A Revolution in Engineering Education Motivated by Needs and Designs

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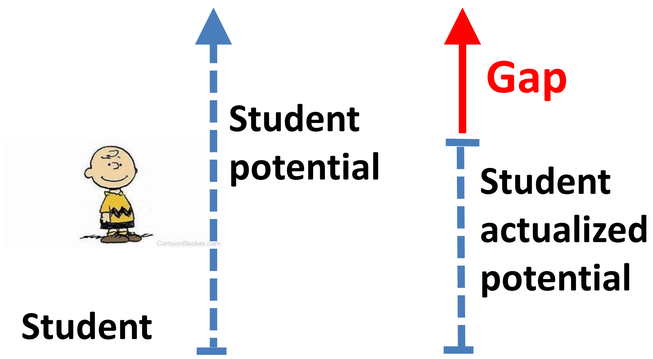
Problem: Students do not actualize their full potential as engineers.



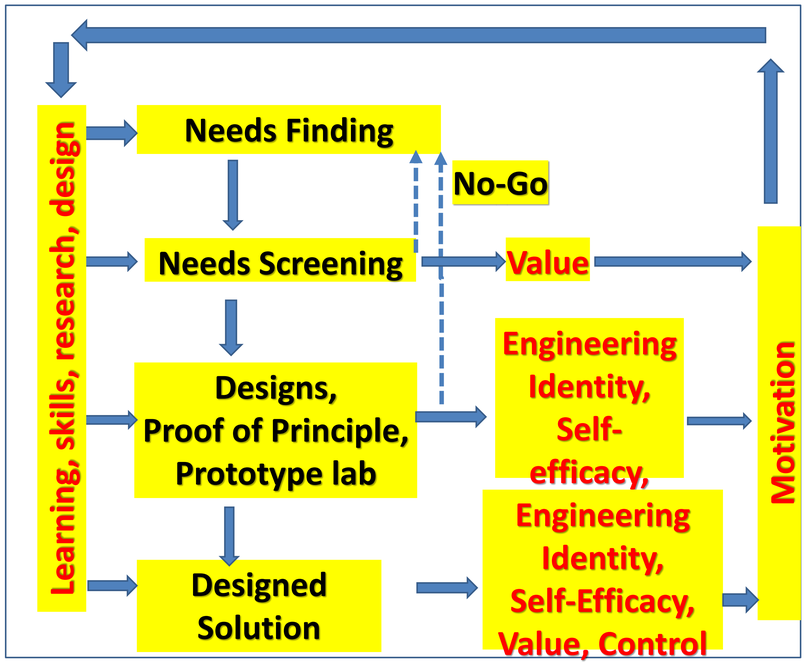
- **Hypothesis: Identifying needs and designing solutions will activate and enhance *learning motivators*:**

- Understanding of ***design in engineering*** as a response to external ***need*** (i.e., control of outcome)
- ***Value*** learned skills/knowledge in engineering to enable design of solutions
- Belief in ***self-efficacy*** as solver of real problems
- Growing ***identity*** as a professional engineer

Theory: Bronfenbrenner's Bioecological Model of Process-Person-Context-Time

Change Strategy: Step 1: Emergent and Step 2: Environmental

Experiment: Create a 4-year continuum of needs and designs in bachelor's programs



Year 01 Action Items

- **Curriculum changes** and approval (added 16 CH of laboratories)
- **Multidisciplinary** faculty (sciences and engrg)
- Two new **post doctoral** appointments
- Assessment measurement **instrument development** and testing
- Design Fellows Program (1): **Undergraduates**
- Design Fellows Program (2): **K-12 Teachers Professional Development** Workshop
- Industrial design mentors with **"reverse internships"** on campus
- Culture of **innovation and entrepreneurship**
- **Scholarship** and reporting

Year 01 Results

CURRICULUM CHANGES for Bioengineering (n=12 labs)

POST-DOCS Recruited (*n* = 2)

FACULTY SCHOLARS Teaching Innovation Scholarships (*n* = 9)

UNDERGRADUATE DESIGN FELLOWSHIPS (*n* = 8)

K-12 TEACHER PROFESSIONAL DEVELOPMENT *n* = 12 (female *n* = 10; male *n* = 2); ages 36-45, in the teaching field 11-20 years, Workshop offered CE credits.

Selected Teacher Comments/Impact

- I learned how to ask those probing questions, spark critical thinking and collaboration
- Learning the engineering design process and integrating that into my own curriculum is what I found to be most valuable.
- Going through the design process as a whole was rewarding. I am eager to use this program and tailor it to my classroom.

ASSESSMENT INSTRUMENT DEVELOPMENT (*n* = 262 students)

Engineering Values Scale (EVS): 8-items
PCA, 1 Component-54%, α = .865: *e* = .267

Engineering Self-Efficacy Scale (ESES): 6-items PCA, 1 Component-58.8%, α = .851: *e* = .276

Engineering Identity Scale (EIDS): 9-items PCA, 2 Components-47% & 19%, α = .857: *e* = .266

Engineering Activities Index (EAI): 6-items

Year 02 Plan

- Measure efficacy of design instruction for 12 classes and labs
- Curriculum changes for Biological and Chemical Engineering
- NCAT Faculty Teaching Innovation Scholars Program
- Post-docs create and teach new courses and labs
- Design Fellows Programs for Undergraduates and K-12 teachers
- Enhance and refine "reverse internship" experience
- Measure innovation risk with go / no-go decisions
- Continued scholarship and reporting

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