Transforming Assessment

Webinar Series

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Systemically Implementing Competency-Based Assessment

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SHAPING THE FUTURE OF TERTIARY EDUCATION

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Lessons Learned from Systemically Implementing Competency-Based Assessment in First Year Engineering

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April 7th, 2021

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Presentation Overview

- Setting the Stage
- The Pilot Implementation
- How It Went
- Next Steps

Setting the Stage

What if you could scrap your current program and start over … with no restrictions?

How would you construct your program?

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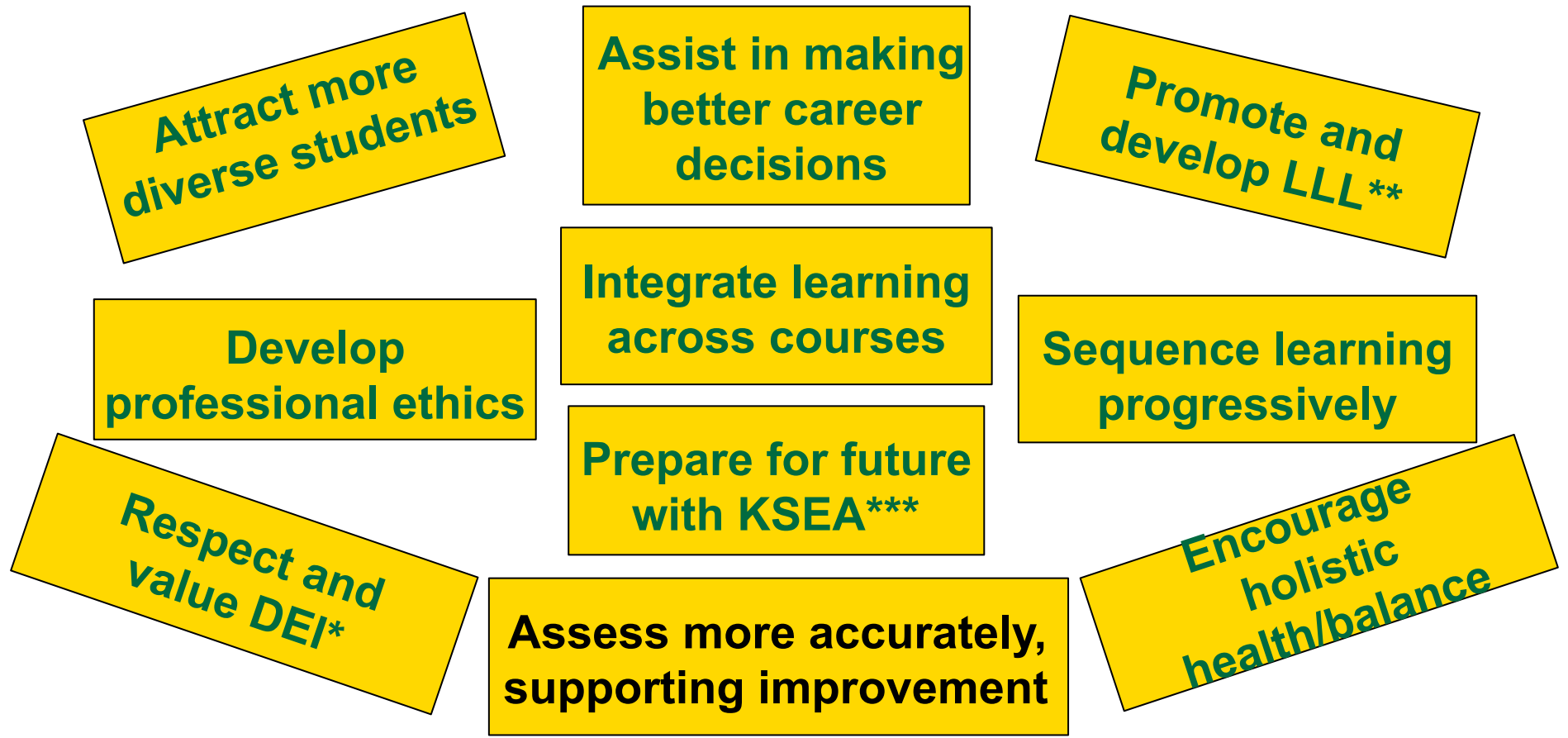
Program Vision

The University of Saskatchewan's College of Engineering will have the most effective first year engineering program in Canada. The first year program will excite, engage and inspire our students, and it will holistically prepare them for the challenges to come in later years. Ultimately, it will also serve to enhance the reputation of the University.



