WORKSHOP 3B: PLANNING AT THE COURSE LEVEL

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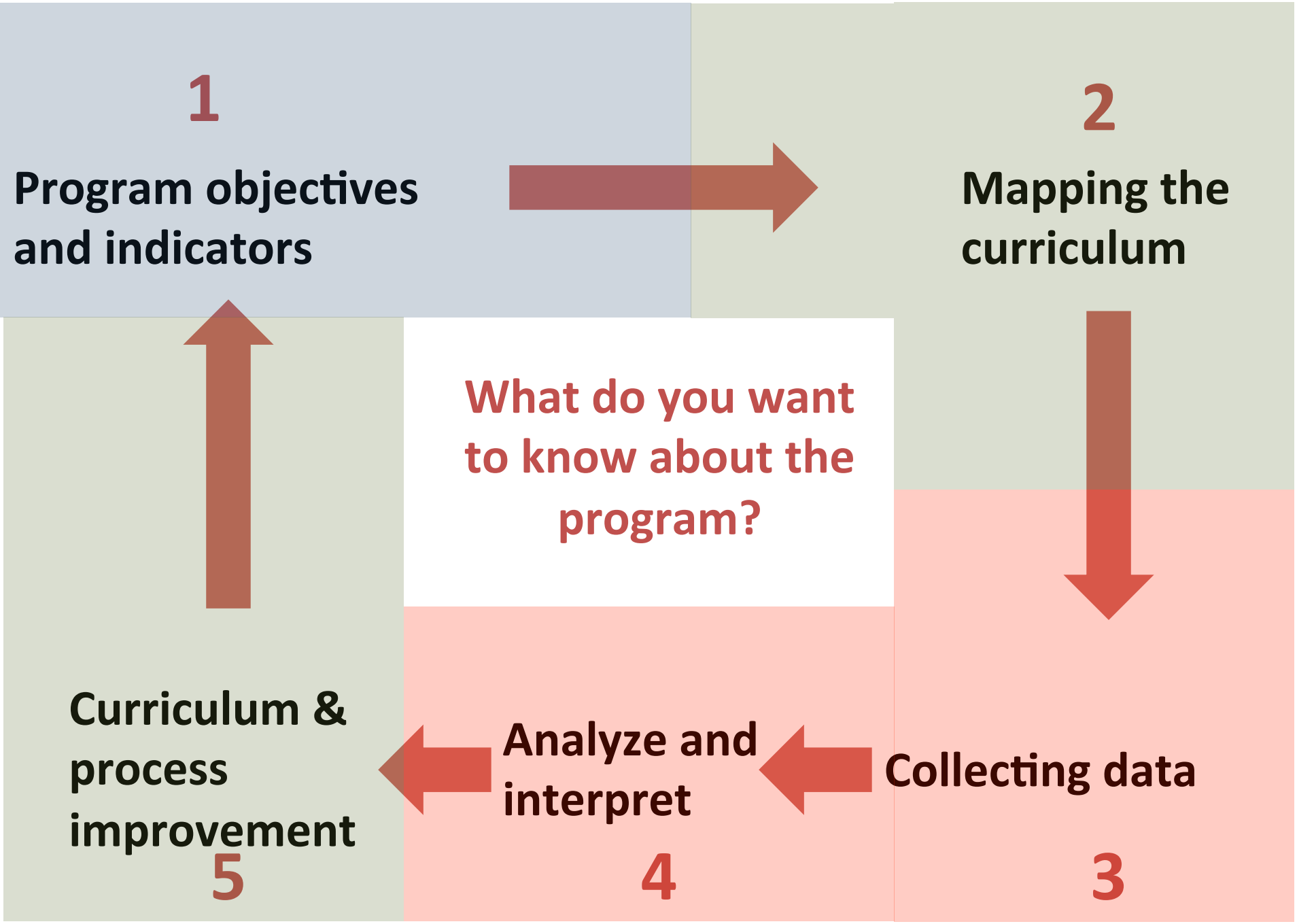
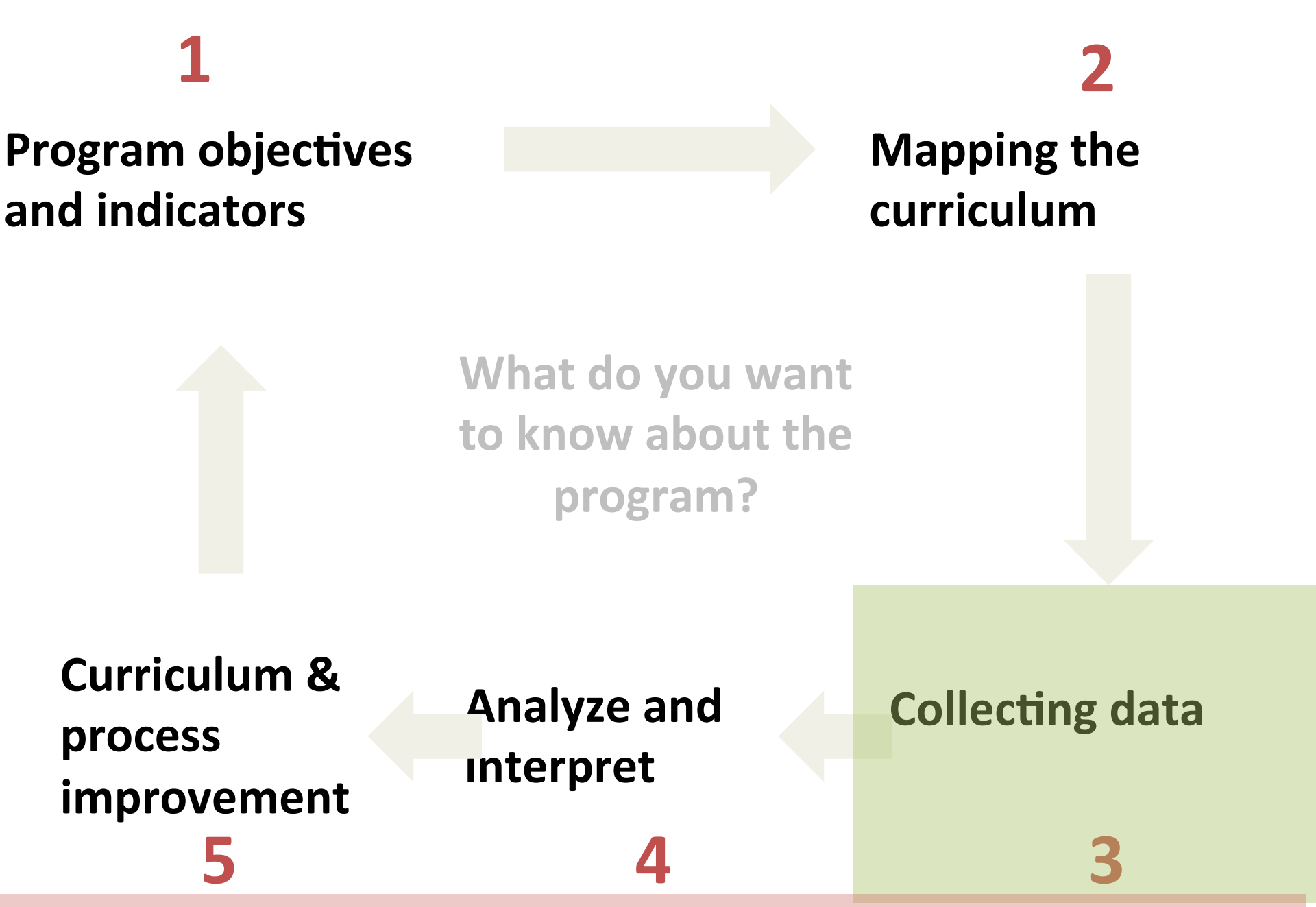

