From Traditional Teaching and Learning to Student Engagement - A Case Study

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The need

▪ A transformation from traditional teaching methodologies is required to actively engage "digital brains". [1] [2]

▪ **Digital technology** is affecting our day to day life in so many levels; it became essential to transform teaching and learning experiences using technological tools.

▪ Canadian undergraduate engineering programs move towards an outcomes-based curriculum that requires the implementation of a **continuous improvement process**

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Engineering and Design: Course Overview

First part: Engineering tools and techniques
- Visualization techniques
- Sketching
- Orthographic projection
- Section views
- Isometric drawing

Second part: Engineering design process
- Problem needs assessment (1)
- Problem formulation (2)
- Abstraction and synthesis (3)
- Analysis (4)
- Implementation (5)

A directed project-based learning approach
- Students brainstorm solutions for the design problems
- Present their solutions as ideational sketches, 3D models, and/or physical models
- Need to apply what they are taught in the first part of the course
So, what to consider for student engagement?

- Classroom design
- Flipped teaching
- Student-centered learning methods
- Technology-based activities

Engagement through active learning
Classroom design for active learning

- To facilitate students’ engagement the layout of the classroom was changed from the traditional design, to a new, user-centered design.

- Students are encouraged to work in groups and to collaborate for different assignments.
Flipped teaching

**How it was implemented**

Using the university Learning Management System (**LMS**):
- lecture content and other related resources are made available to the students before the class

**What was achieved** [3]

**For the instructor** – frees up more of class time to:
- engage students in activities that will help them to master the lecture content
- use assessment tools to determine whether or not the students meet the requirements, do not meet the requirements, or exceed the requirements related to the specific topic

**For students:**
- students are using class time to deepen their understanding and increase their skills at using their new knowledge

Technology-based activities

For instructional activities, two aspects were considered:

- **Selection** of technology-based teaching and learning tools, in the context of a student-centered approach and active learning

- **Implementation** of digital technology in order to expand teaching effectiveness and increase students’ engagement and learning capacity
So, why digital technology?

The need to implement these tools was triggered by the need to:

- **Improve** students’ spatial abilities and visualization skills
- **Engage** the students in the learning process
- **Provide** opportunities for hands-on learning and learning by doing
Mobile Devices: digital sketching

Used in the process of teaching and learning to develop three important competencies:

- freehand sketching
- view generation
- visualization skills

Example: Lenovo tablet and digital sketch of a two-point perspective using SketchBook Pro
Mobile Devices: Augmented Reality

- Augmented reality (AR) is used as a visualization tool.
- The textbook contains embedded markers associated with the 2D applications.
- Markers are scanned using a cell phone or computer tablet with the AR Engineering mobile application.
- It produces a 3D model that will appear on the screen superimposed on top of the marker.
- Improved 3D visualization skills have shown to increase retention of students in engineering. [5]

Example of an object rendered in real time on the screen using AR Engineering [4].


Who will benefit from introducing digital technology?

**Instructor to further improve:**
- The course content
- Delivery methods
- Selection and implementation of digital tools

**Students**
- Allows for a new learning experience
- Makes the learning process faster and more engaging
- Provides opportunities for hands-on learning

**Teaching assistants**
- Opportunity to gain new teaching and learning skills
- Improved ability to communicate with the students and provide feedback

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Additional Challenges

### Increased Enrollment
- Teaching assistants were present during the lab/tutorial sessions.
- Group project encouraged team work and decreased workload for graders.

### Tracking Graduate Attributes
- New learning management system was used.
- Specific assessments and rubric criteria were aligned to learning outcomes/graduate attributes.
Thank you!