*DEI – Diversity, Equity, Inclusion
*LLL – Life Long Learning

***KSEA – Knowledge, Skills, Experiences, Attitudes

Methodological Approach

Began with an assumption of no constraints, including:

- scheduling
- facilities
- personnel
- assessment
- finances
- academic requirements

Focused on content, then structure, then delivery.

Iterative “sculpting”.

Reintroduction of constraints as needed e.g. room restrictions.

Existing Program

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1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34
Sept				Oct				Nov				Dec			Jan				Feb			Mar				Apr				

GE 101.1 Introduction to Engineering	Final Exams	Holiday Break	GE 121.3 Introduction to Engineering Design
GE 111.3 Engineering Problem Solving			GE 124.3 Engineering Mechanics II
GE 124.3 Engineering Mechanics I			PHYS 155.3 Introduction to Electricity and Magnetism
CHEM 114.3 General Chemistry for Engineers			MATH 124.3 Calculus II for Engineers
MATH 123.3 Calculus I for Engineers			3 Credit Unit Natural Science Elective (Physics, Chemistry, Biology, Geology)
COMM 102.3 Introduction to Business Management			3 Credit Unit Humanities/Social Sciences Elective

New Program (v33)

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	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	18	19	20	21	22	23	24	26	27	28	29	30	31	32	33	34
Apr-Aug	Sept				Oct				Nov				Dec			Jan				Feb				Mar					Apr		

Summer Top Ups (Online)

GE 102.2 Intro to Profession

Natural Science Series:
PHYS 152.1, CHEM 142.1, GEOL 102.1, BIOL 102.1

MATH 133.4
Engineering Math I

GE 102.2 Cont'd

CMPT 142.3
Intro. to Computer Science for Engineers

GE 132.1
Engineering Communication I

GE 152.1
Circuits I & Matlab

GE 142.2 Design I

GE 112.1
Engineering Discipline Experience

GE 102.2
Indigenization

GE 122.2
Engineering Mechanics I

Fall Top Ups

PHYS 156.3
Electromagnetism and Waves for Engineering

GE 153.2
Electrical Circuits II

CHEM 146.3
General Chemistry for Engineering

GE 163.2 Process Engineering

GE 133.2
Engineering Communication II

GE 103.1 Cont'd

GE 103.1
Intro to Engineering II

GE 123.3
Engineering Mechanics II

MATH 134.3
Engineering Math II

Winter Top Ups

GE 143.2
Design II

Discipline Bridge Course:
CMPT 146.3 / ME 113.3 / CHE 113.3 / CE 271.2

Students Select Top 3 Discipline Choices

Final Discipline Assignment

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New Program Weekly Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 AM	Lecture or Lab	Lecture or Lab	Lecture or Lab	Lecture or Lab	Lecture or Lab
9:00 AM					
9:30 AM					
10:00 AM	Lecture or Lab	Lecture or Lab	Lecture or Lab	Lecture or Lab	Lecture or Lab
10:30 AM					
11:00 AM					
11:30 AM	Lunch/Rec	Lunch/Rec	Lunch/Rec	Lunch/Rec	Lunch/Rec
12:00 PM					
12:30 PM	Lecture or Lab		Lecture or Lab		Lecture or Lab
1:00 PM		Lecture or Lab		Lecture or Lab	
1:30 PM					
2:00 PM	Lecture or Lab		Lecture or Lab		Lecture or Lab
2:30 PM		Lecture or Lab		Lecture or Lab	
3:00 PM					
3:30 PM	Tutorial (Optional)		Tutorial (Optional)		Tutorial (Optional)
4:00 PM		Tutorial (Optional)		Tutorial (Optional)	
4:30 PM					

Competency-Based Assessment (CBA)

Common in programs like Medicine … but not in Engineering

What should/could it look like in Engineering?

The four pillars of our implementation …

1. a focus on Learning Outcomes (LOs)
2. multiple chances to exhibit competency
3. later/better grades replace earlier/poorer grades
4. different standards for different levels of knowledge and skills

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Competency-Based Assessment (CBA)

1. A Focus on Learning Outcomes (LOs)

Different levels:

- Program LOs (PLOs), course LOs (CLOs), LOs, sub-LOs (SLOs)

Evaluate LOs specifically

- Corollary: assignments/tests/labs have no predictable grade "weight"

Course grades depend on performance against Los

Modules are evaluated independently (students must pass each)

