COE Freshman Year Experience Initiative for Next Generation Vandal Engineers

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Overview

This initiative seeks to implement a shared first year experience for engineering students in all disciplines that equips them for academic success in future STEM courses and that engages them in meaningful personal development as well as career exploration. The proposed freshman experience course adopts best practices in current discipline-based introduction to engineering offerings and is anchored in seven competencies prescribed by the National Association of Colleges and Employers (NACE). NACE competencies include critical thinking/problem solving, oral/written communications, teamwork/communication, digital technology, leadership, professionalism/work ethic, career management, and global/inter-cultural fluency (2020). This project is synergistic with the College of Engineering's Strategic Plan for Diversity and Inclusion that received commendation as an 'exemplar program' in an inaugural program review held by the American Society of Engineering Education (ASEE). For the last six months, faculty leads in all UI engineering departments and from regional transfer institutions have collaborated on a common FYE course design and delivery. Pilot implementation in existing disciplinary courses is scheduled to occur during the 2021-22 academic year followed by a college-wide FYE course (2 credits). A proposal for the latter will be forwarded to College Curriculum Committee for approval in September 2021 with full adoption expected in 2022-23.

Rationale

UI plays a central role within the state/region in raising awareness of STEM careers, partnering/collaborating with high schools and two-year institutions in STEM curriculum development/delivery, and providing opportunities for hands-on learning in conjunction with a wide variety of industry partners. The COE Freshman Year Experience is part of this continuum and it serves as a bridge to academic as well as workforce success for all engineering students. It will leverage our robust industry connections represented in department/college advisory boards, provide authentic, hands-on learning experiences intended to improve performance in pre-engineering coursework, and engage leaders from COE student organizations. Professional development and peer coaching is planned for faculty, staff, and mentors involved in the program as well as those involved in follow-on ENGR courses.

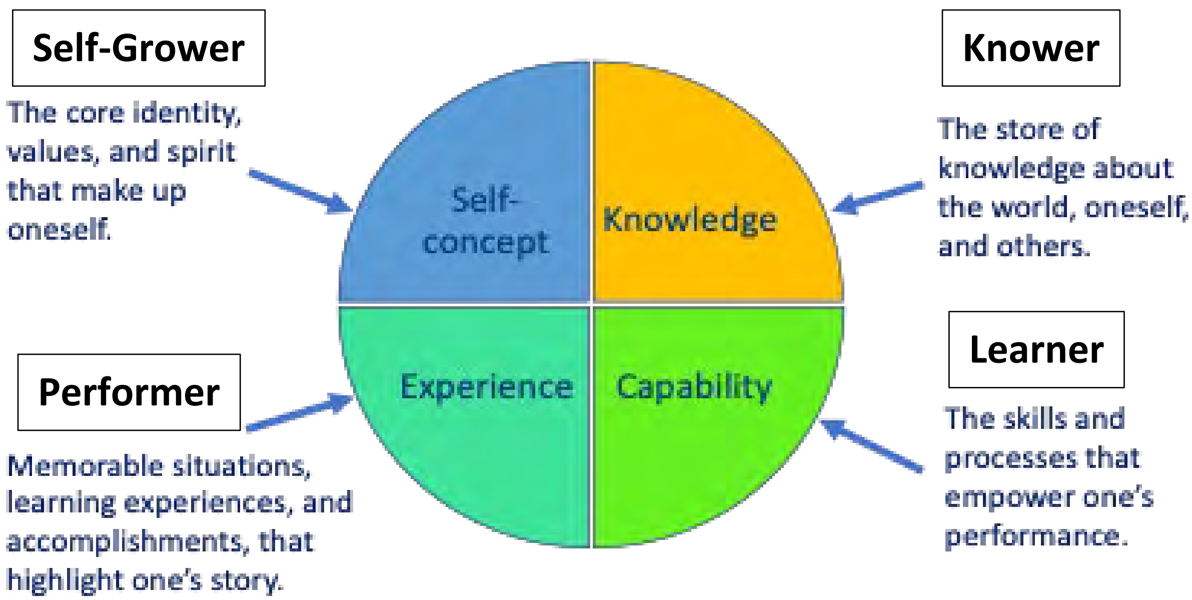
Educational Model

FYE principles articulated by Upcraft (2004) are adopted in our initiative: **Multi-Disciplinary Learning Activities** that affirm selection of one's major and stress identity formation as well as reinforce STEM knowledge/skills; **Hands-on curricular and co-curricular experiences** that help students find a 'home' while engaged in authentic engineering performances; **Digital Resources** that include course management tools, information processing techniques, just-in-time videos, and computational proficiency needed in STEM disciplines; **Student-Centered Advising** that validates cultural background as well as personal/career vision, resulting in a credible academic pathway for realizing success given one's circumstances/history; and **Relationship-Building** that results in enduring friendships with peers as well as one or more instructors.

