University of Idaho
College of Engineering

FRESHMAN YEAR ENGINEERING EXPERIENCE

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MECHANICAL ENGINEERING

PATRICIA COLBERG
CIVIL AND ENVIRONMENTAL ENGINEERING

...IN CONJUNCTION WITH A YEAR-LONG FYE LEARNING COMMUNITY OF FOURTEEN OTHER FACULTY AND STAFF ACROSS THE ENGINEERING DISCIPLINES

PARTICIPANT INTRODUCTIONS

Answer the following in ZOOM chat…

- YOUR NAME
- YOUR DEPARTMENT/PROGRAM
- DO YOU HAVE A FIRST YEAR EXPERIENCE (FYE) COURSE?
- HAVE YOU BEEN INVOLVED IN OR ARE YOU INTERESTED IN TEACHING THIS COURSE?

BRINGING RESEARCH TO PRACTICE…

- Gallup (2018) Strada-Gallup Alumni Survey. https://news.gallup.com/reports/244031/2018-strada-gallup-alumni-survey-mentoring-students.aspx
- Leise, C. et al (2019) Classifying Learning Skills for Educational Enrichment. International Journal of Process Education 10(1): 57-104.
- National Association of Colleges & Employers (2020). Career Readiness Defined. https://www.naceweb.org
- Paguyo et al (2015) Creating Inclusive Environments in First-Year Engineering Classes to Support Student Retention and Learning. ASEE Annual Conference.
- Upcraft et al (2004) Challenging and Supporting the First-Year Student: A Handbook for Improving the First Year of College, Hoboken, NJ, Jossey Bass.
- Utschig, T. et al (2018) Learning to Learn Engineering – A Learning Sciences Approach to Engineering Curriculum Design and Implementation, Proceedings of the Frontiers in Education Conference.

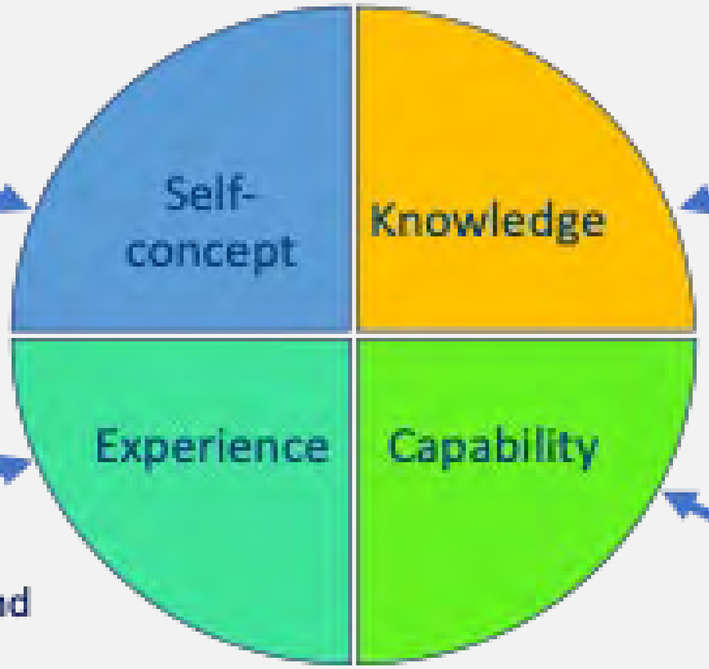
OUR MODEL FOR FYE PERSONAL AND PROFESSIONAL DEVELOPMENT

SELF-GROWER

The core identity, values, and spirit that make up oneself.

KNOWER

The store of knowledge about the world, oneself, and others.



PERFORMER

Memorable situations, learning experiences, and accomplishments, that highlight one's story.

LEARNER

The skills and processes that empower one's performance.

Interacting within a Supportive Community using Modern Learning Infrastructure

FYE OUTCOMES (KNOWER)

- Use mathematical principles and appropriate software tools (EXCEL) to do functional graphing, data analysis, and system modeling
- Develop knowledge/skill related to unit analysis & conversion, vectors, and simple balance concepts that will enhance success in STEM/ENGR courses
- Navigate a Learning Management System (Canvas) as well as ZOOM to access online resources needed for academic and career success

FYE OUTCOMES (LEARNER)

- Find and validate solutions using equations, assumptions, estimation, and units
- Cultivate quality professional documentation skills (emails, graphs, tables, diagrams, sketches, homework, technical reports, and presentations)
- Learn and enhance skills that promote productive team work and networking
- Apply an engineering design methodology within a team project
- Develop habits conducive to becoming a successful college student

FYE OUTCOMES (PERFORMER)

- 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)

FYE OUTCOMES (SELF-GROWER)

- 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 (includes elements of professionalism, career management, engineering ethics)
- Internalize a growth/academic success mindset…
  - Value self-directed learning and growth
  - Seek teaming, when appropriate, to add richness to a process
  - Form value-added relationships with peers inside and outside the classroom
  - Reflect on experiences, products, and processes as a means for improving future performances

Q1: HOW DO THE FOUR AREAS RANK IN PRIORITY IN YOUR FRESHMAN COURSES?