1
Program objectives and indicators
2
Mapping the curriculum
What do you want to know about the program?
Collecting data
3
Analyze and interpret
4
Curriculum & process improvement
5



STEP 3: Collecting data

Tool: Curriculum Map

CURRICULUM MAP FOR SELECT CEAB ATTRIBUTES (OUTCOMES) FOR 1ST YEAR ENGINEERING T=TAUGHT, U=UTILIZED, A=ASSESSED			COURSE					
			APSC 100	APSC 111	APSC 131	APSC 151	APSC 161	APSC 171
KNOWLEDGE BASE	3.01-FY1	Create mathematical descriptions or expressions to model a real-world problem	T,A	T,A	T,A			U
	3.01-FY2	Select & describe appropriate tools to solve mathematical problems arising from modeling a real-world problem	T,A		T,A	U		
	3.01-FY3	Use solution to mathematical problems to inform the real-world problem that gave rise to it.	T,A					
PROBLEM SOLVING	3.02-FY1	Identifies known & unknown information, uncertainty, and biases when presented a complex ill-structured problem	T,A	T,A	T,A	T,A	T,A	
	3.02-FY2	Creates process for solving problem including justified approximations and assumptions	T,A				T,A	
	3.02-FY3	Selects and applies appropriate quantitative model and analysis to solve problems	T,A				T,A	
INVESTIGATION	3.03-FY1	Generates ideas and working hypothesis	U		T,A			
	3.03-FY2	Designs investigations involving information and data gathering, analysis, and/or experimentation	T,A	T,A	U	U	U	U
	3.03-FY3	Synthesizes data and information to reach conclusion	T,A					

Tool: Planning Table

APSC 100: Engineering Practice I 2012-2013 | Course overview

Course learning outcomes: Students will be able to:

1. Apply a prescribed process for solving complex problems.
2. Select and apply appropriate quantitative model and analysis to solve problems.
3. Effectively communicate in written document following a prescribed format and using standard grammar and mechanics.
4. Apply concepts including occupational health and safety principles, economics, law, and equity to engineering problems.
5. Apply critical and creative thinking principles to solve contextualized problems.
6. Apply numerical modeling tool to create model used for solving complex problems.

Pre-class: A pre-class reading or learning activity will be assigned before most lectures and studies. A short quiz will be held at the beginning of the studio each week on the pre-class readings.

Week		Instructional approach and content (*Instructor activity*)	Learning activity (*Student activity*)	Evaluation
1/Sep 10		*Lecture:* motivation, course overview, models, self-regulation.	*In-lecture:* 1. Opening problem, 2. Group activity to consider model for MEA1	*Studio:* Critical thinking pre-test **(CLO5)** WordTravel assignment **(CLO 3)**
2/Sep 17		*Lecture:* (CT conceptual framework, questions), complex problem solving and critical thinking overview, asking good questions, strength of materials – stress and strain, tensile strength ***WRNRS course ironing***	*Pre-reading:* stress and strain, tensile strength *In-lecture:* Group activity to develop process for resolving elevator failure problem *MATLAB Studio:* Intro to MATLAB (MATLAB problem #1: Starting MATLAB, variables, operations, plotting, scripts, and publishing a MATLAB script).	*Studio:* MATLAB quiz #1 OHS online test **(CLO4)**
3/Sep 24	MEA 1	*Lecture:* (CT: purpose, concepts) concept maps, establishing objectives and constraints, safety and hazard analysis. Concision (look at previous examples of student submissions on safety and hazard analysis).	*Pre-reading:* problem solving and critical thinking overview (write up a 2-3 page summary of problem-solving/design process and critical thinking), occupational health and safety module *In-lecture:* Group activity to develop process for resolving elevator failure problem *MATLAB Studio:* Data importing and functions (problem #2)	*Studio:* MATLAB quiz #2
4/Oct 1		*Lecture:* (CT point of view), argumentation, brainstorming.	*In-lecture:* analyze past assignments for effective argument, group activity for MEA *MATLAB Studio:* Curve fitting and interp (problem #3)	*Studio:* MATLAB quiz #3
5/Oct 8		*Lecture:* Teaming & leadership (KW)	*In-lecture:* teaming activities *MATLAB Studio:* Conditional statements (problem #4) M1 first team meeting and teaming inventory	MEA 1 SUBMISSION **(CLO2,3,4,5,6)** *Studio:* MATLAB quiz #4