An example …

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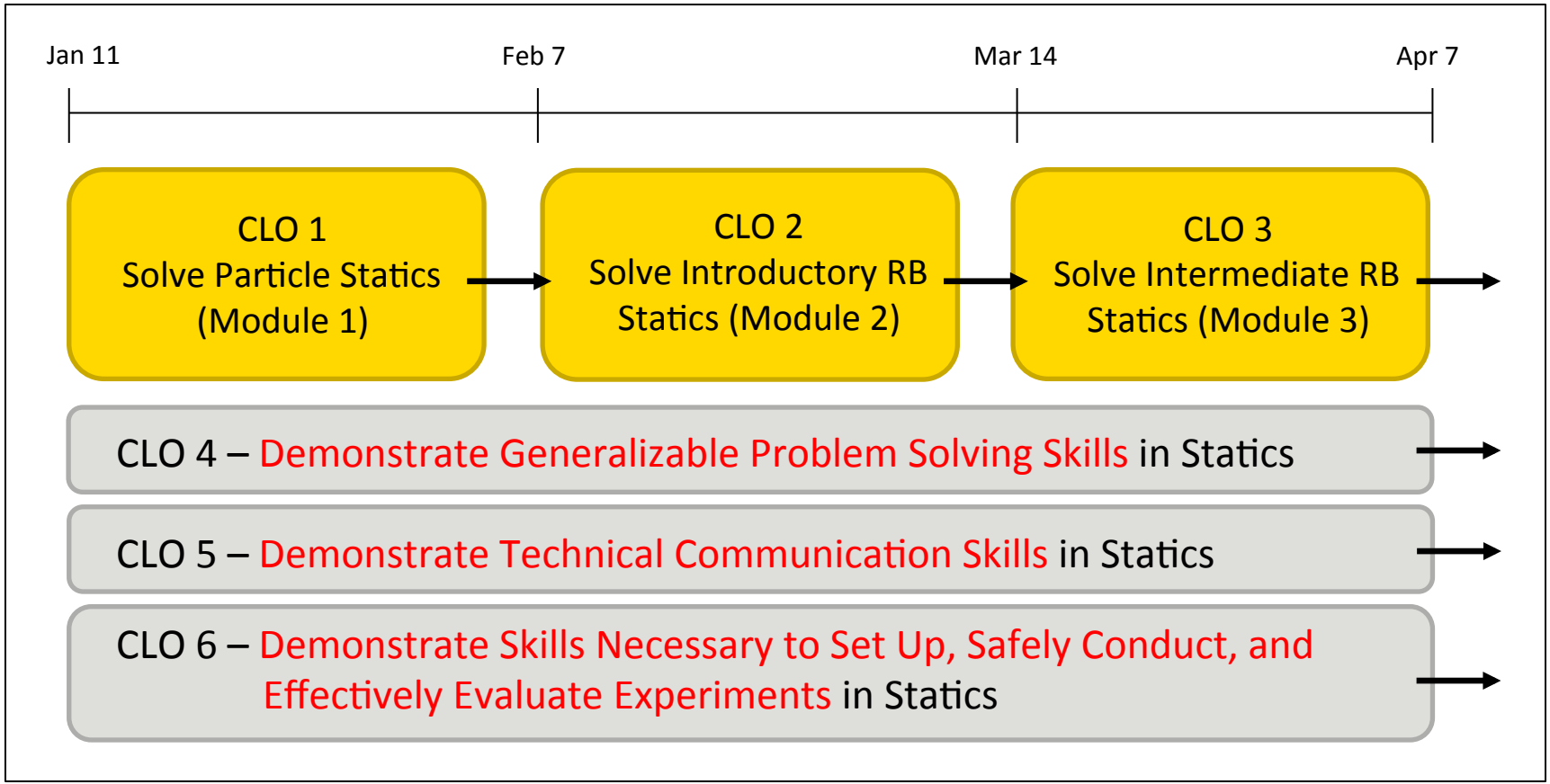
CLO 1 - Solve Particle Statics Problems (25% of Final Course Grade)

CLO 1 will be assessed in a module (Module 1). By the end of this module, students will be expected to:	Weight (%)
LO 1.1 recognize, define, and use terms relevant to 2D and 3D particle equilibrium, and perform simple calculations relevant to 2D and 3D particle equilibrium; (Type A)	Pass/ Fail
LO 1.2 add and subtract vectors using the parallelogram, triangle and Cartesian methods in order to solve basic vector problems;	20
LO 1.3 utilize dot products of 2D and 3D vectors to solve problems;	15
LO 1.4 apply the equations of equilibrium to calculate unknown forces in 2D particle equilibrium problems;	30
LO 1.5 apply the equations of equilibrium to calculate unknown forces in 3D particle equilibrium problems.	35

CLO 4 - Demonstrate Generalizable Problem Solving Skills in Statics (7% of Final Course Grade)

