



ANNUAL REPORT FOR AWARD # 0722221

Michigan State University

CPATH CB: Computing and Undergraduate Engineering: A Collaborative Process to Align Computing Education with Engineering Workforce Needs

Participant Individuals:

CoPrincipal Investigator(s) : Jon Sticklen; Daina M Briedis; Mark Urban-Lurain; Neeraj Buch

Post-doc(s) : Claudia E Vergara

Other -- specify(s) : Mark Jenness; Peter Vunovich

Senior personnel(s) : Louise Paquette; Jeannine LaPrad; Cindee Dresen; Taryn MacFarlane; Gary Yakimov;

Tammy Coxen; Lisa Katz; Kysha Frazier

Participants' Detail

Partner Organizations:

Corporation for a Skilled Workforce: Collaborative Research; Personnel Exchanges

The CSW team brings extensive experience leading workforce development change at the national, state, and local level. CSW has undertaken projects in 45 states and hundreds of communities across the country, helping to align workforce, community and economic development strategies.

On this project, CSW is supporting overall management of the Mid Michigan Innovation Team (MMIT)/ Workforce Innovations in Regional Economic Development (WIRED) initiative, with specific emphasis on governance, connecting new partners, communications and facilitation aimed at shared learning, public choice making, and structural transformation. They are part of the core group involved in the planning and implementation of the project, including:

- * identifying key partners and advisory board members
- * developing employer engagement strategies
- * designing employer interview protocols and employee survey instruments
- * conducting employer interviews

Lansing Community College: Collaborative Research; Personnel Exchanges

Lansing Community College (LCC) has a long history of partnering with private and public industries in Michigan. Because the CSPACE project addresses the range of engineering workforce needs from engineering technical staff to engineers, LCC plays a crucial role by preparing two-year associate degree students in engineering technology and as a feeder school for the MSU Engineering four-year degree programs.

Western Michigan University: Collaborative Research; Personnel Exchanges

The Science and Mathematics Program Improvement (SAMPI) group at WMU is providing evaluation and assessment of the project. SAMPI has extensive experience evaluating STEM higher education and K-12 education projects, including those focused on engineering and technology, and has worked with the MSU College of Engineering on previous projects.

Other collaborators:

Albert Joseph Turner, Jr. is a consultant to this project to ensure alignment with the evolving Computing Sciences Accreditation Board (CSAB) accreditation criteria. Dr. Turner has served as the Chair, Computer Science Accreditation Commission (1988-90); President, Computing Sciences Accreditation Board (1991-93); Executive Committee Member and Training Chair, Computing Accreditation of ABET (2005-present); and Chair of 14 evaluation teams for ABET and CSAB. He has consulted on academic programs for Boeing Corporation and on 14 program evaluations for individual universities and seven for state higher-education agencies.

Activities and findings:

Research and Education Activities:

A fundamental objective of the project is to develop a process that creates partnerships within and among academic institutions, industry, professional engineering societies, and the engineering workforce that have a stake in undergraduate computing education. We are collecting data on all project activities and using that data as part of both internal research and in collaboration with an external evaluator to better understand what aspects of the process contribute to, or inhibit, success. We anticipate the results of this process should be transferable to other academic institutions and workforce stakeholder groups.

The specific project goal is to demonstrate the process in the context of meeting engineering needs for computational problem solving. We envision revising curricula across courses in multiple engineering departments to incorporate computational problem-solving tools within the various disciplinary contexts. From there, graduates enter the workforce, bringing the improved computational problem-solving knowledge and skills.

Activities

During the first year of the project we brought together representatives from the various stakeholders to identify specific workforce computational skills. This advisory board (AB) group is charged with refining and implementing the process for involving a wider group in dialogue and community building. The AB consists of 14 representatives from a cross-section of engineering and computing technology stakeholders, including academia, engineering societies, business/employers and workforce and community/economic development experts. The AB is coordinating the effort to identify and engage a larger group of organizational representatives who have a stake in the future of computing skills within the engineering and technology fields. These representatives include engineering and technology company executives and human resource professionals.