Tool: Rubric

	0-3 (below)	3-4 (marginal)	5-6 (expectation)	7-8 (outstanding)
Information summary section (team)	Little useful information, or information directly copied from assignment.	Some important information or biases not identified, or irrelevant/incorrect information included.	Summarizes and assesses credibility of information used, evaluates uncertainty and biases.	**Meets expectations and:** Includes information from authoritative sources to inform process, model, and conclusions.
Proposed process section (team)	No or inadequate process	Process identified misses some important factors; some assumptions left unidentified or unjustified.	Creates justified process for solving problem, supported by information.	**Meets expectations and:** Comprehensive process model; comparison with other possible approaches.
Model section (team)	No analysis, or model/analysis selected is inappropriate	Model is not complete, or make reasonable conclusions; errors in analysis or inappropriate assumptions	Creates and compares quantitative models in MATLAB using reasonable approximations and assumptions.	**Meets expectations and:** Comprehensive model used incorporating several effects; uncertainty in model's input variables shown by range of output values.
Safety analysis in Conclusions section (individual)	No or trivial analysis.	Analysis includes some factors, but some important factors missed.	Assesses risk; makes supported conclusions about failures and recommendations for safe design.	**Meets expectations and:** Comprehensive range of risks analysis, qualitative where possible.
Model results in Conclusions section (individual)	No evaluation of solution.	Superficial evaluation of solution	Evaluates validity of results and model for error, uncertainty, drawing well-supported conclusions.	**Meets expectations and:** Evaluates model conclusions and presents potential improvements to the models.
Self-assessment (individual)	No or superficial assessment.	Analysis of team and individual work identifies few areas for improvement.	Critical analysis that identifies conclusions, potential biases, potential inaccuracy, etc.	**Meets expectations and:** Comprehensive critical analysis applied with clear proposals for potential improvement.
Argumentation (individual)	Unsupported or trivial arguments	Arguments include some but not all critical elements	Makes claims supported by data and backing, with appropriate qualifiers	Claims supported by authoritative backing and comprehensive qualifiers, in context in which they apply.
Communication throughout report)	Report difficult to understand	Understandable but poorly formatted following guidelines; many grammatical errors	Clearly formatted following guidelines with few grammatical errors	**Meets expectations and:** Concise, varied transitions, attractively formatted, no grammatical errors.

Program | APSC 100 | APSC 111 | APSC 131 | APSC 171 | ...

Course | Course Learning Outcomes ⇔ Assessment ⇔ Instructional Approach

Deliverable | Team Report | Tutorial Quiz | Teaming Evaluation

APSC-100: Engineering Practice I || 2012-2013

Course learning outcomes

1. Applies prescribed process for solving complex problems (3.02-FY1)
2. Selects and applies appropriate quantitative model and analysis to solve problems (3.02-FY2)
3. Evaluates validity of results and model to describe limitations and quantify error (3.02-FY3)
4. Composes structured document following prescribed format using standard grammar and mechanics (3.07-FY1)
5. Analyzes quantitative data to reach supported conclusion with explicit uncertainty (3.03-FY1)
6. Describe occupational health and safety principles (3.04-FY1)
7. Apply critical thinking principles to contextual scenarios (3.02-FY4)
8. Apply numerical modeling tool to create model used for solving complex problem. (3.05-FY1)
9. Construct arguments with claim, data, backing, and qualifier (3.02-FY5)

Week	Learning objectives	Instructional approach and content	Learning activity	Evaluation
1	4,5	***Lecture***: motivation, course overview, models.	***Lecture:*** Group activity to consider model for elevator failure problem	***Studio:*** CLA/Cornell Critical thinking pretest **(CLO7)** Word/Excel assignment **(CLO 4,5)**
2	1,2,3,8	***Pre-studio:*** MATLAB online module 1 ***Lecture:*** complex problem solving, risk, hazard analysis ***WHMIS course (evening)***	***Lecture:*** Group activity to develop process for resolving elevator failure problem ***Pre-studio:*** MATLAB online readiness quiz (no grades) ***MATLAB Studio***: intro to MATLAB (MATLAB in-class problem #1) OHS online safety module	MATLAB quiz #1 OHS online test **(CLO6)**
3	8,9	***Pre-studio:*** MATLAB online module 2 ***Lecture:*** argumentation, brainstorming, MEA1 expectations	***Lecture:*** analyze past assignments for effective argument ***MATLAB Studio***: Importing data (in-class problem #2)	MATLAB quiz #2
4	1,8	***Pre-studio:*** MATLAB online module 3 ***Lecture:*** concept maps, enthalpy	***Lecture:*** Group activity to develop process for enthalpy wheel problem ***MATLAB Studio***: Curve fitting and interp (in-class problem #3)	MATLAB quiz #3 Assignment 1 **(CLO1,2,3,4,7,8,9)**
5	8	***Pre-studio:*** MATLAB online module 4 ***Lecture:*** Teaming & leadership	***MATLAB Studio:*** Conditional statements (in-class problem #4) Teaming inventory	MATLAB quiz #4
6	…	…	…	…

-100: Engineering Practice I || 2012-2013
se learning outcomes
Applies prescribed process for solving complex problems (3.02-FY1)
Selects and applies appropriate quantitative model and analysis to solve problems (3.0
Evaluates validity of results and model to describe limitations and quantify error (3.02
Composes structured document following prescribed format using standard grammar a
Analyzes quantitative data to reach supported conclusion with explicit uncertainty (3.0
Describe occupational health and safety principles (3.04-FY1)
Apply critical thinking principles to contextual scenarios (3.02-FY4)
Apply numerical modeling tool to create model used for solving complex problem. (3.0
Construct arguments with claim, data, backing, and qualifier (3.02-FY5)

