CEEA2018: UBC, Vancouver, Canada

greening engineering

in a learner-centered participatory environment

a workshop

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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.

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Teach as taught!

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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”

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What are the pedagogies that make-up engineering education?

How are they related to engineering professional practice?

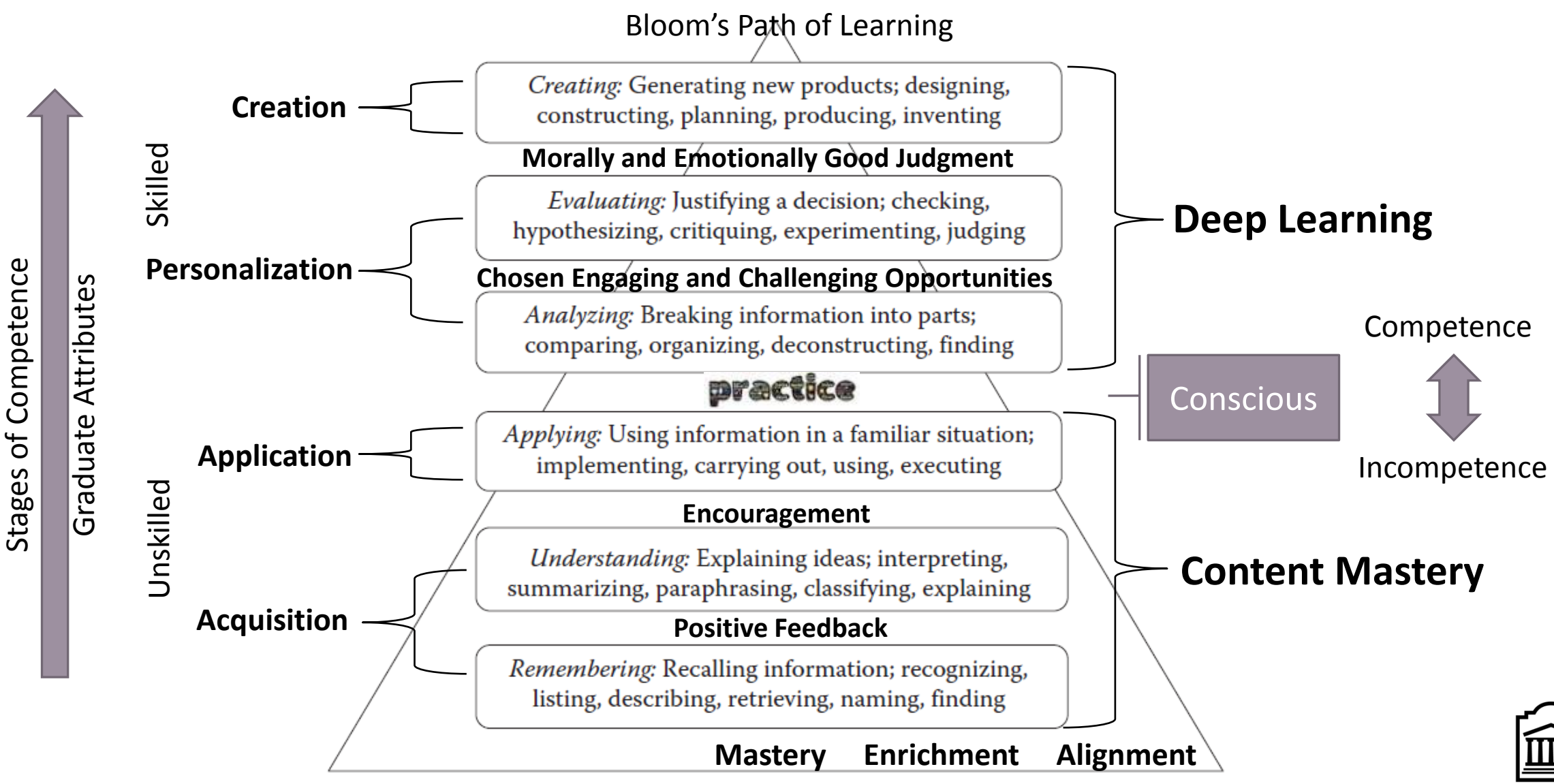
When students leave the school, **what** they should know?

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.