An important part of the process is the development of protocols to engage stakeholders as well as the development of survey and interview tools. A major research activity has been the development of employer interview protocols and employee surveys. The interview targets stakeholders at engineering and technology companies in the region and the surveys target both employers and engineering/technical employees within the Mid-Michigan region.

To date, this activity has included pilot interviews with several engineering firms and governmental agencies representing a broad scope of engineering disciplines and business sectors. The results of the interviews are being used to revise and fine-tune our interview protocols as well as inform employee survey development.

The Corporation for a Skilled Workforce (CSW), one of the partners on

the grant, has been instrumental in developing sampling frames based on U.S. Department of Labor statistics of various industry segments and employment breakdowns for four-year engineers and two-year engineering technicians.

CSW has also worked, via their participation in the WIRED initiative, on building community relationships with a wide variety of mid-Michigan employers for interviews and surveys.

A major component of our community building effort is to bring together diverse stakeholders from academia, industry and the public sectors. These stakeholders are not only from different sectors, but are physically distributed. We are exploring the use of Web 2.0 technology, particularly Wikis, as a means of collaboratively developing our research protocols, data storage and analysis and communication. We also utilize video conferencing facilities to reduce travel and facilitate team building.

The Science and Mathematics Program Improvement (SAMPI) group at Western Michigan University is conducting the evaluation for CPACE. The SAMPI-Western Michigan University external evaluation team has completed the following evaluation activities during the first year of the project:

- Attendance at five management team meetings
- Attendance at/observation of April 2008 Advisory Board Meeting
- Reviewed and provided feedback on employer interview protocol, employee survey, employer recruitment brochure, and other documents as requested
- Monitored/reviewed communications among management team and documented/verified project activities through electronic Dashboard
- Regular email and electronic Dashboard communications with project PIs and management team members

Findings:

Using the data collected during the pilot interviews we have been able to revise and improve our interview protocol in ways that allow us to identify the key computational skills used in each company by focusing specifically on the mission-critical computational tools. By concentrating on each company's mission-critical technology, we hope to find the common computational themes that cross disciplinary boundaries.

The pilot interviews to date have informed our sample representation in terms of type of company (size, sector) and engineering discipline.

As part of the pilot phase of the research, we are developing a protocol for engineering faculty to review the interviews to identify the computational problem-solving skills and principles that are represented in the interviews.

Training and Development:

The project includes a postdoctoral researcher who is gaining valuable experience in social science and education research.

Outreach Activities:

This project is a collaborative effort to bring together a community of stakeholders and academics around the issues of computing education to better prepare students for employment within engineering and technology fields. A major expected outcome of this project is the development of a dynamic process that documents every step of the research from engaging the different stakeholders to implementing a process for curricular reform. The detailed documentation of the process is crucial to achieve this outcome. One of the tools that we are using is a Wiki webpage (<http://cpace.egr.msu.edu>)

which is a collaborative, dynamic media. The Wiki web page has a public domain that explains the scope of our project.

Our advisory board is a crucial component of our outreach strategy. They are assisting us in implementing engagement strategies so that we have optimal success creating outlets for public awareness and data collection from employers.

We plan to facilitate engagement opportunities that will allow employers to communicate with one another, members of the steering committee, faculty, and other project stakeholders about the outcomes of this project. These opportunities will also allow employers to engage with higher education institutions, promote faculty buy-in through cognitive institutionalization, and facilitate collaboration to improve undergraduate computing education.

Journal Publications:

Claudia E. Vergara, Mark Urban-Lurain, Daina Briedis, Neeraj Buch, Jeannine LaPrad, Louise Paquette, Jon Sticklen, Thomas F. Wolff, "Work in Progress - Computing and Undergraduate Engineering: A Collaborative Process to Align Computing Education with Engineering Workforce Needs (CPACE).", *ASEE/IEEE Frontiers in Education Conference*, vol. 38, (2008), p. F4A-15., " " Accepted

Book(s) of other one-time publications(s):

Other Specific Products:

Recruiting brochure

We developed a brochure we use to help recruit employers to interview and engineers to survey.