(REFLECT FOR A MOMENT AND RAISE YOUR HAND IF YOU WOULD LIKE TO SHARE)

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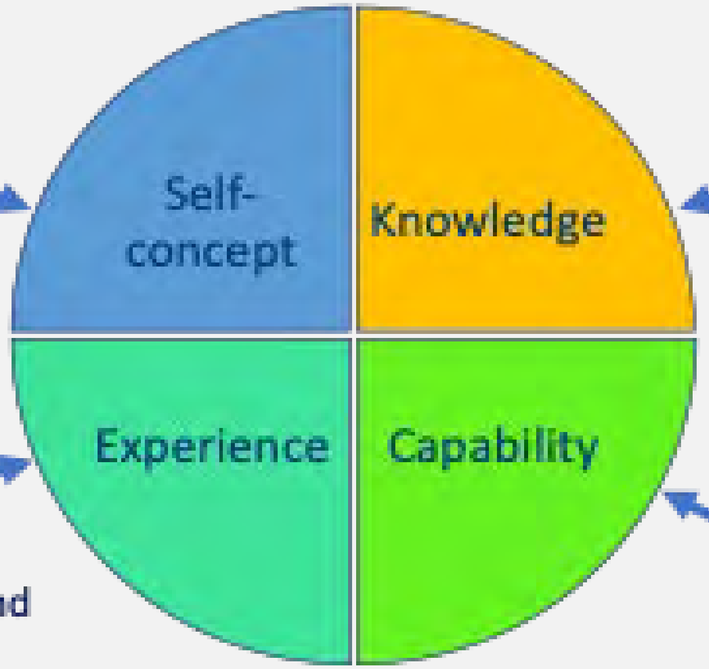

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Q2: WHAT AREAS ARE MOST IMPORTANT FOR STUDENT SUCCESS:

(A) IN THE FIRST TWO YEARS? (B) IN COMPLETING A DEGREE? (C) IN THE WORKPLACE/SOCIETY?

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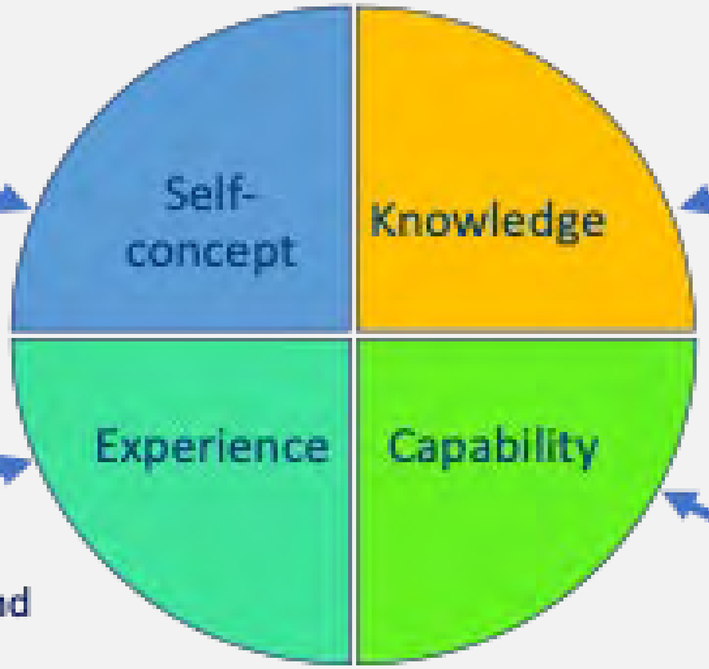

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Q3: WHAT IS THE BIGGEST CHALLENGE YOU OR YOUR DEPARTMENT ENCOUNTER IN ADOPTING CURRICULAR ELEMENTS IN EACH OF THE FOUR AREAS?