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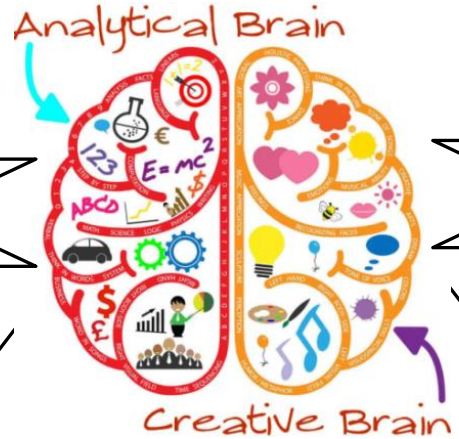
topics rather than **subjects**

what**, why,** how

problem solving

personalization



involve me i learn

(deep learning)

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

ancient Chinese proverb

whole system

choice

problem finding

studio

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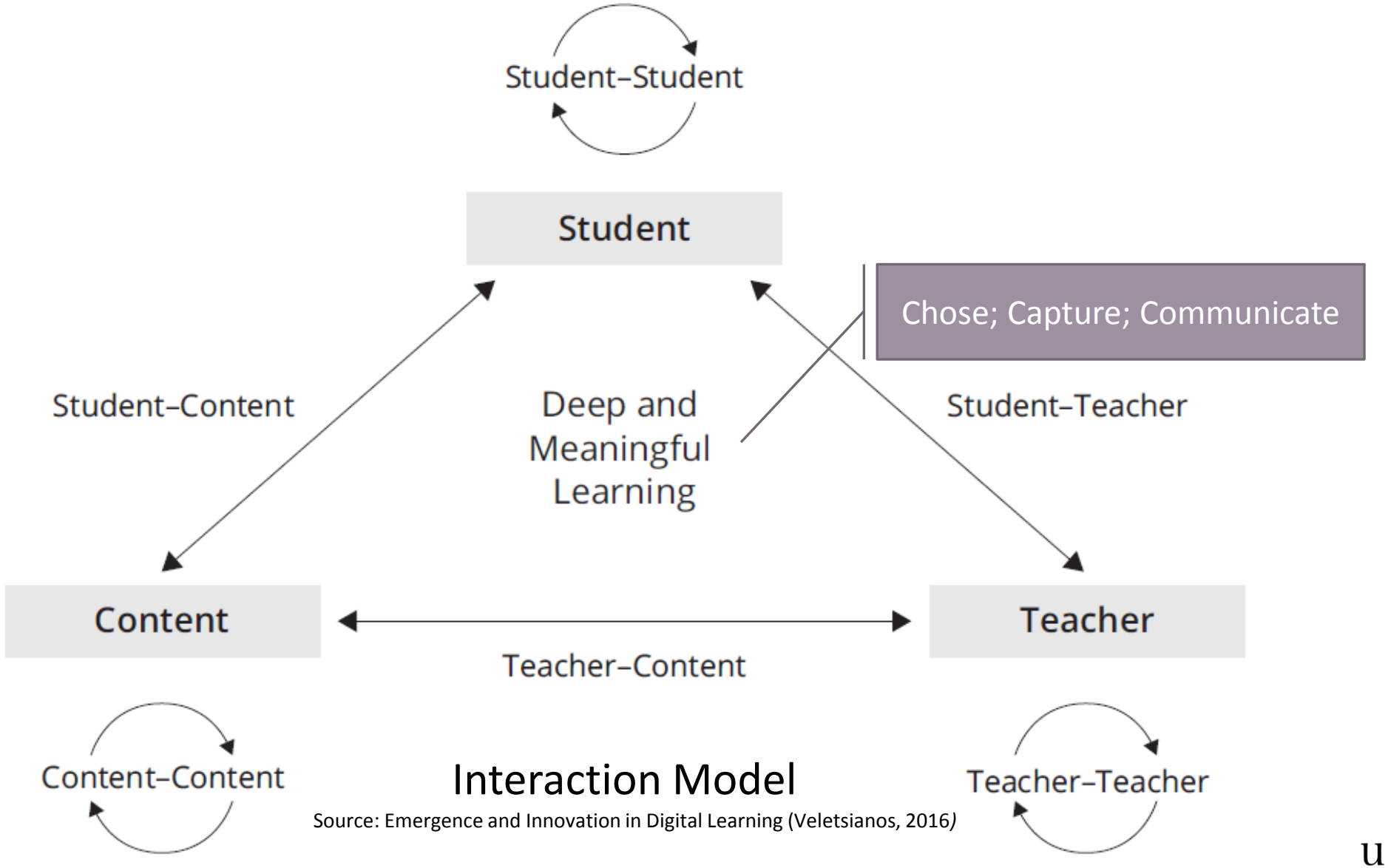
Think Feel Act