	1 (not demonstrated)	*2 (marginal)*	*3 (meets expectations)*	*4 (outstanding)*	*Mark*
Gathers information from appropriate sources *3.04-FY4: Gathers info*	No significant information used, not cited; blatant plagiarism.	Insufficient usage; improper citations.	Gathers and uses information from appropriate sources, including applicable standards, patents, regulations as appropriate, with proper citations	Uses information from multiple authoritative, objective, reliable sources; cited and formatted properly	/4
Plans and manages time and money *3.11-FY1: Manage time and money*	No useful timeline or budget described; poorly managed project; safety issues	Poor timeline or budget; infrequent meetings; minor safety problems	Plans and efficiently manages time and money; team effectively used meetings; safety considerations are clear	Efficient, excellent project plan presented; detailed budget; potential risks foreseen and mitigated	/4
Describes design process *3.04-FY1: Uses process*	No discussion of design process.	Generic design process described.	Describes design process used to design system, component, or process to solve open-ended complex problem.	Comprehensive design process described, with appropriate iterations and revisions based on project progress	/4
Incorporates social, environmental, and financial factors *3.09-FY4: Sustainability in decisions*	No consideration of these factors.	Factors mentioned but no clear evidence of impact on decision making.	Incorporated appropriate social, environmental, and financial factors in decision making	Well-reasoned analysis of these factors, with risks mitigated where possible	/4
Demonstrates appropriate effort in implementation	Insufficient output	Sufficient implementation but some opportunities not taken, or feedback at proposal not incorporated in implementation	Appropriate effort, analysis, and/or construction demonstrated to implement product, process, or system	Outstanding implementation	/4
Compares design solution against objectives *3.04-FY7: Compares solution*	No evaluation of design solution	Some factors missed in evaluating design solution	Compares the design solution against the project objectives and functional specifications, providing qualitative evaluation where appropriate	Comprehensive evaluation of design solution, with well-defended recommendations for future work or implementation	/4
Creates report following requirements	Poorly constructed report	Some organization problems, minor formatting problems, redundancy, spelling grammar/errors	Report achieves goal using formal tone, properly formatted, concisely written, appropriate use of figures, few spelling/grammar errors	Professional tone, convincing argument, authoritative, skillful transitions	/4
				Overall Grade:	/28

Sample Rubric (Queens)

Why not use grades to assess outcomes?

Student transcript

Electric Circuits I	78
Electromagnetics I	56
Signals and Systems I	82
Electronics I	71
Electrical Engineering Laboratory	86
Engineering Communications	76
Engineering Economics	88
...	
Electrical Design Capstone	86

How well does the program prepare students to solve open-ended problems?

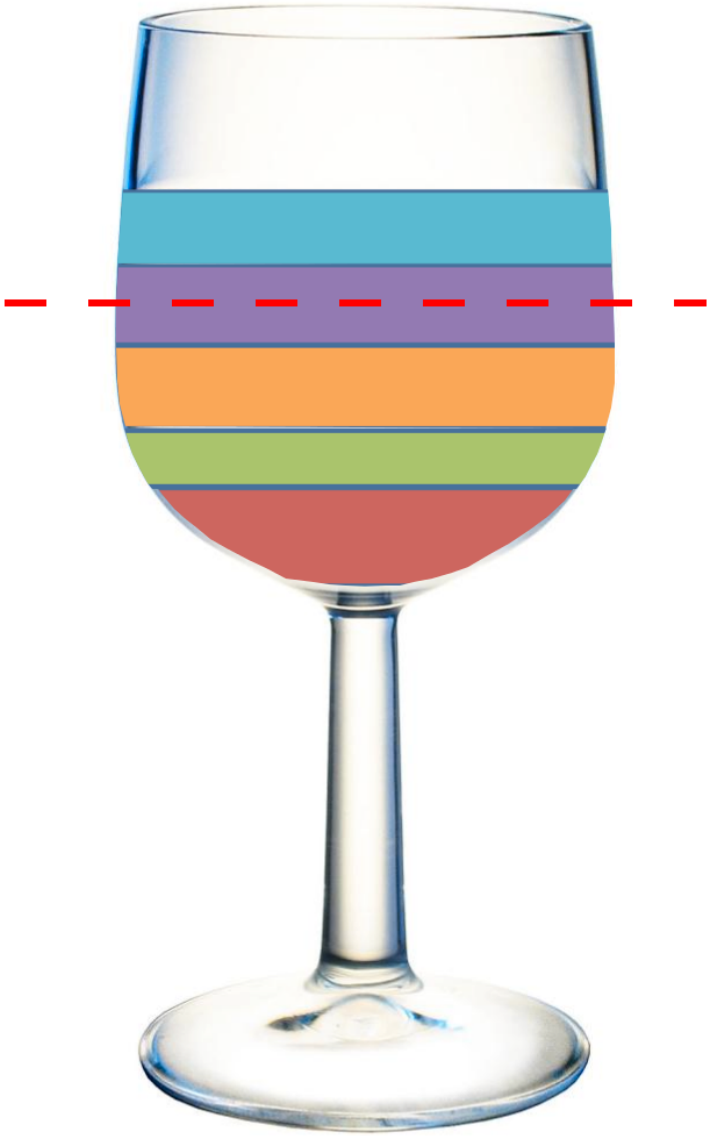
Are students prepared to continue learning independently after graduation?

Do students consider the social and environmental implications of their work?

What can students do with knowledge (plug-and-chug vs. evaluate)?

Course grades usually aggregate assessment of multiple objectives, and are *indirect* evidence for *some* expectations

