

Objective of the innovation

Improve, expand and evaluate an existing effort in teaching interdisciplinary capstone engineering.

- Engineering students can be better prepared for industry and other careers if they are exposed to significant interdisciplinary experiences.
- Criterion 3 Student Outcomes (d) in the ABET accreditation requirements requires that engineering graduates must have a demonstrated ability to work on multidisciplinary teams [1].
- Interdisciplinary teams are more effective at achieving a desired outcome [2].

Description of the innovation

Faculty teaching the courses in bioengineering, electrical engineering and mechanical engineering collaborate to develop interdisciplinary design course.

- Each department maintains its own official course, requirements and instructor.
- The courses meet simultaneously approximately 75% of the time and share a course schedule, deadlines and deliverables.
- Students have an enhanced opportunity to work on interesting, real-world design challenges because of improved capabilities of interdisciplinary teams.

TABLE 1: TOPICS COVERED IN COURSE

Design process	Business planning
Communication & documentation	Elevator pitch competition
Intellectual property	Industry demonstrations
Leadership and teamwork	Life Cycle Analysis
Brainstorming	Engineering standards
Project management & planning	Design of experiments
Human factors in product design	Safety planning

Oshman Engineering Design Kitchen

12,000 ft² space for undergraduate students in all engineering departments at Rice University to design, prototype and deploy solutions to real-world engineering challenges.

Reducing the barriers for engineering design

Opened in January 2009. Primary goals for the facility were to:

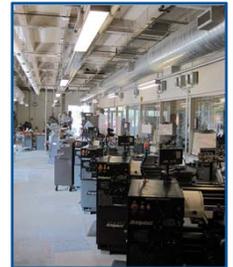
- 1) provide a space where undergraduate students from each of the 8 departments within the school could work on their engineering design problems
- 2) provide a venue for departments enhance opportunities for students to work on real-world, interdisciplinary design challenges
- 3) develop additional opportunities for younger undergraduates to participate in engineering design activities.



Oshman Engineering Design Kitchen; > 750 of the 1100 engineering undergraduate students use the OEDK annually



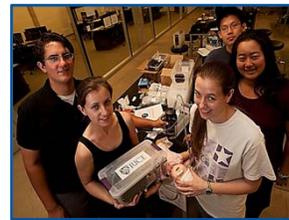
Design, build and test space in the OEDK. Student teams get assigned a table for the duration of their project.



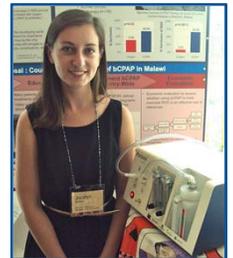
Machine Shop; Students learn to complete their own machining tasks



Collaborative capstone engineering design in action; Photo taken at 8:30 am when the 130 students from BIOE, ECE and MECH meet



Interdisciplinary team, Baby Bubblers designs a low cost bubble CPAP system for developing world clinics, May 2010



bCPAP system is completing clinical trials and has received a \$2M grant for country-wide dissemination to all central and district hospitals in Malawi.

Initial Results

Benefits:

- Increase in interdisciplinary teams (BIOE, MECH, ELEC) from 10-15% to 30% (Figure 1).
- An increase in quality and success of capstone design projects. (13/40 teams winning national or international awards in 2011, Figure 2).
- An increase in teams that have won national and international awards for their work. A majority of these award winning teams are interdisciplinary teams.

Limitations:

- Reluctance on the part of additional departments to participate in the combined capstone experience, reduces the scope of projects that can be tackled.
- Many of the students in these departments are requesting to work on projects offered in the collaborative capstone courses.
- It is absolutely critical that additional faculty and departments be willing and eager to participate because initially the work level increases and collaboration is hard work.

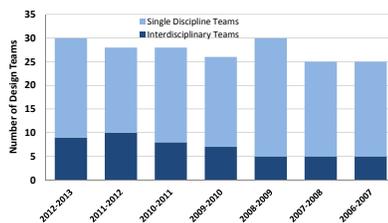


Figure 1: Number of single discipline and interdisciplinary teams for the time period 2006-2013.

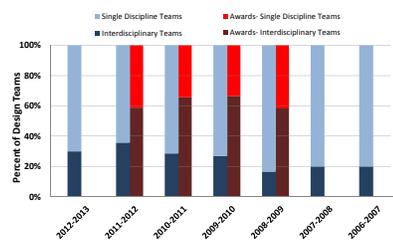


Figure 2: Proportion of interdisciplinary teams compared to the proportion of interdisciplinary teams that won major local, state, national or international awards for the time period 2006-2013. A much larger proportion of award winning teams are interdisciplinary.

Future Learning Activities

Develop additional collaborations across departmental lines in order to broaden to options for students to work in teams with students from multiple disciplines.

- Develop additional course modules that are pertinent to additional disciplines.
- Work closely with at least 2 additional departments in the school of engineering to develop plans and opportunities for interested students.
- Develop design project ideas that are real-world engineering challenges that cut across more disciplinary boundaries.
- Evaluate the benefit to students, if any, of this teaching approach.

REFERENCES

- 1] Engineering Accreditation Commission, Criteria for Accrediting Engineering Programs: Effective for Evaluations During the 2011-2012 Accreditation Cycle. ABET, Inc. 2010.
- 2] K. A. Jehn, G. B. Northcraft, and M. Neale, "Why Differences Make a Difference: a Field Study of Diversity, Conflict and Performance in Workgroups," Administrative Science Quarterly, vol. 44, no. 4, p. 741-763, 1999.