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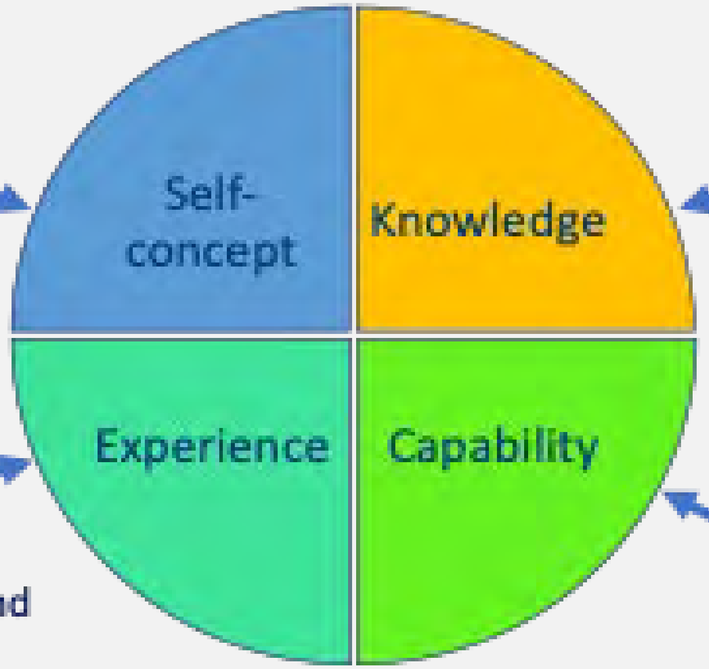

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LEARNING ACTIVITY DESIGN

- Purpose/Why – **What are we doing? Where will I use this?**
- Learning Skills – **What lifelong learning skills are involved?**
- Learning Objectives – **What does ‘done’ look like?**
- Resources – **What information/models will I be using?**
- Preparation/Preassessment – **Am I ready?**
- Plan – **What is our path for constructing knowledge?**
- Critical Thinking – **Can I articulate what I know/don’t know?**
- Exercises – **How do I tackle authentic challenges?**
- Reflection/Assessment – **What are my key take-aways?**

Utschig et al, “Learning to Learn Engineering – A Learning Sciences Approach to Engineering Curriculum Design and Implementation”, Proceedings of 2018 Frontiers in Education Conference

PLANNED ACTIVITIES

Becoming a Successful Engineering Student…

Analyzing a Syllabus, Reading Methodology, Unit Conversions, Estimation, Assessment Methodology, Excel Tables & Graphs, Diagramming, Sketching, Problem Solving, Engineering Math Skills, Documenting Calculations, Academic Integrity, Exam Review, Exam Debrief

Becoming a Successful Engineering Professional…

NACE Competencies, NAE Grand Challenges, Career Exploration, Resume Writing, Networking/Interviewing, Career/Academic Plan (includes integrating curricular and co-curricular elements), Design Process, Teamwork Process, Technical Presentations, Technical Reports, Student Panel, Project Work, Growth Paper, Mentoring, Safety Case Studies

COURSE DELIVERABLES (HOMEWORK - weekly)

- problem solving solutions (applying ENGR documentation guidelines)
- exploration of readings and online resources (including answers to critical thinking questions and some automated quizzes)
- 250+ words of written response to an academic planning prompt, a problem solving prompt, a career management prompt, a personal assessment prompt, a course assessment prompt, or feedback from a previous submission

COURSE DELIVERABLES (EXAM)

- In-class exam covering technical content (similar format/expectations to that encountered in future STEM courses

COURSE DELIVERABLES (PROJECTS)

- Team-Based Project Report (written & oral components)
- Individual Professional Growth Portfolio

PROFESSIONAL GROWTH PORTFOLIO

- **Explanation of <u>personal life goals & vision</u>**
  (integrating personal, social, and professional domains)
- **Exploration of <u>engineering pathway or specialized role you find appealing</u>**
  (with input from UI Career Services & COE alumni)
  => draw on industry panel discussion and one-on-one phone/ZOOM interview
- **<u>Analysis of expected performance</u> in a job posting of personal interest**
  (with input from UI Career Services & COE alumni)
  => draw on industry panel discussion and one-on-one phone/ZOOM interview
- **<u>Evaluation of current performance</u> in each NACE competency**
- **<u>Assessment of personal professional development</u>**
  (reflecting on the past semester and planning for next semester)
- **<u>Resume</u>**
  (reviewed and revised)

CONCLUDING THOUGHTS…

- LEARNING OUTCOMES: Achieving holistic student success (across knower, learner, performer, and self-grower roles), within FYE courses and beyond, is more robust if deliberately pursued across multiple course experiences.
- SUSTAINABILITY: Ongoing attention by a core group, such as our 2020-21 faculty/staff learning community, is needed to advance changes in academic culture that are foundational to realizing NACE-based learning outcomes.
- SUPPORT STRUCTURES: What forums/spaces need to be innovated for faculty/staff to collaborate on implementing coordinated educative practices that are conducive to well-rounded student success (in all corners of the university)?