Your course



Lab Investigation

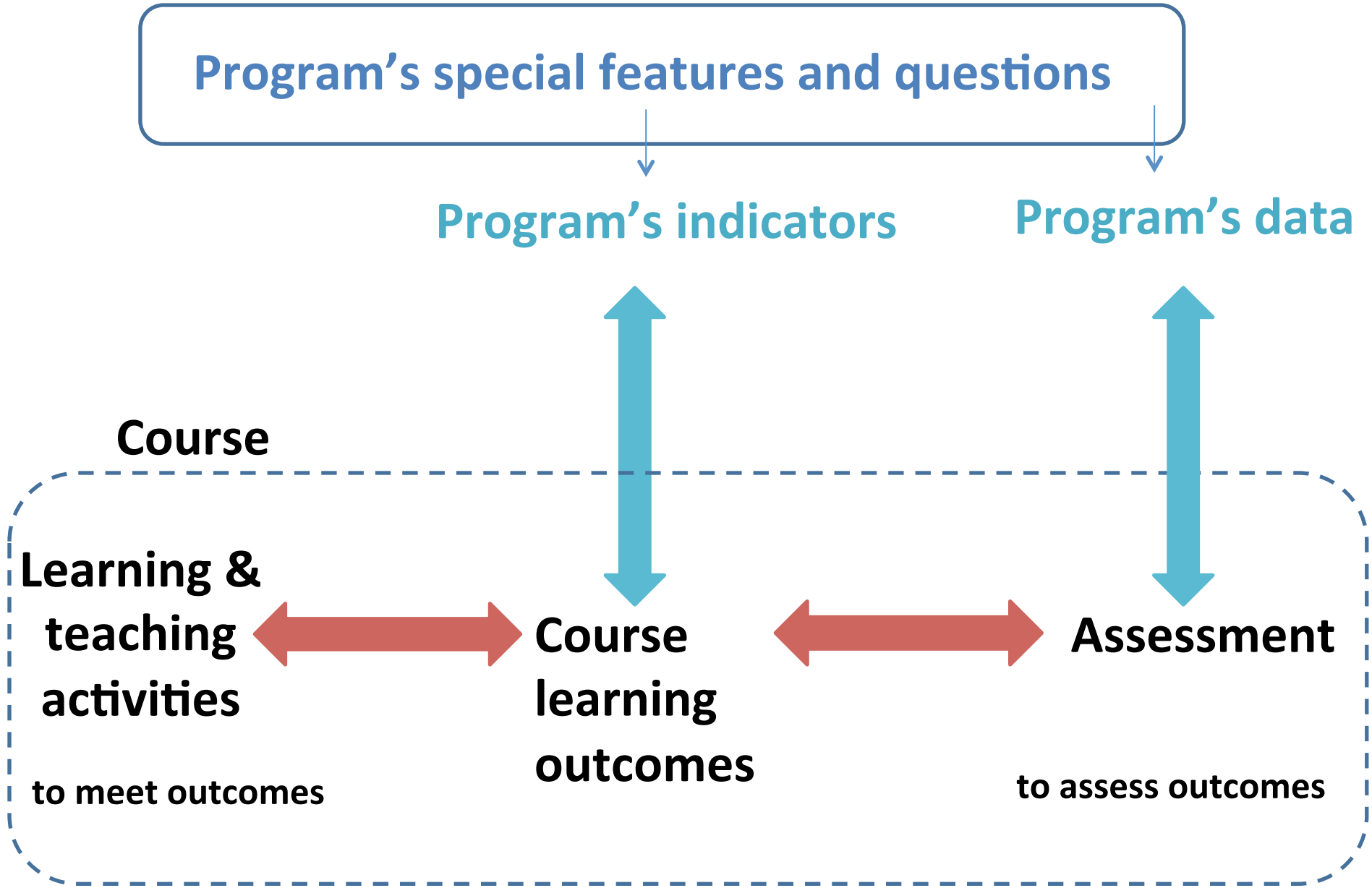
Problem Solving

Writing

Concept #2

Concept #1

ASSESSMENT AS COURSE INSTRUCTOR


Program's special features and questions
Program's indicators
Program's data
Course
Learning & teaching activities
to meet outcomes
Course learning outcomes
Assessment
to assess outcomes

At the course level,e.g. in a syllabus:

APSC-100 (Engineering practice)

This course will help you develop the following attributes:

{design, problem analysis, lifelong learning,…}

By the end of this course students will be able to:

1. Follow a provided design process to design system, component, or process to solve an open-ended complex problem as directed by a mentor. *{design}*
2. Critically evaluate information for authority, currency, and objectivity. *{lifelong learning}*
3. Lays out project plan with clear scope, milestones and delegation appropriate to project stage {*project management*}

Some of the learning outcomes could be a more specific form of the program-wide indicators.

Assessment Tools

How to measure learning against specific expectations?

- **Direct measures** – directly observable or measurable assessments of student learning
  - E.g. Student exams, reports, oral examinations, portfolios, concept inventories etc.
- **Indirect measures** – opinion or self-reports of student learning or educational experiences
  - E.g. grades, surveys, focus group data, graduation rates, reputation, etc.

Selecting Assessments

- Looking for assessments that are:
  - **Valid**: they measure what they are supposed to measure
  - **Reliable**: the results are consistent; the measurements are the same when repeated with the same subjects under the same conditions
- Capitalize on what you are already doing
- Look for "leading Indicators"
- One approach for dealing with qualitative assessments (not the only!) is with **Rubrics**

Assessment Tools

- Local written exam (e.g. question on final)
- External examiner (e.g. Reviewer on design projects)
- Standardized written exam (e.g. Force concept inventory)
- Oral exam (e.g. Design projects presentation)
- Performance appraisal (e.g. Lab skill assessment)
- Oral interviews
- Simulation (e.g. Emergency simulation)
- Surveys and questionnaires
- Behavioural observation (e.g. Team functioning)
- Focus group
- Portfolios (student maintained material)
- Archival records (registrar's data, records, ...)

Course planning table: link outcomes to assessment tools

ELEC-252 2013-2014 || Weekly overview

Course learning outcomes (CLO): Students will be able to:

1. *Select and use a small signal model to predict behaviour of common nonlinear active devices
2. Calculate current and voltage at nodes of non-linear devices when connected using common bias networks using large signal model
3. *Calculate component values to implement common amplifier configurations
4. In a small team, select and design an appropriate amplifier topology for a real-world application

Pre-class: A pre-class reading or learning activity will be assigned before most lectures and studios. A short quiz will be held at the beginning of the tutorial each week on the pre-class readings.

Week	Lecture approach and content	Tutorial approach and content	Assessment (CLO, and % of course grade)
1:Sep 9	Motivation for the course, course overview, academic integrity expectations, group-based clicker problems.	Electronics concept inventory pre-test (same test to be given at end of course)	***Electronics concept inventory pre-test*** targeting CLO 1,2,3 (worth 1% of course grade)
2:Sep 16	Two terminal and three terminal active devices (diodes and transistors). Non-linear vs linear devices, applications. Group and individual clicker questions.	Team problem solving, followed by computer-based quiz question.	***In-tutorial computer-based quiz*** *targeting CLO 1 (worth 4% of course grade)*
3:Sep 23	***Lecture:*** Applications and characteristics of amplifiers.	Team project planning: Identify requirements of project, power requirements, frequency range	
4: Sep 30	***Lecture: …***	Team problem solving, followed by computer-based quiz question.	***In-tutorial computer-based quiz*** *targeting CLO 1 (worth 4% of course grade)*
6: Oct 14	***Lecture:*** ….	…	***Midterm exam:*** *2 questions will target CLO1 (worth 20% of course grade)*
…	…	…	…
12:	…	…	***Final team project:*** *targets CLO4 (worth 10% of course grade)*
EXAM			***Final exam:*** *Two questions will target each CLO (worth 50% of course grade)*

Group working time (20 min)

Work with a group of 2-3 people, and select a course as the context for assessing some indicators.

Select or create course learning outcome for that course, or pick some indicators developed this morning, or use some of the sample learning outcomes from this morning… (find something!)