Interaction Model

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

Digital tools to support the language of reflection

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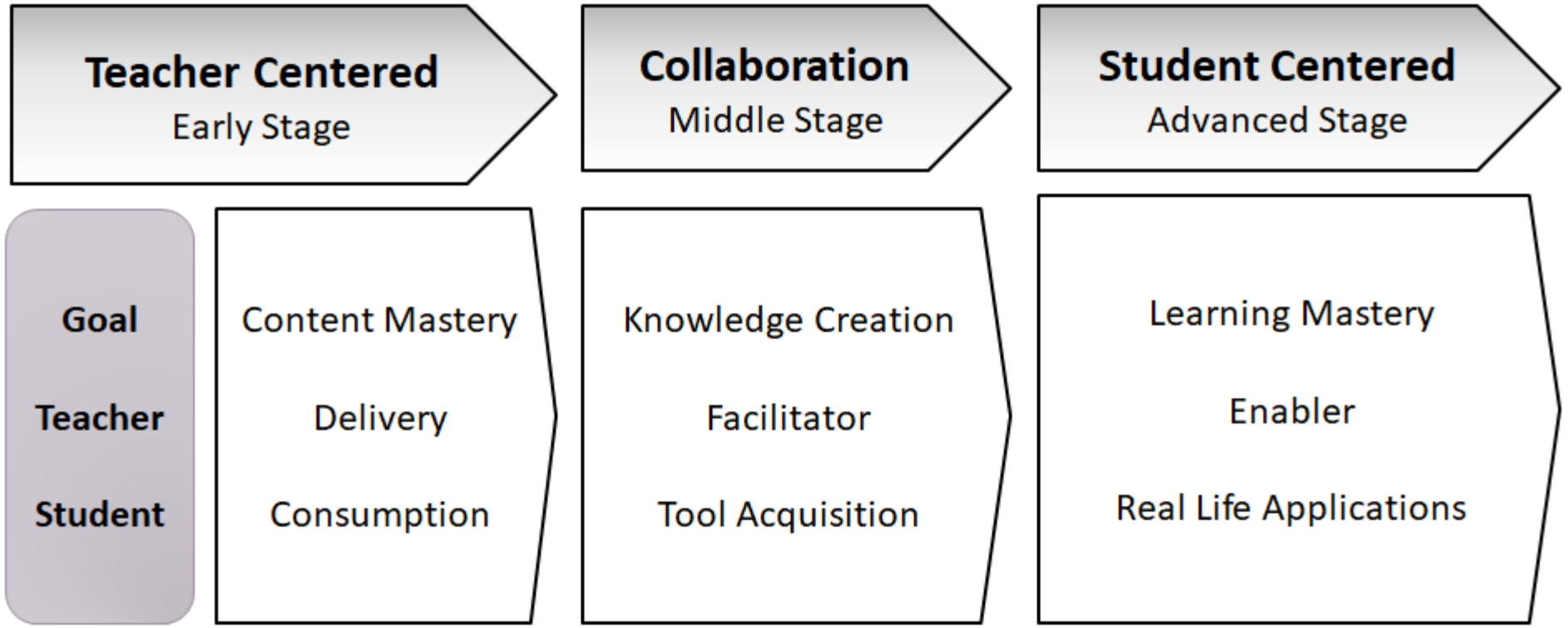
Toward state of flow experience



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The “bucket theory of knowledge”

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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

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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

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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

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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

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Engage students in the hard work of learning.

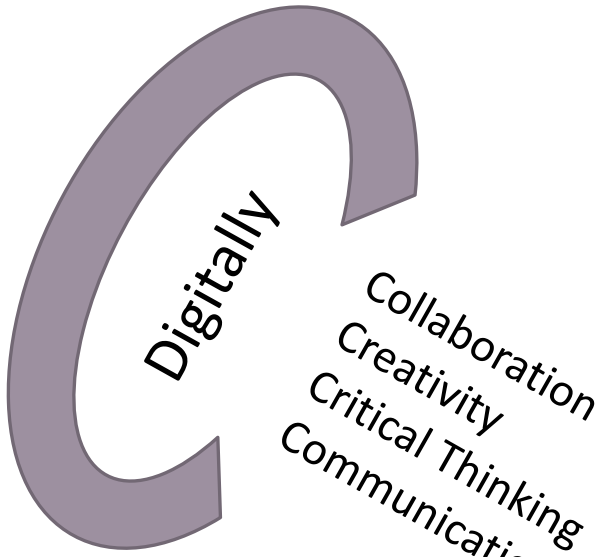
Discuss what's being learned, why it's being learned, and how it can be learned more often than grades.

