Prototype to Production (P2P): Conditions and Processes for Educating the Engineer of 2020
NSF DUE-0618712
Website: http://www.ed.psu.edu/educ/e2020/p2p

Study Origins: NAE’s Engineer of E2020
A vision of the contexts for engineering in 2020:
• Dynamic technological environment
• Complex societal, global, and professional contexts

Attributes of the Engineer of 2020
• Strong analytical skills
• Practical ingenuity
• Creativity
• Communication competencies
• Business, management, and leadership skills
• High ethical standards and professionalism
• Agility, resilience, flexibility

Expected Outcomes of the P2P Study
Goals
• Provide baseline portrait of engineering education and its readiness to produce the engineers of 2020
• Identify educational practices and conditions in 2–4-year institutions that promote learning
• Identify learning–related differences in the experiences of women and underrepresented students
• Develop a comprehensive map of in- and out-of-class experiences influencing student learning
• Validate a conceptual model for future engineering and education studies

Use Prototype-to-Production Study (P2P) to:
• Provide a quantitative, nationally representative comparison for six detailed, qualitative case studies
• Triangulate findings of case studies
• Validate hypotheses regarding effective practices identified in case studies

Conceptual Framework

Survey Development

Methods
Four-Year Institutions
• Population
  • All schools with at least two ABET-accredited undergraduate programs in:
    • Biomedical or bioengineering
    • Electrical engineering
    • Chemical engineering
    • Civil engineering
    • Mechanical engineering
  • Sampling Design
    • 6 X 3 X 2 disproportional stratified random sample
    • 6 disciplines
    • 3 levels of highest degree offered (bachelor’s, master’s, or doctorate)
    • 2 levels of control (public or private)
    • 9 pre-selected institutions to ensure inclusion of:
      • 6 case study sites from companion study
      • 3 institutions with general engineering programs

Community Colleges
• Sampling Design
  • Purposeful selection of 15 community colleges with the largest numbers of students transferring to a four-year engineering program

Sample and Response Rates

Sample Findings: Interdisciplinary Skills
This Analysis and Interpretations
• Aspects of the curriculum and co-curriculum contribute to interdisciplinary skills
• A greater emphasis in P&T on education research and related activities may reduce faculty time to incorporate other disciplinary perspectives in their courses
• Active learning pedagogies promote the sharing of multiple perspectives through small group activities
• Faculty attitudes toward curricular breadth affect course content and may prompt faculty to urge certain kinds of co-curricular involvement
• Significant relationships differed by engineering sub-discipline (not shown)

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Sample Analysis: Interdisciplinary Skills
Variables
• Interdisciplinary Skills: how well students apply perspectives from multiple fields
• Student–reported experiences: curriculum, co-curriculum, pedagogies, climate
• Faculty–reported institutional practices: promotion/tenure, grading practices, instructional methods, attitudes toward ugrad engineering, curriculum planning

Analysis
• Multiple linear regression
  1. Relate student experiences to interdisciplinary skills (MI in this example)
  2. Relate institutional practices to significant student experiences

Sample Participating Four-Year Institutions (n=32)

Survey Participating Two-Year Institutions (n=5)

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