

Abstracts of the five proposals selected by the Engineer of 2020 Committee to receive seed grant funding for 2008

“Creation of an Instrument to Measure Selected Attitudes in Purdue’s Engineer of 2020”

Monica Cox

Abstract:

This seed grant proposes to study undergraduate engineering and uses a mixed methods approach to examine undergraduate students’ embodiments of the selected attributes. Using a mixed methods approach, the goals of this research are to (1) to identify, within academia and industry, observable outcomes that Purdue’s Engineer of 2020 should demonstrate for three targeted attributes (“leadership,” “recognize and manage change,” and “synthesize engineering, business, and social perspectives”); and (2) to design, develop, and validate an assessment instrument of the identified outcomes. The results of this study will serve as the basis for the development of seminars and workshops, the inclusion of undergraduates in summer and academic-year research projects, and the creation of a new course aligned with the attributes targeted within this proposal. This research engages a variety of stakeholders (i.e., engineers in industry, engineering faculty, engineers in academia; and undergraduate students) in an empirical study of undergraduate engineering education. The proposed tool may be used to collect data which might be parsed by a variety of variables (e.g., gender, ethnicity) in an effort to note the similarities and differences in the current states of Purdue’s Engineer of 2020 attributes. Although several of the Purdue 2020 attributes have been explored via existing centers and initiatives, this research is innovation because of its exploration of leadership and change-- topics that are not explicitly taught or researched at the undergraduate level within the College of Engineering.

“Multidisciplinary Insights for Learning Engineering Aerospace Design (MILEAD)”

Daniel DeLaurentis

Abstract:

As the body of collective human knowledge expands, innovators are increasingly becoming specialized to achieve new breakthroughs (e.g., micro-sensors, smart bio-devices). However, the key to innovation in large-scale *complex systems* lies in the ability to synthesize individual specialties, often across diverse disciplines. Thus, the best complex system design engineers in the next generation must be the best system integrators and multidisciplinary collaborators.

The PE 2020 Committee identifies *target attributes* for students facing the challenges of the twenty-first century. In addition to the technical skills, these target attributes include teamwork, and communication skills as well as abilities to synthesize engineering, business, and societal issues. Successful synthesis requires sensitivity to the other’s perspectives along with the ability to identify connections to allow new ideas to emerge from the team. Our conjecture is that this ability can be intentionally developed through traditional academic learning environments **and** in virtual worlds.

The effective use of virtual environments in this new design setting largely remains beyond reach, and the knowledge of how learners exploit collaboration among peers and with experts in such environments is poorly understood. In this project, we will focus specifically on the efficacy of expert experience by faculty and advanced students on the complexities of design. Our focused activities in this project leverage our concurrent effort to develop and teach an engineering design course in a Serious Game format. We design and evaluate our approach using our expertise in education theory and methods, particularly in the area of technology-supported teaching and innovation.

With these goals in mind, we will develop a new digital library created and shared by a network of instructors, students, departments, and industry experts via web portals and virtual worlds. The use of cyber-infrastructure could connect students directly to experts and peers to support their learning the art of design practice more effectively. The rich digital library we envision needs to be seeded with educationally appropriate resources to demonstrate its potential for intentional learning at the undergraduate engineering level. Specifically, we aim to illustrate the potential for using video interviews with experts from faculty, industry and senior undergraduates to develop learners’ critical ability to identify and synthesize their ideas with others.

"Student's Attitudes and Threshold Concepts Towards' Engineering as an Environmental Career: Research by Participatory Design of an Educational Game"

Inez Hua and Johannes Strobel

Abstract:

Environmental issues are not just a concern for the end-user, but provide a challenge and a growing niche market for many engineers and engineering companies. Despite the growing importance, recent surveys show that the general population and engineering students (a) lack basic environmental knowledge and (b) agree that the topic is very important. This project aims to research attitudes and threshold concepts (or gatekeeper concepts) of incoming first-year engineering students in regards to the relationship of environmental issues and engineering. The project utilizes an innovative elicitation technique: in a participatory process, students will co-design an educational game to teach product life cycle assessment to high school and first-year engineering students. Results can inform educators and administrators on where to prioritize in order to maximize impact on students' learning.

“Spiraling Towards 2020: Project Centered Multidisciplinary Spiral Curriculum as a Model for Developing Purdue’s Engineer of 2020”

Martin Okos, O. Campanella, Neal Houze, J. Lister, Nate Mosier, David Radcliffe, Bernie Tao

Abstract:

Since the late 1990’s, fewer students are enrolling in engineering, both nationally and at Purdue University (Engineering workforce commission). Engineering education is facing a pivotal time as it seeks to reverse these trends. This proposal focuses on attracting and retaining students by enhancing their understanding of the relationships between engineering and its impacts on real world needs/challenges through the development of project-based spiral curricula.

This project begins with the hypothesis that a project centered spiral curriculum is an exciting way to effectively incorporate Purdue’s Engineer of 2020 Target Attributes in many of the College’s engineering programs. PE2020 offers graduates the characteristically strong technical foundation along with a dynamic set of ‘soft skills’ which are not traditional hallmarks of an engineer.

The specific objectives of the project include: A) to critically evaluate project centered and spiral curricula from other institutions and their ability to be transferred to the Purdue environment; B) to develop, teach and evaluate two prototype courses in BFPE and Chemical Engineering that demonstrate the integration of a select number of targeted PE2020 attributes in practice; C) to design a prototype project based spiral curriculum that incorporates the target attributes of the Purdue University Engineer of 2020 into the BFPE program; D) to develop a “lessons learned” data base to guide CoE in wider adoption of spiral curriculum by a) forming a CoE advisory group ,who will assist in assessing outcomes, b) by progressively evaluating the operation of courses using reflective instruments by faculty and students with assessment by advisory group, and c) by presenting results at regional and national meetings; and finally E) to seek funding from outside sources such as from foundations, USDA, and NSF.

“The Engineer as an Entrepreneur: Using Case-Driven, Problem-Based Learning to Develop Adaptive Expertise”

Joe Sinfield, Robin Adams, Aman Yadav

Abstract:

The primary **objective** of this project is to develop a series of 5 – 7 case-based instructional modules that leverage entrepreneurial contexts to convey key lessons that will help engineering students develop many of the attributes sought in the Engineer of 2020.

Project approach

To achieve the stated objective, emphasis will be placed on three primary activities:

1. Identify business cases that exemplify and encourage the practice of specific attributes sought in the Engineer of 2020 (emphasis will be placed on leadership; teamwork; communication; decision-making; management of change; working effectively in a diverse teams; examination and response to engineering, business, and societal perspectives; building analytical skills to approach unstructured, open-ended problems; Innovativeness; entrepreneurial and intrapreneurial capabilities; and demonstration of Continuous, adaptable learning).
2. Develop case content, teaching approaches and supporting materials that enable modular communication of key concepts.
3. Pilot case study formats in select student settings to gauge their effectiveness and inform the formulation of a case teaching program relevant across the College of Engineering. Pilot settings will be strategic so that we can assess the extent to which these cases can be scaled up for the broader cross-section of educational experiences present at Purdue.