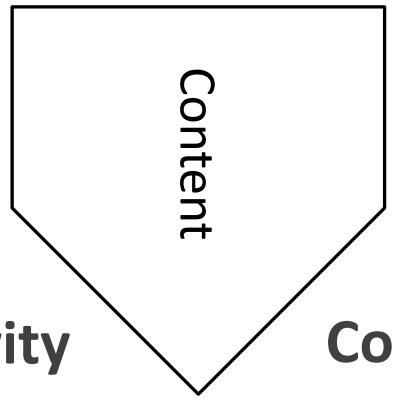
Encourage students to reflect on what they learn.

Invite questions to play a more prominent role than answers.

Motivate students by giving them some control over the learning processes.

Promote collaboration.

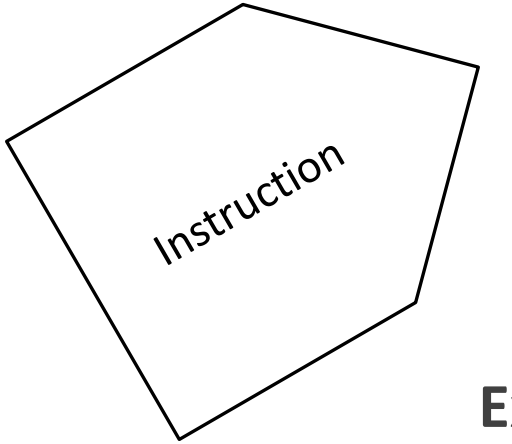




Activity **Context**

Learning Designers

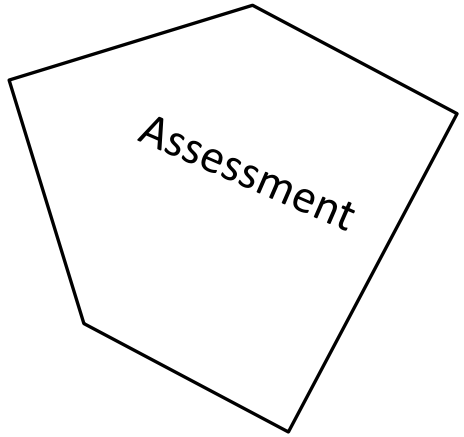
Prior Knowledge



Technology

Choice

Motivation



Experience and Reflection

Learner-centered teaching

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Faculty questions and concerns

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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

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Studio learning

Team projects and the idea of CDIO

Open-ended problem solving

Learning-by-doing

Engagement in research

Workshop case: course subject content

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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

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Critical and inventive thinking

Communication, collaboration and information retrieval skills

Problem finding, defining, and solving

Social and emotional competencies

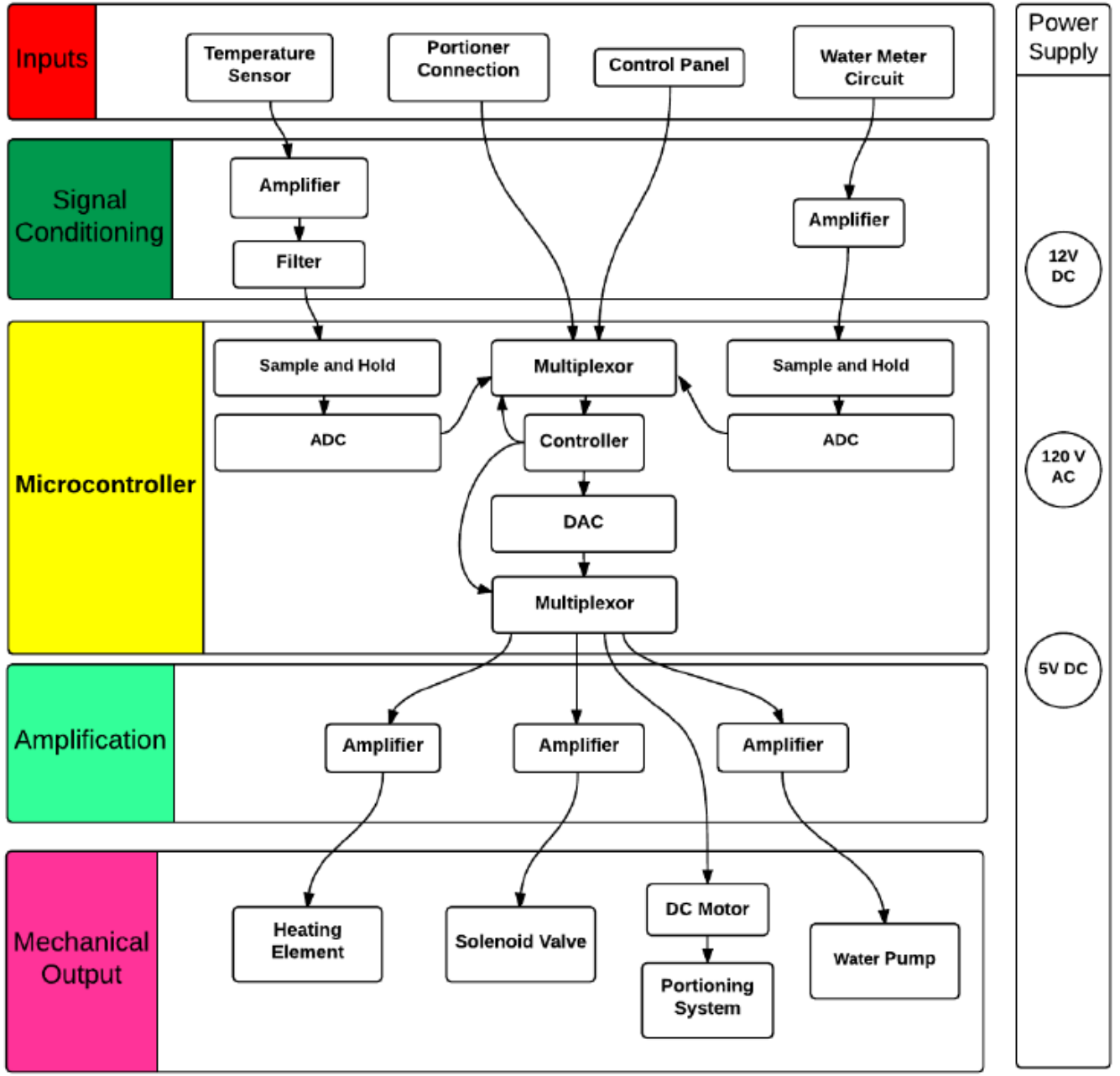
Initiative and creativity basic skills in entrepreneurship

