Welcome

Outline:
- What is Pedagogy?
- Brief history of Engineering Education
- Facts about today's Engineering Education
- Best Practices: How we teach today's engineers
Presenters

Fethiye Ozis, Lecturer
Environmental Engineering

John Tingerthal, Associate Professor
Civil Engineering
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What does Pedagogy mean to you?

- Take a minute to write down your definition of “Pedagogy” in your notes
Pedagogy vs. Andragogy

Pedagogy:
The art and science of teaching children

Andragogy:
Originally referring to the art and science of helping adults learn, currently viewed as a learner-centered model of education

Knowles, 1973
Pratt, 1993
**Brief History of Eng. Education**

- 1798: West Point
- 1835: 1st Degree (CE)
- 1862: Morrill Land Grant Act
- 1899: 1st Degree
- 1866: 300 grads
- 1889-1913: 1413 grads
- 1909: 1st PE (Wyoming)
- 1918: Mann Report
- 1934: Wikenden Report 3474 grads
- 1944: G.I. Bill
- 1947: Sputnik
- 1955: Grinter Report
- 1957: 45,000 grads
- 1960: Social Activism
- 1970: Research
- 1994: Green Report
- 2005: ABET EC2000, NAE Engineer of 2020
- 2012: ASEE Lohmann-Jameson Report
Five Major Shifts in 100 years

- Emphasis on Hands-on/practical Science and analysis
- Content Learning outcomes
- Emphasis in engineering design
- applying education, learning, and social-behavioral sciences research
- integrating information, computational, and communications technology

http://doi.org/10.1109/JPROC.2012.2190167
Bachelor's degrees conferred by postsecondary institutions (U.S.)

The Countries With The Most Engineering Graduates

Top countries for graduates in engineering, manufacturing and construction*

- Russian Federation: 454,436
- United States: 237,826
- Iran: 233,695
- South Korea: 147,858
- Ukraine: 130,391
- France: 104,746
- Japan: 168,214
- Indonesia: 140,169
- Mexico: 113,944
- Vietnam: 100,390

* 2015 rank out of 124 economies. No data available for China, India

Sources: World Economic Forum 2015/UNESCO Institute for Statistics
Integrating More Design

Design4Practice: Putting the practice back into curriculum

D4P History:
The Design4Practice program was developed in 1994, and was originally intended as a team-taught class that simulated a corporate environment. The classes were multi-disciplinary in that each engineering student regardless of engineering fields participated in the classes. The instructors came from all the engineering fields. The intent was to provide a series of design classes where students would integrate their technical skills learned in their discipline and apply them to team based design challenges. As NAU has grown from a smaller teaching college to a larger research based institution, the Design4Practice program has evolved to meet the changing needs of the industry and society at large.

The D4P Program:
The Design4Practice (D4P) program is a four-class sequence culminating in the senior capstone experience. The D4P courses are designed to prepare students for an environment that requires the synthesis of technical knowledge, skills, and creative problem-solving. The four “pillars” of the D4P Program are: 1) Engineering Design, 2) Communication, 3) Teamwork, and 4) Professionalism.
Facts about Engineering Education

Example of a Classroom Assessment Technique: Preconception Check

- Distribute the papers
- **Red** and **Green** Cards
- Complete the T/F assessment on your own.

- Raise Green Card for True
- Raise Red Card for False
Learner-Centered Education:

Less Us,  More Them
Creating student-centered contexts for learning

“I think it’s an exaggeration, but that there's a lot of truth in saying that when you go to school, the trauma is that you must stop learning and you must now accept being taught.”

— Seymour Papert
Weimer (2013)

Learner Centered Teaching is the teaching focused on learning, and when successful, it:

- Engages students in the hard and messy work
- Motivates and empowers students by giving them control over their learning
- Encourages collaboration among the learner community
- Promotes students' reflection about what and how they are learning
- Includes explicit learning skills instruction
Miller (2011)

Recent Findings, Theories and Trends to Watch: (pp 120-121)

- Increased emphasis on the connection between memory and attention
- New understanding of limitations on Working Memory capacity
- New refinements in how we apply theoretical ideas of capacity limitations
- Widespread acceptance of and increased interest in applying the testing effect
- Decreased emphasis on individual learning styles, particularly perceptual learning styles
Student’s motivations are strongly influenced by:

- What they think is important (Value)
- What they believe they can accomplish (Expectancy)

(Parsons, J. E., Futterman, R., Goff, S. B., Kaczala, C. M., & Meece, J. L.; 1983)
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Value

Interest Value + Utility Value + Attainment Value - Cost = Task Value
Role of Educator:

- **Good Practice**

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<thead>
<tr>
<th>Encourages Contacts Between Students and Faculty</th>
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<td>Develops Reciprocity and Cooperation Among Students</td>
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<td>Uses Active Learning Techniques</td>
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<td>Gives Prompt Feedback</td>
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<td>Emphasizes Time on Task</td>
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<td>Communicates High Expectations</td>
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<td>Respects Diverse Talents and Ways of Learning</td>
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*Chickering & Gamson (1987)*
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Shift in Millennials: Technology

While watching the following video, which practices do you think we are actually using?

On the provided index card, write:

- 2 practices that you think are **prevalent** at universities
- 2 practices that you think are **rare** at universities

<table>
<thead>
<tr>
<th>Prevalent Practices</th>
<th>Rare Practices</th>
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Technology Shift in Education:

http://www.youtube.com/watch?v=IoFL5gT_m8I
Five Major Shifts in 100 years

- Emphasis on Hands-on/practical → Science and analysis
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“The hard and messy work of learning can only be done by the students”

Maryellen Weimer, 2013
Plus
(what worked?)

Delta
(What could be improved?)
THANK YOU!