CLO 4 will be assessed throughout the course. By the end of this course, students will be expected to:	Weight (%)
LO 4.1 frame solutions to 2D and 3D statics problems with Given, Find, Assumptions, diagrams/FBDs, equations of equilibrium from the FBDs, and Conclusions; (Type A)	Pass/ Fail
LO 4.2 exhibit technical accuracy and thoroughness in framing solutions to 2D and 3D statics problems with Given, Find, Assumptions, diagrams/FBDs, equations of equilibrium from FBDs, and Conclusions; and	50
LO 4.3 identify and classify statics problem types and features.	50


Jan 11
Feb 7
Mar 14
Apr 7
CLO 1
Solve Particle Statics
(Module 1)
CLO 2
Solve Introductory RB
Statics (Module 2)
CLO 3
Solve Intermediate RB
Statics (Module 3)
CLO 4 – Demonstrate Generalizable Problem Solving Skills in Statics
CLO 5 – Demonstrate Technical Communication Skills in Statics
CLO 6 – Demonstrate Skills Necessary to Set Up, Safely Conduct, and Effectively Evaluate Experiments in Statics

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Competency-Based Assessment (CBA)

2. Multiple Chances to Exhibit Competency

Every LO is assessed at least 3 times.

Sequential modules end in “Module Tests” (MTs).

- No final exams

Top Up Module Tests offer further chances, if needed.

Competency-Based Assessment (CBA)

3. Later/Better Grades Replace Earlier/Poorer Grades

Say LO 1.1 is assessed three times (two assignments, one MT).

First assignment: LO is graded for a question (or two), yielding a percentage grade indicating a level of competence.

Second assignment: if grade is better than grade for this LO in first assignment, keep new grade (otherwise average them).

Module Test: if grade is better than current grade for this LO, keep new grade (otherwise average them).

Competency-Based Assessment (CBA)

4. Different Standards for Different Levels of Knowledge/Skills

Type A – fundamental definitions/skills that need to be automatized

- pass/fail, unlimited tries, automated evaluation

Type B – basic fully integrated problems, characteristic of the field

- need at least 70% to pass module, multiple tries (3+), marked by TAs

Type C – "difficult" fully integrated problems; tough/tricky problems

- no minimum grade required, single chances, marked by instructors

The Pilot Implementation

Fall 2020 – GE 124 Mechanics I (Statics)

400 first year engineering students, synchronous remote teaching.

Just 3 sequential modules (CLOs 1, 2, 3 from Slide 13).

Weekly live (online) tutorial sessions.

Confounding issues:

- remote teaching (synchronous/live lectures with 2 instructors)
- open book, remote assessments
- potential for cheating

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How It Went

Failure rate similar to previous years but mostly due to no-shows.

Higher grades (+10-15%) but work quality was clearly higher too.

Confusion regarding CBA system for many (staff and students).

Fair/flexible due to 3+ chances and clear multi-level expectations.

Forgiving for sickness/absence, especially helpful in COVID.

Anecdotally, lower stress.

Not certain, but cheating seemed to be relatively infrequent.

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How It Went

Difficult for staff to set up,

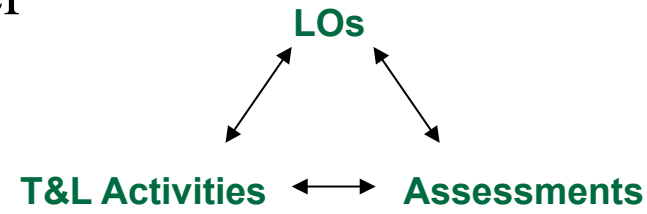
but easy once operational, especially for Top Ups.

CBA works very well with constructive alignment*.

Difficult to implement with LMS, however

Marking workload is high and intense.

Experiences reflected the literature.



* **Biggs. J.** (2003) Teaching for Quality Learning at University – What the Student Does 2nd Edition SRHE / Open University Press, Buckingham.

Next Steps

Poll current first year students re: CBA vs. “regular” assessment.

Full implementation (include PLOs) next Fall/Winter in all First Year Engineering courses (but not Arts & Science courses).

Engineering courses will include other types of courses such as Drawing & Sketching, Technical Communication, and Design.

Make marking more efficient.

Pilot Statics again this Spring.

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Acknowledgements

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Thank You for Your Attention

Any Questions?

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Webinar Session feedback

http://taw.fi/feedback

With thanks from your hosts

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Recording available
http://transformingassessment.com

Next session – 5 May 2021

Honing self-assessment via serious games and team learning

Reg http://taw.fi/5may2021

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