Welcome to the SDSU ASEE Best Practices in Engineering Education Series

Session #40 since starting in Spring 2011

Today’s Topic:
ASEE TUEE Phase IV Report 2018 - Views of Faculty & Professional Societies

• Help yourself to pizza / drinks
TUEE = Transforming Undergraduate Education in Engineering
https://tuee.assee.org/

- Phase I, Synthesizing and Integrating Industry Perspectives, 2013
  - Generated KSAs – Knowledge, Skills, and Abilities
    - Discussed in Best Practices session in April 2014

- A major framework for reviewing KSAs is “the T-shaped professional,” an individual who has both deep domain knowledge and broad professional skills.
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1.0 Professional Competence

1.1 Intrapersonal Competence
   - 1.1.1 Self-Directed, Lifelong Learning
   - 1.1.2 Intellectual, Innovative, Critical Thinking
   - 1.1.3 Ethical
   - 1.1.4 Conscientiousness

1.2 Engineering Competence
   - 1.2.1 Technical, Analytical
   - 1.2.2 Scientific
   - 1.2.3 Mathematical
   - 1.2.4 Innovative, Creative, Design Thinking

1.3 Interpersonal Competence
   - 1.3.1 Communication
   - 1.3.2 Teamwork
   - 1.3.3 Leadership, Project Management
   - 1.3.4 Social, Intercultural
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1.1 Intrapersonal Competence

1.1.1 Self-Directed, Lifelong Learning

- **K**—Knowing how to learn and where to find resources; Understanding lifelong learning
- **S**—Doing self-assessment, management, development; Practicing life-long learning
- **A**—Curious; Motivated; Pro-active; High achiever; Introspective;

1.1.2 Intellectual, Innovative, Critical Thinking

- **K**—Knowing/understanding other disciplines (beyond STEM); Multi-literate; Understand problem solving; Comprehending value of diversity
- **S**—Adept problem finder/manager/solver; Making informed/good decisions; Apply knowledge; Deal with ambiguity/conflict/plurality; Make inferences/judgments
- **A**—Innovative; Creative; Insightful; Open-minded; Resourceful; Growth/entrep. mindset

1.1.3 Ethical

- **K**—Understand what constitutes ethical/moral behavior and professional responsibility; Understand civic responsibility
- **S**—Accept responsibility; Act with empathy; Respect others; Consider broad contexts; Make informed, equitable, inclusive judgments; Embrace diversity, inclusion
- **A**—Honest; Having high integrity/EQ; Reliable; Dependable; Concern for positive impact

1.1.4 Conscientiousness

- **K**—Understanding value of stakeholders/needs; Understand professional standards/constraints; Understanding personal attributes/capabilities
- **S**—Acts professionally, with integrity and high standards; Critique self; Manage time, priorities, risks, motivations, integrity, learning; Develop mastery
- **A**—Reflective; Responsible; Self-aware; Persistent; Humble; Motivated; Careful; Punctual
1.2 Engineering Competence

1.2.1 Technical/Analytical
- K—Technical subject matter expert; Engineering knowledge; synthesize information, knowledge of constraints; Problem identification
- S—Analysis expertise; Apply knowledge, theory to practice; Perform technical tasks; Solve technical problems; Evaluation skills
- A—Logical; Insightful;

1.2.2 Scientific
- K—Knowledge of basic science; scientifically literate; Physical, chemical, environmental and biological sciences knowledge;
- S—Apply scientific knowledge and methods to engineering work
- A—

1.2.3 Mathematical
- K—Knowledge of statistics; Algebra, Calculus, Differential equations; Numerical methods
- S—Apply mathematical knowledge and methods to engineering work
- A—

1.2.4 Innovative/Creative/Design Thinking
- K—Knowledge of innovation and design; knowledge of producing solutions for specified needs
- S—Apply design, creative process, entrepreneurship skills;
- A—Entrepreneurial;
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**1.3 Interpersonal Competence**

- **1.3.1 Communication**
  - **K**—Understand communication process/effects;
  - **S**—Effectively use written and oral communication; negotiation/mediation skills; Effective listening skills; Share information;
  - **A**—

- **1.3.2 Teamwork**
  - **K**—Understand group behavior/processes;
  - **S**—Engage and manage group behaviors/processes; Effectively collaborate; Coordinate efforts; Embrace diverse ideas, processes;
  - **A**—Collaborative; Cooperative; Responsible; Accountable

- **1.3.3 Leadership, Project Management**
  - **K**—Understand project management, leadership and business;
  - **S**—Apply business and management skills; Set goals, mission, vision; Skilled leader; Influence/enlist others; Accomplish goals;
  - **A**—Visionary, Influential,

