Second NSF Workshop on Science Education in Computational Thinking
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Mark Urban-Lurain
urban@msu.edu

CPACE

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

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CPACE Goals

- Bring together academics, business and industry, professional organizations
- Create a collaborative process to redesign undergraduate computing curriculum
- Document and evaluate the process
- Prepare CPATH Transformation grant proposal to implement redesign of computing education in engineering programs
Collaboration from the Start

- Four year engineering programs
  - Michigan State University
- Two year transfer and technical programs
  - Lansing Community College
- Engineering employers
  - Corporation for a Skilled Workforce
    - Workforce Innovation in Regional Economic Development (WIRED)
    - Mid-Michigan Innovation Team (MMIT)
- Evaluation
  - Science and Mathematics Program Improvement (SAMPI) at Western Michigan University
Transformation Model

Abstract computational principles

Align principles with computer science concepts

ID opportunities for curricular integration

ID Specific workforce computational skills

Implement Computational problem-solving curricula

Education Stakeholders

Accreditation Stakeholders

Business Stakeholders

Community Colleges & Universities

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Community Colleges & Universities

MSU CSW LCC WMU

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Anticipated Outcomes

- Develop engagement process
- Identify and engage stakeholders
- Collect data about workforce computational needs
- Identify key computational problem solving skills
- Abstract computing principles and concepts aligned with computational problem solving skills
- Disseminate findings
- Evaluate the project model and prepare reports of each phase of the activity
- Submit full implementation NSF CPATH Transformation grant
Current Status

Align principles with computer science concepts

ID opportunities for curricular integration

Implement Computational problem-solving curricula

Abstract computational principles

ID Specific workforce computational skills

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Community Colleges & universities

ABET CAC MMIT WIRED

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Summary of Preliminary Data

- Employer interviews
  - Seven pilot interviews
  - Six interviews with companies represented by the AB members

- Focus: Role of technology and computation to meet engineering challenges
Summary of Preliminary Data

Current Engineering Practices

Future of Engineering

Computational Aspects of Engineering
Current Engineering Practices

- Communication skills.
  - Ability to organize and present data
- Team work
- Critical thinking
- Innovative thinking
- Problem solving; (both conceptual and operational)
- Ability to learn/adapt/multitask
- Ability to move between abstractions in software and physical systems
- Understanding principles, application and limitations of computational tools
- Need basic computational skills
- Using technology to collaborate across/outside organization
- Using tech to support broad problem solving and decision making
- Understanding business practice
Computational Aspects of Engineering

- Multiple CAD programs including 3D modeling
- Process simulation packages
  - Design to manufacturing
- Numeric computational platforms
  - e.g. MATLAB, MATHCAD, Mathematica, MAPLE, PolyMath
- Software collaboration tools
- Project management software
- Excel (high level capabilities)
- MS Office
- Knowledge of some programming
  - (e.g. Visual Basic)
- Facile with multiple software systems
Future of Engineering

- Corporate development, leadership, management skills
- Increasing integration of engineering data across larger systems (i.e., logistics & ordering)
- Globalization
- Design for the Environment (DFE)
- High computational level
  - Programming to an end result
- More experience in R & D
  - New applications for existing materials
  - Material development
  - Electronic communication
  - Next generation of technology?
  - Increasing use of simulation to reduce materials usage in design phase

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Process Lessons So Far

- About the value and effects of the CPACE partnership
  - Each partner brings skills and resources to the project
  - Effectiveness of collaboration when core outcomes and implementation strategies were understood by everyone
  - Considering needs of all partners strengthens partnership

- About collaborating to develop/pilot project materials
  - Establishing “rhythm” takes time
  - Data collection instrument development took a lot of time

- About conducting interviews/surveys
  - Value in broadening number and kinds of participants
    - Engineers must be included in the interviews
  - Interviewees very willing to share ideas, insights, and perspectives
  - Advisory Board provided entré to participants
CPACE Team

Michigan State University

Thomas F. Wolff
Mark Urban-Lurain
Jon Sticklen
Daina Briedis
Neeraj Buch
Claudia Vergara

CSW

Jeannine La Prad
Cindee Dresen
Tammy Coxen
Kysha Frazier
Taryn MacFarlane

Lansing Community College

Louise Paquette

Western Michigan University

Mark Jenness
Pete Vunovich

Award Number 722221
Questions?

- Mark Urban-Lurain
  urban@msu.edu

- http://cpace.egr.msu.edu

- cpace@msu.edu