EXTRA SLIDES FOLLOW, IF NEEDED TO SUPPORT Q/A

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Purpose/Why

Physical phenomena are associated with units and these provide insight about what type of entity is represented (i.e. length, mass, time, force, energy, power). Physical entities can be converted back and forth between a variety of unit labels. Tracing units in engineering calculations helps validate that you are using the correct equations and that your result is meaningful. In this activity you will learn and practice the ‘railroad track’ method for converting physical quantities and mathematical expressions into different unit labels. This knowledge and skill adds value to problem solutions in your current STEM courses as well as future Engineering Science courses.

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Learning Skills

Being logical – applying a rational pattern of thinking
Simplifying – reducing to a minimal set of primary components and variables
Documenting – capturing the details of something (in written form)
Being organized – knowing what is needed and where to obtain it
Being metacognitive – stepping back to better understand one's thinking/result

Learning Objectives

a) Interpret information given in unit conversion tables
b) Recognize different physical entities associated with different unit labels
(i.e. length, force, energy, and power)
c) Use the 'railroad track' method to facilitate and document unit conversion
d) Validate that unit conversions are done correctly

EXAMPLE ACTIVITY – UNIT CONVERSIONS

- Resources (posted on BbLearn or Canvas)

  a) notes/Powerpoint slides
  b) short video/mini-lecture
  c) unit conversion tables
  d) helpful websites with unit conversion data
  d) example conversion solutions

- Preparation/Preassessment

  a) possible on-line readiness assessment quiz
  b) bring needed materials to class
  c) what questions do you have about the class preparation materials

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Plan

a) Sharing of quiz results, lessons learned, and questions from class preparation

b) Just-in-Time mini-presentation by instructor in response to step (a)

c) Form teams of 3-4 with roles of captain, resource manager, documenter, and quality control agent

d) As a team, answer the critical thinking questions (CTQ)

e) As a team, perform and document solutions to the in-class exercises

f) As a class, compare/contrast CTQ answers and exercise results

g) Instructor reviews homework expectations

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Critical Thinking Questions

a) What are two different sources of unit conversion data?

b) What are the advantages/disadvantages of each source of conversion data?

c) How can you tell if a quantity represents length? Force? Energy? Power?

d) What is the basic principle behind the ‘railroad track’ method?

e) What are three best practices in documenting a unit conversion?

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Exercises

1. On a racing motorcycle, Dr. Dan used to go through Turn 1 at Pacific Raceways at about 250 kph. What is this speed in mph?
2. If the price of gasoline in the UK were 1.429 Euro/Liter, what is the cost in US Dollar/gallon
3. At its highest density (atmospheric pressure, and 4.0 °C) water has a density of 1000 kg/m^3. Convert this to lbm/gallon. Convert this to slugs/in^3.
4. The net thermal efficiency (η_o) of an engine can be defined by the equation: $\eta_o = \frac{1}{-\Delta H_* sfc}$

For a particular engine using gasoline fuel (–ΔH = 42 MJ/kg) the specific fuel consumption is measured to be 248 g/kW*hr. Calculate the net thermal efficiency for this engine [%].

Some useful unit conversions:

1 kg = 2.20462 lbm = 0.0685218 slug

1 m = 3.28084 ft = 39.3701 in = 0.000621371 mile

1 gallon = 231 in^3 = 0.00378541 m^3 = 3.78541 Liter

1 Euro = $1.10 US Dollar

EXAMPLE ACTIVITY – UNIT CONVERSIONS

Reflection/Assessment

What did you find most difficult in this learning activity? What learning skills were most helpful in addressing these challenges?

What are three best practices for documenting unit conversions that you knew about previously or that you learned in this activity?

What are two examples in other classes this semester where you can apply these?

FACILITATING LEARNING/GROWTH

http://www.processeducation.org/cls/web/

ACROSS FOUR DOMAINS OF PERFORMANCE, with supporting PROCESSES & LEARNING SKILLS

Cognitive Domain

Social

Affective

Evaluation and Assessment of Quality

Leise et al, “Classifying Learning Skills for Educational Enrichment”, International Journal of Process Education, Vol 10 (1), 2019.