Start on a course planning table, identifying when and how those indicators will be assessed.

A template is in the Workshop 3B Google Drive directory.

FOLLOW-UP: DISCUSSION?

Example: Evaluating knowledge

- Physics course instructors administering the Force Concept Inventory (FCI) before and after course in mechanics to assess conceptual understanding
- Allows for benchmarking, which is difficult to do for most other indicators.

SCORING/EVALUATING

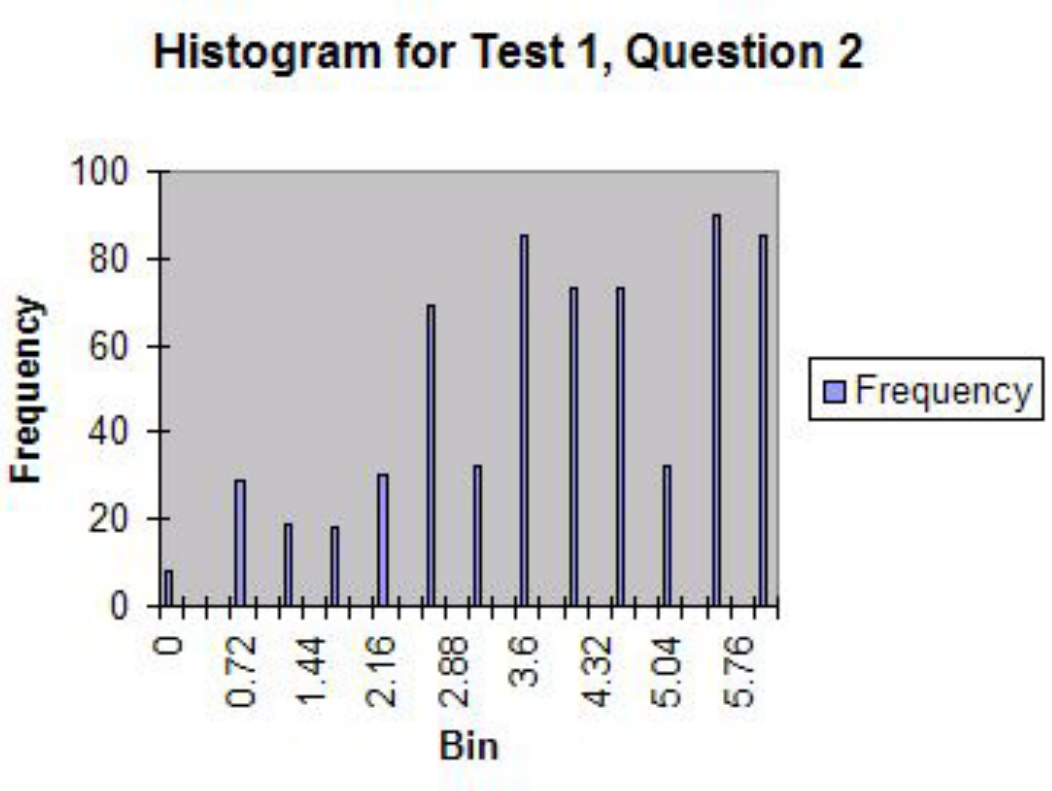
Example: Evaluating knowledge

- Calculus instructor asked questions on exam that specifically targeted 3 indicators for "Knowledge":
  1. "Create mathematical descriptions or expressions to model a real-world problem"
  2. "Select and describe appropriate tools to solve mathematical problems that arise from modeling a real-world problem"
  3. "Use solution to mathematical problems to inform the real-world problem that gave rise to it"

Example (cont'd):

- The student can create and/or select mathematical descriptions or expressions for simple real-world problems involving rates of change and processes of accumulation (overlaps problem analysis)

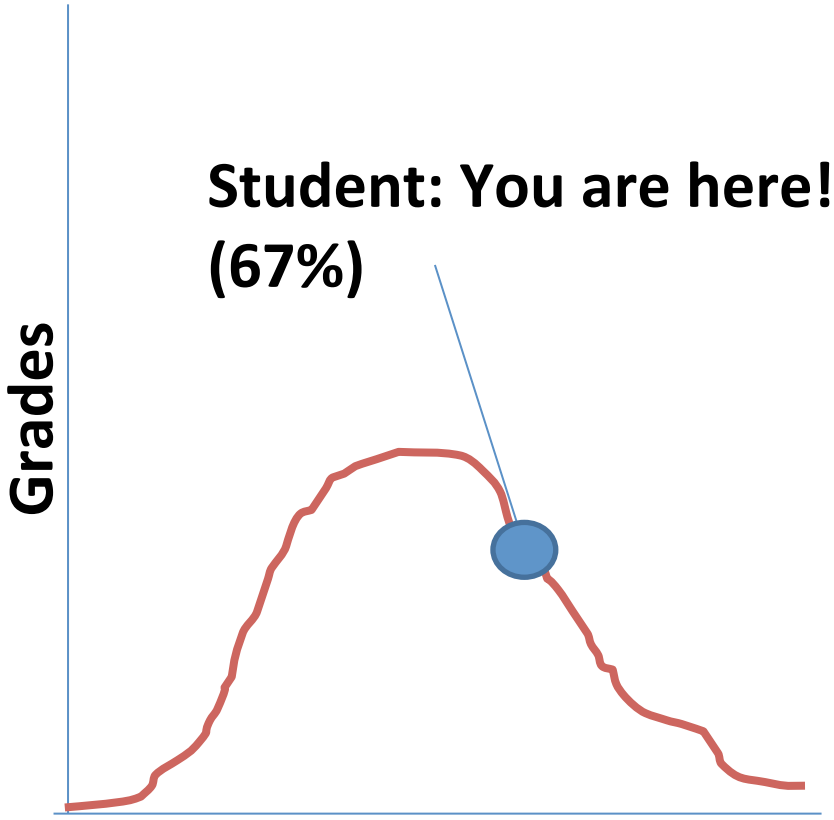
Context: calculating Intersection of two trajectories



When assessing non-quantitative student work

- Need to ensure that instructor, students, curriculum committee, and program visitors clearly know how items are scored for data gathering
- Often we use norm-referenced grading – certain percentage get an ‘A’, ‘B’, etc. Or grades are bell curved to achieve some desired distribution

Norm referenced evaluation



Used for large scale evaluation to compare students against each other

Criterion referenced evaluation

Student has marginally met expectations because submitted work mentions social, environmental, and legal factors in design process but no clear evidence of that these factors Impacted on decision making.