We distribute the brochure to our Advisory Board and to prospective employers and working engineers. We also make a PDF of the brochure available on our web site (<http://cpace.egr.msu.edu>)

Internet Dissemination:

<http://cpace.egr.msu.edu>

We are using a Wiki, which is a collaborative, dynamic media. The Wiki is used to keep a detailed record of all the discussions and meetings between the collaborators in the project, these records are used as raw data from which we extract and analyze important information and conclusions to document not only the final findings, but the process by which these findings emerged.

The Wiki has three "spaces:" 1. a Public space with information about our project; 2) a Project Staff space used for research, data storage and analysis and communication among project team members; and 3) an Advisory Board space for communication among and with our Advisory Board members.

Contributions:

Contributions within Discipline:

Please see the uploaded PDF file:
CPACE - Contributions to Discipline - annual report.pdf

Contributions to Other Disciplines:

While the model is being developed specifically in the context of computational problem-solving in engineering, we anticipate that the process we are developing could be applied to other disciplines to better articulate curriculum with the needs of various stakeholders. For example, in biological sciences, the research to find alternative energy will need to be aligned with industrial processes in order to move ideas from the laboratory into efficient industrial process. By engaging the various stakeholders in the curriculum development process, it may be possible to better prepare future graduates for these evolving workplace needs.

Contributions to Education and Human Resources:

Improving relevance should improve retention among all groups, but may have a additional impact on underrepresented groups. For example, Seymour & Hewitt found that women and minorities often leave STEM disciplines because they do not see the relevance of the courses and question their involvement in STEM disciplines. By improving the articulation with workforce needs and aligning the curriculum to better represent the computational problem-solving that engineers will need, we expect all students - and particularly underrepresented groups - to benefit and anticipate improved retention in engineering among these groups.

The entire project focus is on Human Resource Development, rather than on basic science or engineering research. By focusing on improving curriculum in a context that connects to the workforce and other stakeholder needs, we are extending the usual sphere of influence for curriculum beyond the academy. While the direct beneficiaries of these efforts will be engineers and employers who hire them, we see the partnerships that are being developed among stakeholders as being crucial to broadening the human-resource base for science and technology.

Contributions to Resources for Science and Technology:

The project goal is to institutionalize the process so that curricular change includes a wider group of stakeholders. This project is reinforcing the relationship between Michigan State University (MSU) and Lansing Community College (LCC). By extending the range of stakeholders, CPACE can advance LCC technology programs to appeal to a broader audience of underrepresented groups and increase the likelihood that their graduates will be marketable. It also can improve the transfer rates from LCC to MSU for students to complete B.S. engineering degrees at MSU.

Another result of the closer relationship between MSU and LCC is the recent successful STEP proposal (NSF DUE 0757020) in which many of the same team members from MSU and LCC are collaborating to improve retention in engineering. LCC will be playing a pivotal role in this project by sharing their extensive experience with Supplemental Instruction and training MSU faculty to implement a Supplemental Instruction program at MSU.

Contributions Beyond Science and Engineering:

For engineering education to prepare graduates to flourish in a new global economy, innovation and flexibility in curricular design based on constituency input and quality improvement principles is necessary. However, curricular change in higher education requires faculty buy-in through cognitive institutionalization. Faculty must perceive the reforms as 1) consistent with the principles and concepts of their disciplines and 2) as part of the norms accepted by other faculty. Therefore, reform efforts must emphasize engagement of higher education and higher education engineering and computer science

faculty in the process of regional economic change and school-to-work education.

The process developed in this project will ensure that a wide variety of stakeholders - business, community leaders and post secondary educators - collaborate to identify workforce computational skills, define how these skills can be integrated across a curriculum, and develop revised curricula that integrates computational problem-solving across engineering departmental courses. By documenting, evaluating, and making the process explicit, it can serve as a model for national efforts to revitalize undergraduate computing education in engineering, and should be extensible to other computing education reform efforts.

Special Requirements for Annual Project Report:

Categories for which nothing is reported:

Products: Book or other one-time publication

Special Reporting Requirements

Animal, Human Subjects, Biohazards



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