greening engineering
in a learner-centered participatory environment
a workshop

Riadh Habash, PhD, P.Eng

the message: toward positive engineering schools
knowledge content is a means to an end, not an end in itself.
greening is about discovering, integrating, experiencing, and collaborating across functions, disciplines, and people.
Teach as taught!

While looking back over my about 35 years as an educator, I have witnessed significant change on many things but few basic things still remain unchanged. In technology, we have progressed from slide rules to calculators to computers and the Internet. Just notice; what that entails?

Currently, we are witnessing an exciting times for engineering! The challenge is how do we teach 21st century skills and competencies to students. Shall we focus on the traditional curriculum content or on the environment in which they learn?
The “what” and “why”

**What** are the pedagogies that make-up engineering education?

**How** are they related to engineering professional practice?

**When** students leave the school, **what** they should know?

**What** types of knowledge are currently taught? **Why** they are taught?

**How** do students understand their experience during their study?

Are pedagogical practises driven by **what** the students do in class or by **what** the instructor does?

**How** do we integrate new approaches with a minimum student resistance?
Engineering is a creative social activity; it is about design under constraint.
Profession is work that requires sophisticated skills; the use of judgment; and the art of discretionary leadership.
topics rather than subjects
what, why, how
problem solving
personalization
whole system
choice
problem finding
studio

involve me i learn
(deep learning)

tell me i forget
teach me i may remember
(content mastery)

ancient Chinese proverb

Think    Feel    Act
Interaction Model

Source: Emergence and Innovation in Digital Learning (Veletsianos, 2016)

Digital tools to support the language of reflection
Toward state of flow experience

Teacher Centered
Early Stage
- Content Mastery
- Delivery
- Consumption

Collaboration
Middle Stage
- Knowledge Creation
- Facilitator
- Tool Acquisition

Student Centered
Advanced Stage
- Learning Mastery
- Enabler
- Real Life Applications
The “bucket theory of knowledge”

Course content should not be used as an end in itself, but as a means of helping students learn how to learn.

Teaching should shift from covering all required content to guiding principles of the learning process.

Grading should not be based on reciting back lecture notes. Sometimes, grading is very degrading for students.
**Knowledge Creation**
(High-level use of technology)
Analyze data; collaborate with peers and teachers; develop and use simulations, build products; create presentations.

**Information Consumption**
(Basic use of technology)
Practice skills and procedures; take test or turn in homework; find information in the Internet; write reports, etc.
Knowledge needed in engineering

**Core:** Theoretical science- math-based knowledge.

**Lifelong self-educate, to meet new problems:** Design concepts; criteria and specifications; quantitative data; practical considerations; knowledge of tools and strategies in project management.

**Societal skills:** Knowledge of values, norms, and context.
3 Ps of Learning

personalization; participation; productivity

Student learn in many ways, so the challenge for teachers is to discover which approaches help students learn most effectively.

Reflection as a personalized process of informal engagement enables learners to produce results by using real-world contexts, carrying out “whole” tasks, and solving problems as they arise.
Acquisition to participation to creation

Personalized learning is to get away from the concept of “lesson” by designing topic-case-project-based forms of learning.

Gone are the days when people learned and worked in isolation. Media have transformed learning to collaborative environments.

Through applying learner-centred pedagogy, students gain insights by dealing with real-world questions and problems.
Learner-centered teaching (LCT) when students influence the content, activities, and pace of learning

Engage students in the hard work of learning.
Discuss what’s being learned, why it’s being learned, and how it can be learned more often than grades.
Encourage students to reflect on what they learn.
Invite questions to play a more prominent role than answers.
Motivate students by giving them some control over the learning processes.
Promote collaboration.
Learner-centered teaching

- Prior Knowledge
- Activity
- Context
- Experience and Reflection
- Learning Designers

Digitally
Collaboration
Creativity
Critical Thinking
Communication

Instruction
Technology
Choice
Motivation
Assessment
Faculty questions and concerns

What are the characteristics of LCT?
Why would we adopt a LCT?
Can we cover the content in syllabus using LCT?
Can we use LCT when teaching large classes? How?
Are instructors’ fears of student resistance to LCT well-founded?
How do we respond to student resistance when using LCT?
Are there effective ways to minimize that resistance?
Sage on the Stage or Guide on the Side

Studio learning
Team projects and the idea of CDIO
Open-ended problem solving
Learning-by-doing
Engagement in research
Workshop case: course subject content

**ELG3336**: Electronics for Mechanical Engineering  
**Textbook**: Principles and Applications of Electrical Engineering  
**Components**: Lectures; Tutorials; Labs.

**Course Content:**  
Operational amplifiers  
Semiconductors, diodes, transistors  
Digital logic circuits and systems
Targeting skills and competencies

Critical and inventive thinking
Communication, collaboration and information retrieval skills
Problem finding, defining, and solving
Social and emotional competencies
Initiative and creativity basic skills in entrepreneurship
Project management and leadership skills
Writing, presentation, and speaking skills
Ethical, environmental, and sustainability awareness.
A typical “whole” mechatronics system as a “topic-case-project-based” platform for teaching the subject content of ELG3336.
Realizing competencies

The course subjects can be taught within the context of each layer and component of the whole mechatronics system.

Each student or group of students may identify and define a “mechatronics problem” of their choice.

The problem progresses with open-ended design tasks of each layer and component.
Realizing competencies

Analysis and design tasks make case for tests and exams.
Project ideas are conceived, designed, implemented, and operated.
Entrepreneurial aspects are explored.
Business plan and design details are written and presented.
Functioning prototype are exhibited.
Learning by Doing: Project Video
Fostering the state of flow experience

Find out what students know and challenge.

Make assignments relevant to real life applications.

Encourage choice with motivation and engagement in mind.

Set clear goals with proper feedback.

Build positive relationship.

Offer hands-on experiences.
A state of flow experience: human hamster wheel: a collaborative uOttawa student project with Canada Science and Technology Museum
A state of flow experience:

uOttawa SAE Aerospace
March 9, 2018
Florida Air Museum
Questions

a learning journey from routine and unfeeling to

enlightenment

empowerment

emancipation

entrepreneurial mindset.