Used to evaluate students against stated criteria

	1 (not demonstrated)	*2 (marginal)*	*3 (meets expectations)*	*4 (outstanding)*	*Mark*
Gathers information from appropriate sources *3.04-FY4: Gathers info*	No significant information used, not cited; blatant plagiarism.	Insufficient usage; improper citations.	Gathers and uses information from appropriate sources, including applicable standards, patents, regulations as appropriate, with proper citations	Uses information from multiple authoritative, objective, reliable sources; cited and formatted properly	/4
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Demonstrates appropriate effort in implementation	Insufficient output	Sufficient implementation but some opportunities not taken, or feedback at proposal not incorporated in implementation	Appropriate effort, analysis, and/or construction demonstrated to implement product, process, or system	Outstanding implementation	/4
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Sample Rubric (Queens)				**Overall Grade:**	/28

threshold target

Old Evaluation Form (UBC)

	0	1	2	3	4	5
Is the parameter/factor being studied important to the overall project success? The team should be able to describe why they are conducting the prototype test and what they hope to find with it. They should be able to explain why this particular prototype test is preferred over a calculation or simulation.						
Has an appropriate prototyping method been selected? Given what the teams want to find, have they selected a good approach? (Does it have sufficient accuracy? Is it reasonably insensitive to other parameters? Is there an obvious better/simpler/more accurate way to run the test?)						
What is the quality of the prototype, the test execution, and the results? Did the team do a good job in building their prototype, running their tests, and analyzing/interpreting the data?						
Are the findings being used appropriately? How does the team plan to incorporate the results of the prototype test to their design? Do they understand the limitations of the data they have collected?						
Totals						

Evaluation Reformatted as Rubric (UBC)

Criterion	Level of Mastery			
	Unacceptable **0**	**Below Expectations** **1**	**Meets Expectations** **2**	**Exceeds Expectations** **3**
2.1 Problem Identification	Team is NOT able to identify the parameter they are using the prototype to study.	Parameter studied is NOT directly relevant to project success.	Parameter studied is appropriate for project, AND the team is able to provide *some* justification why.	Parameter studied is appropriate for project, AND the team is able to provide *strong* justification why.
3.2 Investigation Design	Team has NOT built a prototype.	Prototyping method is NOT appropriate for the parameter being studied (i.e. will not yield desired data).	Prototyping method is *at least somewhat* appropriate for the parameter being studied; a simpler approach MAY exist	Prototyping method is appropriate for the parameter being studied, AND the team is able to *clearly* justify why the physical prototype used is superior to other physical or virtual prototypes.
3.3 Data Collection	No data collected; prototype does NOT work	The prototype works BUT data collection / analysis techniques are inappropriate.	Data collection and analysis are done appropriately AND data quality is *fair*.	Data collection and analysis are done appropriately AND data is of *high* quality.
3.4 Data Synthesis	No conclusions are drawn, OR inappropriate conclusions are drawn.	Appropriate conclusions are drawn from the data, BUT the team is NOT able to explain the how the data affects the project.	Appropriate conclusions are drawn from the data, AND the team is able to provide *some* explanation of how the data affects the project. Some implications are overlooked.	Appropriate conclusions are drawn from the data, AND the team is able to provide *strong and complete* explanation of how the data affects the project.
3.5 Analysis of Results	The team does NOT consider limitations or errors in the tests, or validity of the conclusions.	The team considers errors, limitations, and validity in the tests, BUT does NOT quantify errors or take appropriate action.	The team quantifies errors, and considers limitations and validity, AND takes action, BUT action is *limited* or somewhat inappropriate.	The team quantifies errors, and considers limitations and validity, AND is able to *justify* and take appropriate action.

Group working time (20 min)

Take an activity from the course you worked on, and start developing a way of evaluating it (e.g. a rubric)

A rubric template is in the Workshop 3B Google Drive directory.

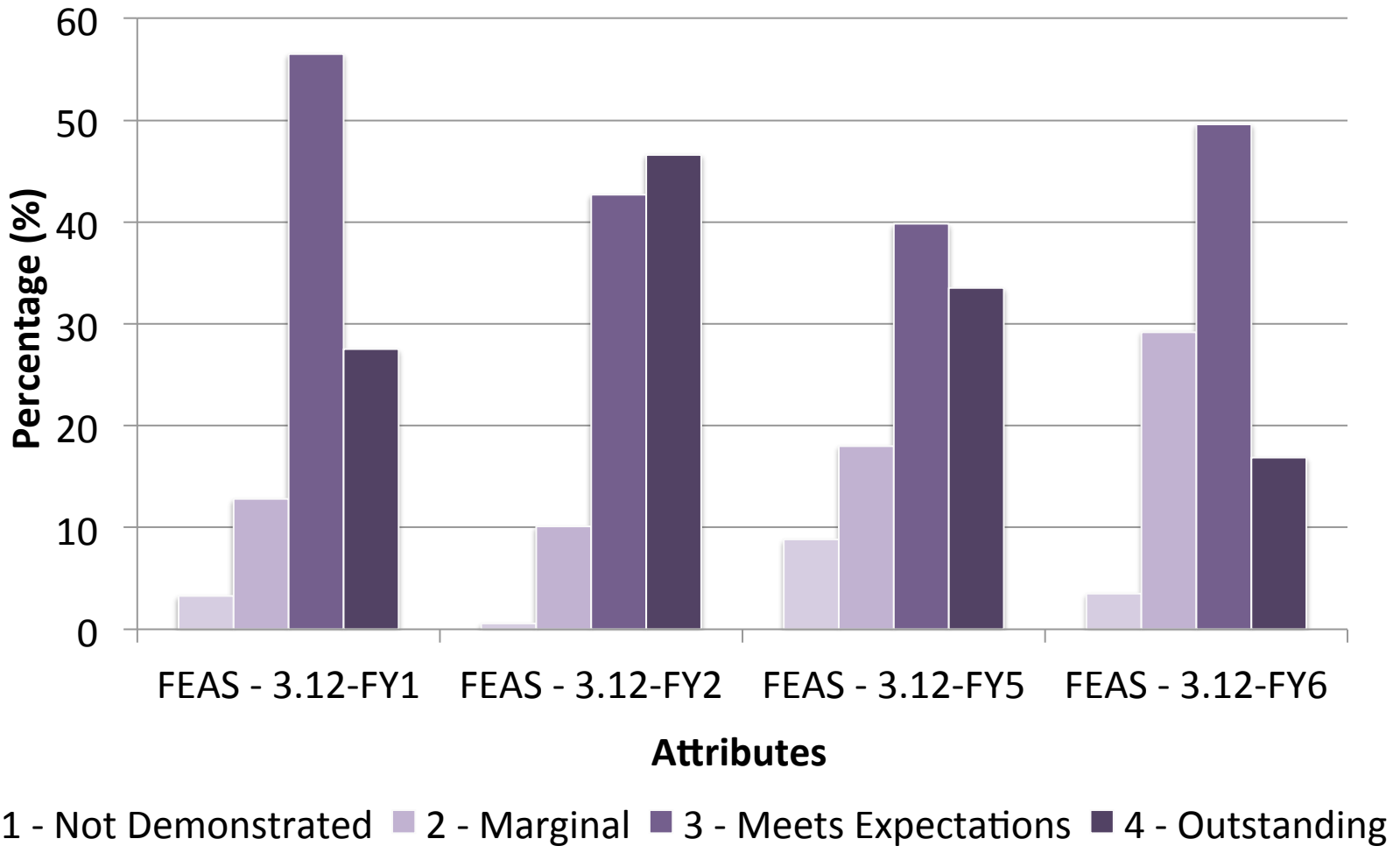
Avoid duplication in grading if possible