COGNITIVE DOMAIN (14 SKILLS)

Information Processing:

- Filtering – eliminating irrelevant information or focusing on specific information
- Scanning – quickly searching a resource or situation to identify critical words or prompts
- Validating Sources – rating obtained resources based on quality and credibility

Critical Thinking:

- Inquiring – asking key questions
- Being logical – applying a rational pattern of thinking
- Estimating – approximating from mathematical models
- Strategizing – mapping out a way to use knowledge
- Transferring – using ideas, analogies, or patterns in a new context
- Diagramming – clarifying relationships through visual representations
- Using schema – locating the appropriate structure (esp. governing equations) to provide orientation

Problem Solving:

- Defining the problem – specifying the targeted end state or resolution
- Identifying assumptions –discovering implicit presumptions or beliefs that may be operative
- Selecting tools – integrating resources that increase effectiveness
- Validating solutions – using multiple methods to insure correctness

SOCIAL DOMAIN (10 SKILLS)

Communicating:

Active listening – maintaining attention on what is being said with interaction

Articulating an idea – distilling the essence of the message

Structuring a message – sequencing elements for the desired impact

Documenting – capturing the details of something (esp related to engineering problem solving)

Writing technically – using applied or professional language to communicate knowledge

Relating with others:

Performing in a role – fulfilling requirements of a particular position

Cooperating – acting jointly to achieve goals

Supporting the team – upholding collective performance

Networking – interacting/forming strategic relationships

Seeking mentoring – asking for guidance/support from an expert to grow performance

AFFECTIVE DOMAIN (8 SKILLS)

Setting goals – identifying purpose and the associated outcomes
Planning – generating structured tasks that promote a successful performance
Being organized – knowing what is needed and where to obtain it
Coping – dealing effectively with a situation or issue that is difficult

Updating life vision – mapping new paths to realize your identity in achieving goals/dreams
Committing to success – devoting yourself to accomplishing your goals or rising to a challenge
Accepting consequences – agreeing to own the full outcome of an action or decision
Prioritizing – consistently putting the most important things first

EVALUATION/ASSESSMENT OF QUALITY DOMAIN (5 SKILLS)

Being non-judgmental – withholding or avoiding using one's personal standards or opinions
Seeking feedback – asking for assessment/evaluation to strengthen self-assessment
Being self-honest – recognizing when one's own filters and assumptions reflect biases
Being metacognitive – stepping back to better understand one's thinking and behaviors
Practicing reflection – increasing understanding of new truths, identities, values, feelings, and actions

TEAM PROJECT

- Solicit student interest areas based on Grand Challenges and other prompts
- Instructor generates synthesized list of projects for students to bid on
- Students vote for top projects and instructor assigns teams of 4-6
- Weekly team meetings through remainder of term w/informal instructor contact
- Mid-semester design review (written proposal + powerpoint presentation)
  - updated problem statement based on information gathering/literature review
  - definition of criteria for success
  - initial concepts outlined for further exploration
  - safety/risk analysis
- Final report
  - selection of alternatives
  - solution detailing/analysis/refinement
  - identification/acquisition of materials and components (with limited budget)
  - produce and evaluate prototype
  - communicate lessons learned

FEEDBACK FROM F20 PILOTING (CE 115)

- The course was fun and challenging. This class made me more excited to begin my Civil Engineering degree.
- CE 115 was extremely helpful in fleshing out the different aspects of civil engineering.
- The book [Landis] gave me the confidence to keep going. It showed me it will be difficult, but very possible.
- The class sessions were always worthwhile, and the overall class helped me understand civil engineering and my ambitions for the college much better than I did before taking it.
- I really felt like I got an intro to the full array of careers one can have within the civil engineering field. I really appreciate all the people who came in to talk about their job. Thank you so much!

FEEDBACK FROM F20 PILOTING (ME 123)

- The learning curve was reasonable, the labs/design competitions were super fun, and the exams were based on material that was well taught. There was quite a bit of teamwork on Friday challenges, labs, etc., and that was personally helpful.
- I enjoyed the assignments working with common engineering software and the strong emphasis on figuring out what major is right for you. I learned more about myself than the class.
- This class showed me that I really need to focus and make a better effort in my classes. This course really reminded me of why I wanted to major in engineering and I would really recommend it to anyone who is even considering this course.
- I learned a lot about what engineers do, how they communicate, and most importantly what I will expect if I continue in Mechanical engineering. I really enjoyed this class, and I'm ready for more challenging engineering classes to come!