- **1.3.4 Social, Intercultural**
  - **K**—Aware/Understand social/community processes; Aware/Understand historical, political, economic processes
  - **S**—Ability to work on diverse/inclusive teams; Build community; Ability to interact across cultures, societies, communities
  - **A**—
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• Phase II, Insights from Tomorrow’s Engineers, 2013
  • Invited students to express their views on the strengths and weaknesses of the current chronological curricula structure and teaching methodologies.
  • Concluded that schools were paying insufficient attention to an array of KSAs needed to produce the desired T-shaped professional.
    • They did not fault the rigorous grounding in math, science, and engineering fundamentals that are a priority of engineering programs, but criticized how these and other courses were taught
• Phase II, Insights from Tomorrow’s Engineers, 2013
  • Recommendations
    • From the first year onward, calculus, physics, and chemistry courses should include examples of real-world engineering applications
    • Design-based projects, supplemented by extra-curricular activities, competitions, and makerspaces, should be part of the curriculum from the outset and incorporated throughout to stimulate learning and creativity
    • Exposure to industry, business training, ethics, and communication skills all require more attention.
    • Increase mentoring opportunities
Phase III, Voices of Women’s Participation and Retention, 2015
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• Phase III, Voices of Women’s Participation and Retention, 2015
  • Recommendations
    • Creating an online dashboard that shows the composition of engineering schools according to (minimally) gender, race, and ethnicity (ASEE).
    • Identifying gender diversity as an institutional value that must be implemented in a multiple ways across campuses (campus administrators).
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• Phase III, Voices of Women’s Participation and Retention, 2015
  • Recommendations
    • Promoting equity by reflecting such values in grant policies, providing further incentive to comply (sponsoring agencies).
    • Bringing leaders together to focus on diversity and inclusion data management and training (professional societies).
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- Phase IV, Views of Faculty and Professional Societies, 2017
  - Working toward a Competency Map

  - “Can do” competencies comprise the knowledge and skills required to perform the work of an engineer.

  - “Will do” competencies are the traits of personality and attitude that motivate engineers to perform.
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• Phase IV, Views of Faculty and Professional Societies, 2017
  • Assessing Competencies
    • Compared with discipline-specific content, KSA competencies are more challenging to assess.
  • Participants provided a number of existing tools that could be applied to KSAs
    • For technical/analytic competence: Each discipline’s Body of Knowledge; FE Exam; Concept Inventories (e.g., Thermal and Transport Concept Inventory, TTCI); Readiness Assurance activities
    • For ethics: Engineering Code of Ethics; Developmental Assets Framework (Search Institute); Leadership Style Inventory
Phase IV, Views of Faculty and Professional Societies, 2017

Participants provided a number of existing tools that could be applied to KSAs

- For scientific/technical competence: Lean Certification; Certificate Manufacturing Engineering (offered by SME); ASCE BOK2; Problem Recognition and Solving and Rubric; undergraduate research publications presented at conferences

- For mathematical competence: Force Concept Inventories; FE Exam; Physics Concepts Inventory; Concept Warehouse; Wiley PLUS; online assessment systems
Phase IV, Views of Faculty and Professional Societies, 2017

- Participants provided a number of existing tools that could be applied to KSAs
  - For innovative, creative design and critical thinking competencies: Rose-Hulman Rubric for Curiosity, Connections, Creating Value; Critical Thinking Assessment Test (CAT); Design Competition SME; KEEN List of Skills for Entrepreneurial Design; Stanford D-School design-thinking rubric; SAE Collegiate Design Series (Baja; Formula)
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- Phase IV, Views of Faculty and Professional Societies, 2017
  - How can professional societies assist in affecting curricular and pedagogical changes?
    - Reforms could be encouraged by presenting awards (presumably from societies) for faculty, departments, programs, and even colleges that go “above and beyond” their normal duties to achieve change.
    - Societies could provide teaching workshops and forge inter- and multi-society collaborations
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- Phase IV, Views of Faculty and Professional Societies, 2017
  - How can professional societies assist in affecting curricular and pedagogical changes?
    - ASEE, for instance, could serve as a facilitator/catalyst for all societies to disseminate activities
    - Reevaluate program criteria, collaborating with ABET and professional societies to integrate new KSAs into program assessment
    - Provide assessment instruments and a train-the-trainer workshop module
Phase IV, Views of Faculty and Professional Societies, 2017

Summary - Examples of proposed improvements to curricula, mentoring, and experiential learning opportunities included

- a “curriculum map” with a body of knowledge for each KSA;
- enlisting societies as “brokers” among industry, faculty, and students;
- creating dynamic repositories for curricular materials or, similarly, a faculty resource portal with guides to training, best practices, mentoring, case studies, and webinars; and
- online learning modules on ethics, leadership, and communications.
• Thank you for your attendance