness of our courses, this fall 2010 we added a new course evaluation for EPD 397 that will help us directly evaluate how well we meet the learning objectives. We are working on a website to share this assessment data with all departments.

### **Introduction to Engineering**

The Introduction to Engineering (InterEgr) program course offerings in CoE are intended to contribute to students' awareness of various engineering disciplines and the impact of engineering solutions in a global, economic, environmental, and societal context. InterEgr courses are to have specific objectives that contribute to the ABET outcomes relative to communication, teamwork, ethical responsibility, life-long learning and provide an overview of the engineering disciplines. Course directors are asked to provide the following information on an annual basis:

- CoE (or Dept) Educational Goals
- Relevant ABET Outcomes (a – k) *The program will provide students with...*
- Student Learning Outcomes
- Methods of Assessment
- Individual(s) Responsible for Assessment Activities
- Process for Using Assessment Results to Improve Program

### **Student Leadership Center**

The Student Leadership Center conducted a survey to learn more about student needs and current perceptions in the area of leadership skill development. The purpose of the survey is to obtain student input to help guide decisions on future programs and course offerings centered on leadership that will be meaningful and useful to students.

### **Conclusions and Recommendations**

The CoE Office of Academic Affairs examined various assessment management tools and approaches during the academic year with the intent of streamlining the collection and use of relevant assessment data for accreditation, evaluation of programs and student achievement, and for continuous improvement in the design and delivery of engineering education. This process has involved conversations with internal and external stakeholders and will hopefully result in a more efficient and effective process to gather and report on instructional decision making information in the learning environment to enhance the overall teaching and learning outcomes for students and faculty. The opportunity to connect resources across campus and tap the expertise of engineering educational partners and professional societies will further promote a sustainable culture of assessment within the CoE.

## Attachment A

### Engineering Beyond Boundaries 2009-2010 Projects

Project	Results
1. Modules for Data Acquisition and Experimental Measurements Development and Integration	Established commonality in software (Labview) amongst three departments (ME, CBE, CEE) and three courses. Developed several data acquisition modules
2. Engineering Communication Across the Curriculum: A Plan to Develop Online Modules and a Wiki to Supplement Communication Education in CoE	Developed four trial modules. These are being used in Tech Comm but implementation in other courses outside Tech Comm continues to be a work in progress.
3. Exploring Interdisciplinary Fluid Mechanics	A draft learning module for one specific subject (Conservation of Mass) was developed to allow evaluation of the feasibility of the project.
4. Removing redundancy in control theory-based courses in Mechanical Engineering and in Nuclear Engineering using eCOW2 and on-line streaming video	Report forthcoming
5. Developing a Coordinated Teaching Structure Between the Departments of EP and ME to Promote Enhanced Learning of Mechanics of Materials (EMA 303 and ME 306)	EMA 303 and ME 306 were coordinated with a common syllabus, common text book and common exams. Some common assignments have been used. Assessment was undertaken to evaluate satisfaction with on-line modules and active learning experiences.
6. Engineering and Biology: Technological Symbiosis Goes Online	Course developed, offered and approved as InterEGR 301. 14 students enrolled for Fall 2010.