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

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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

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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

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Fostering the state of flow experience

Find out what students know and challenge.

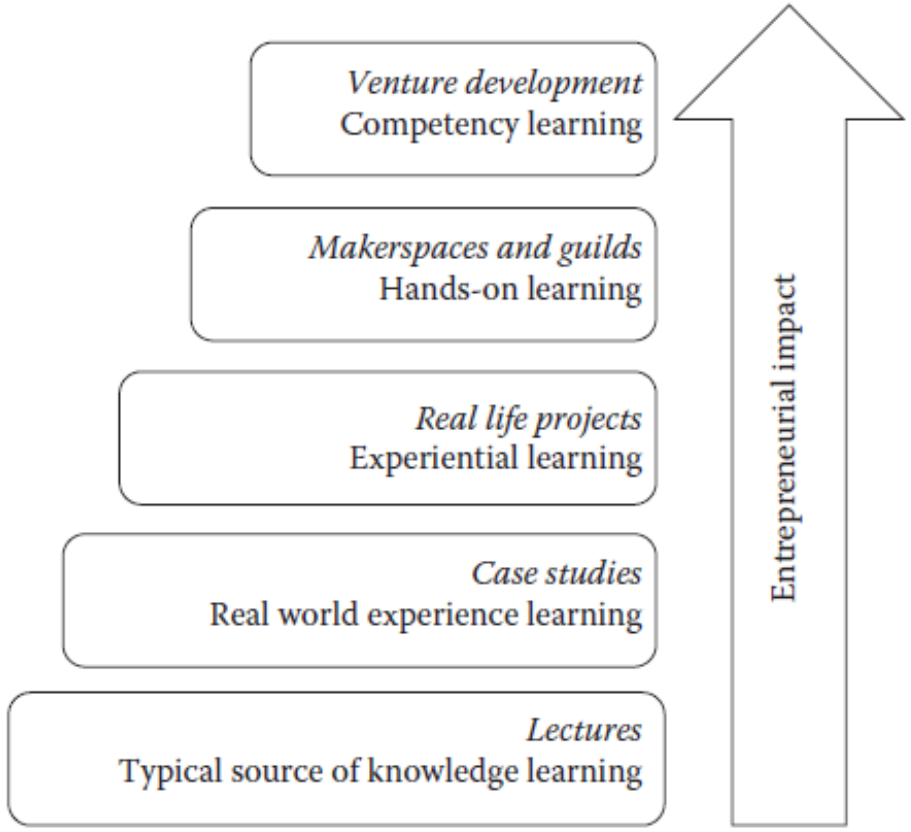
Make assignments relevant to real life applications.

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

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A state of flow experience:

uOttawa SAE Aerospace

March 9, 2018

Florida Air Museum

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Questions

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a learning journey from routine and unfeeling to

enlightenment

empowerment

emancipation

entrepreneurial mindset.