

## Northwestern Center for Engineering Education Research

### NCEER Newsletter No. 3

### January 25, 2010

#### News

➤ Four Northwestern engineering faculty members were selected by the National Academy of Engineering to participate in the first Frontiers of Engineering Education (FOEE) Symposium, a 2 ½ day event dedicated to enhancing engineering education, which took place November 15-18, 2009 in Herndon, VA. Eric Perrault (BME), Ann McKenna, Elizabeth Gerber and Todd Murphey (all of ME) were competitively nominated by their peers to attend based on their commitment to educational innovation. The focus of the FOEE program was on “effective ways to ensure that students learn the engineering fundamentals, the expanding knowledge base of new technology, and the skills necessary to be an effective engineer or engineering researcher.” The full list of participants can be found at: <http://www.nae.edu/16697.aspx>. NCEER is holding an open panel discussion about the symposium with the participants on February 4 at 12 noon in the Biomedical Engineering conference room (E311).

➤ The NU BME department, in conjunction with the BME department at Vanderbilt, has been awarded a summer REU program beginning in summer 2010 and running through 2012. This Site REU program is a follow-on to the successful REU associated with the VaNTH ERC (see below). Faculty mentors are needed to provide education research projects and supervise student work on them. Besides mentoring a student, this is an opportunity to obtain some assistance in improving a course. If you have an idea for an engineering education project you'd like to have an REU student work on with you next summer, please contact Mark Bourgeois at [m-bourgeois@northwestern.edu](mailto:m-bourgeois@northwestern.edu).



➤ Ann McKenna has been invited to serve as an Associate Editor for the [Journal of Engineering Education](#).

## NCEER Project Spotlight: VaNTH ERC Assessment

A comprehensive meta-analysis of many projects within the VaNTH ERC was published in the *Journal of Engineering Education* (JEE) in October, 2009. VaNTH was an interdisciplinary multi-site NSF Engineering Research Center, funded from 2000-2007. The institutions involved were Vanderbilt, Northwestern, UT Austin and the Health Sciences and Technology program at Harvard and MIT. Unlike all other ERCs to date, the VaNTH ERC was dedicated not to engineering research itself but to research in engineering education – particularly undergraduate education. Its mission was to apply the principles of challenge-based learning, whose value had been confirmed in research with pre-college students, to the engineering college classroom.

This article, whose first author is an assessment specialist at Vanderbilt, is thus the most comprehensive review of one of the largest recent engineering education interventions. Results from thirty-three separate modules in five different BME courses were evaluated. The primary question at issue was whether these challenge-based modules in fact enhanced student learning, and whether the benefits, if found, were replicable in other places, including very different institutional environments, and by other instructors.

In short, there were found to be major benefits to challenge-based instruction, and these benefits did transfer to other instructors and locations. However, one of the most notable results was the difference in enhancing students' transferable skills, versus their learning of facts and procedures. "Consistent with the HPL [How People Learn] framework, measures that focused on depth of understanding (e.g., transfer, adaptive expertise) consistently produced larger effects than those indexing the acquisition of facts, procedural skills, or lower-order content-based knowledge" (p. 346). Thus, challenge-based instruction was found to increase the ability of students to apply the skills learned to new but similar problems; however, it did not typically increase the transmission of straightforward factual knowledge as much. This is a logical result of the challenge-based strategy. *Journal of Engineering Education*, vol. 98 no. 4 (October 2009), pp. 335-348

## NCEER Project Spotlight: Malcolm MacIver CAREER Award



Mitra Hartmann of BME and ME, Robert Findler of EECS and Malcolm MacIver of BME and ME, have all received NSF CAREER awards. MacIver's biomedical research focuses on the interplay of biomechanics and the nervous system in organisms; for example, the interaction and control of an organism's limbs by the entire integrated nervous system, including sensory systems, peripheral nerves, and the brain. For the education component of his CAREER award, MacIver will focus on a basic conceptual blockage he sees frequently in teaching this material. Rather

than seeing the nervous system and body as a single interacting system, many students – not to mention the general public – intuitively see the brain as the exclusive, central controller and the rest as merely either an input or output system. This preconception results, he says, in “an inability to conceptualize mechanical functionality as a crucial component to understanding the nervous system.”