Our initiative seeks to grow the capacity of the institution for higher levels of diversity and inclusion outcomes in teaching/advising, scholarship, and service. Rather than pursuing strategies that focus on an isolated population of engineering learners, we want to enhance the educational experience of all engineering students. We will apply best practices in engineering education to impact groups underrepresented in engineering as well as those overrepresented in engineering.

Our model for student development is based on transformation of the whole self that includes balanced attention to growth of academic identity, mastery of STEM knowledge, cultivation of life-long learning capabilities, and culturally relevant authentic learning experiences. Figure 1 portrays personal and professional development as a synthesis of these four aspects that are identified with roles of knower, learner, performer, and self-grower.

Figure 1: Holistic Model of Personal and Professional Development



<u>Learning Outcomes</u>

These coalesce under the four roles shown in Figure 1.

Knower outcomes include:
* Use mathematical principles and appropriate software tools (EXCEL) to do functional graphing, data analysis, and system modeling
* Develop knowledge/skill related to unit analysis, unit conversion, and balance equations that will enhance performance in future STEM/ENGR courses
* Navigate a Learning Management System to access and internalize online resources needed for academic and career success

Learner outcomes include:
* Find and validate solutions using assumptions, estimation, equations, and units
* Cultivate quality documentation skills (emails, graphs, tables, diagrams, sketches, homework, technical reports, and presentations)

* Enhance skills that promote productive team work
* Develop habits conducive to becoming a successful college student

Performer outcomes include:
* Practice cooperative learning/problem solving (through class activities)
* Prepare for and take exams/quizzes involving STEM concepts
* Engage in a successful team-based design project
* Write a meaningful Professional Growth Paper (w/resume & alumni interview)

Self-Grower outcomes include:
* Make an informed decision for pursuit of an engineering degree based on a deeper understanding of what engineers do as well as their societal roles
* Internalize a growth/academic success mindset...
  - Value self-directed learning and growth
  - Seek teaming, when appropriate, to add richness to a process
  - Reflect on experiences, products, and processes as a means for improving future performance

Course Activities

Learning introductory STEM concepts, engaging in simple engineering problem solving, engaging in team-based design challenges, practicing professional communication skills, and exploring careers defines the content of an introduction to engineering course (Landis, 2013). A comprehensive model for learning how to learn engineering is given by Utschig et al (2018) and the methodology they outlined will serve as the foundation for activity design and delivery in this project. An accompanying model for assessment that recognizes and analyzes strengths, improvements, and insights about one's application of learning skills (Leise et al, 2019) provides reinforcement for professional skill development (Wasserman & Beyerlein, 2007). A process-oriented approach to STEM instruction is also well-supported by the work of Hake (1998) as well as Hanson and Wolfskill (2000).

Classroom culture and course facilitation will incoporate three main processes identified by Paguyo et al (2015) that are essential for cultivating professional identity.

1. ***Doing*** **–** participating in the activities of the profession, learning the necessary skills and knowledge, and developing an affinity for professional activities (aka acquiring accountable disciplinary knowledge).
2. ***Interacting*** - developing a social network with others in the profession. Identities are formed as we position or identify ourselves in a group and are identified or positioned by others.
3. ***Sensemaking*** **–** When identity is considered as a narrative, this sensemaking is a story we tell ourselves about who we are and how we fit. This part of professional development is a process of negotiation between the roles and expectations placed on a profession by society, and the individual who enters the negotiation with their own abilities and desires.

Implementation Plan

The new 2-credit course will meet twice a week throughout the entire semester. It will be a combination of formal activities and informal individual/team/instructor meetings. In the long-term, section size will be 40-50 students with four sections anticipated in the Fall semester and one section in the Spring semester. After course start-up, a dual credit version of the course is planned.

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