MacIver believes this pedagogical challenge is the result of a more basic cultural preconception: that the brain and/or mind is entirely distinct from the body, which is essentially its passive instrument. This bias, as he sees it, is deeply rooted in Western thought, and so it is the focus of public exhibits MacIver is creating under the award. The first is a proposal to update to an exhibit of electric eels at the Shedd Aquarium which will allow visitors to both visualize and hear the electric discharges of the eels, showcasing how the electrical discharge corresponds to the movement of the eels. A second effort is a collaboration with new media artists Marlena Novak and Jay Allan Yim of Northwestern. The installation will feature 16 tanks, each of which will hold an electric fish of a different species. Each species discharges its electric field at a unique frequency, from 30 Hz (lowest B natural on the piano) to 2000 Hz (G sharp six octaves higher). A visitor can use a remote control wand to cue the sound from each tank, allowing participants to fuse their sense of hearing with control of their movement.

Additional information on MacIver’s work is available at <http://www.neuromech.northwestern.edu/>

## NCEER Project Spotlight: CenterPiece Article on Mindful Design



The Fall 2009 issue of Northwestern’s Office for Research [CenterPiece](#) publication spotlighted curricular work conducted by several NCEER scholars, including Elizabeth Gerber, Ann McKenna, Penny Hirsch and Bruce Ankenman. The article describes recent efforts to integrate environmentally sustainable design thinking into our first year required engineering design and communication course, EDC. A pilot program was included in the course last Fall, and ideas for how to expand the effort into the entire course are under consideration.

## Upcoming Conferences and Events

- ❖ [Summit Series on Engineering Grand Challenges](#), Illinois Institute of Technology, Northwestern University, University of Illinois at Chicago, University of Illinois at Urbana-Champaign, and University of Chicago, April 21-22, 2010
- ❖ [ASEE Annual Conference and Exposition](#), June 20 - 23, 2010, Louisville, Kentucky

- ❖ The 40th Annual Frontiers in Education Conference (FIE 2010) will be hosted by The University of Virginia and Virginia Tech in Washington, D.C., October 27–30, 2010. For a list of paper formats and topics of interest, conference information and submitting an abstract, visit <http://fie-conference.org/fie2010/>.
- ❖ The International Network for Engineering Education and Research (INEER) is holding their annual ICEE Conference on Engineering Education at the Silesian University of Technology (SUT) in Gliwice, Poland on July 18-22, 2010. For more information, visit <http://www.ineer.org>

## Recent Publications and Community Resources

- ❖ “[Developing Metrics for Assessing Engineering Instruction: What Gets Measured is What Gets Improved](#)” provides a concise description of a process to develop and institute a valid and acceptable means of measuring teaching effectiveness in order to foster greater acceptance and rewards for faculty efforts to improve their performance of the teaching role that makes up a part of their faculty responsibility. Although the focus of this book is in the area of engineering, the concepts and approaches are applicable to all fields in higher education.
- ❖ “[Engineering in K-12 Education: Understanding the Status and Improving the Prospects](#)” reviews the scope and impact of engineering education today and makes several recommendations to address curriculum, policy, and funding issues. The book also analyzes a number of K-12 engineering curricula in depth and discusses what is known from the cognitive sciences about how children learn engineering-related concepts and skills. In addition, the [Fall 2009 issue of NAE’s The Bridge](#) was devoted to K-12 engineering education.
- ❖ [Over Two-Hundred Annotated References on Systems Thinking](#). Systems Thinking is characterized by the consideration of natural, scientific, engineered, human, or conceptual entities as systems in which the component parts interact with one another and with other systems so as to produce emergent properties which cannot be understood through analysis of the single parts of the system. References are given in alphabetical order with superscripts that indicate their origin in the following categories: Ecology, Economics, Education, Engineering, Evaluation, General, and Physics.
- ❖ NAE releases new report on engineering curricula. The National Academy of Engineering (NAE) has released a new workshop summary, “[Engineering Curricula: Understanding the Design Space and Exploiting the Opportunities](#).” The April 2009 workshop focused on exploring how engineering curricula could be enhanced to better prepare future engineers.

For questions, or if you have any engineering education news to share in a future newsletter, please contact Mark Bourgeois at [m-bourgeois@northwestern.edu](mailto:m-bourgeois@northwestern.edu). We are always interested in learning more

about any awards you have received, projects that have been funded, results from your research, or any other news that would be of interest to the community.

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