- Why grade students for their course grades separately from assessment for program improvement?
- E.g. use embedded questions
  - Set tests, exams, quizzes, etc. such that specific questions are linked to specific indicators
  - Record marks separately by question, or on a rubric dimension (discussed later)

Summary: Assessments

- Determine how indicators will be assessed (reports, presentations, observation, etc.)
- Direct assessment and indirect assessment can be useful
- Rubrics can help to increase reliability and validity
- Another approach: embedded questions
  - Set tests, exams, quizzes, etc. such that specific questions are linked to specific indicators
  - Record marks separately by question

Histograms for Lifelong learning (Queens)



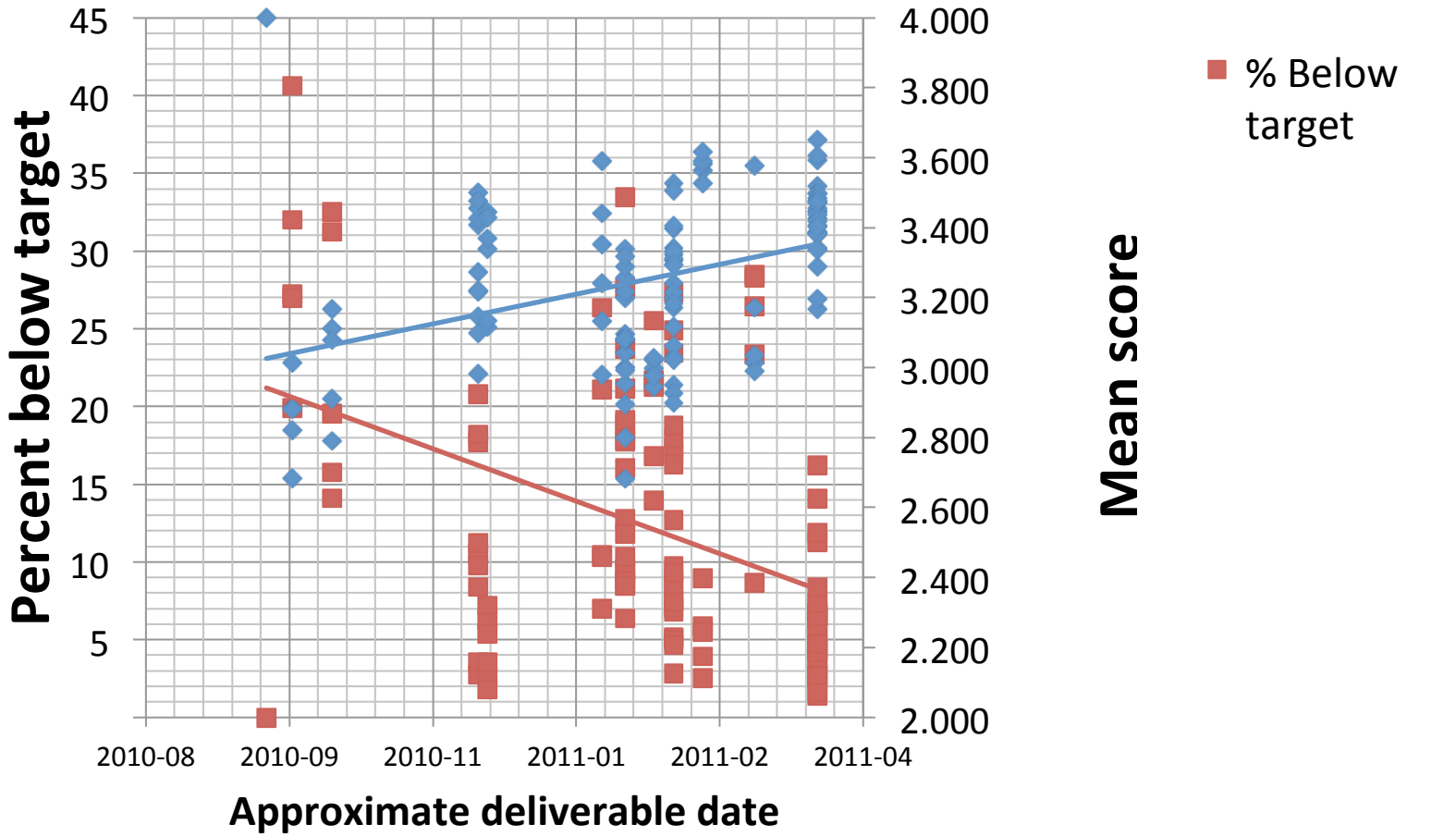
3.12-FY1 Uses information effectively, ethically, and legally to accomplish a specific purpose, including clear attribution of Information sources.

3.12-FY2 Identifies a specific learning need or knowledge gap.

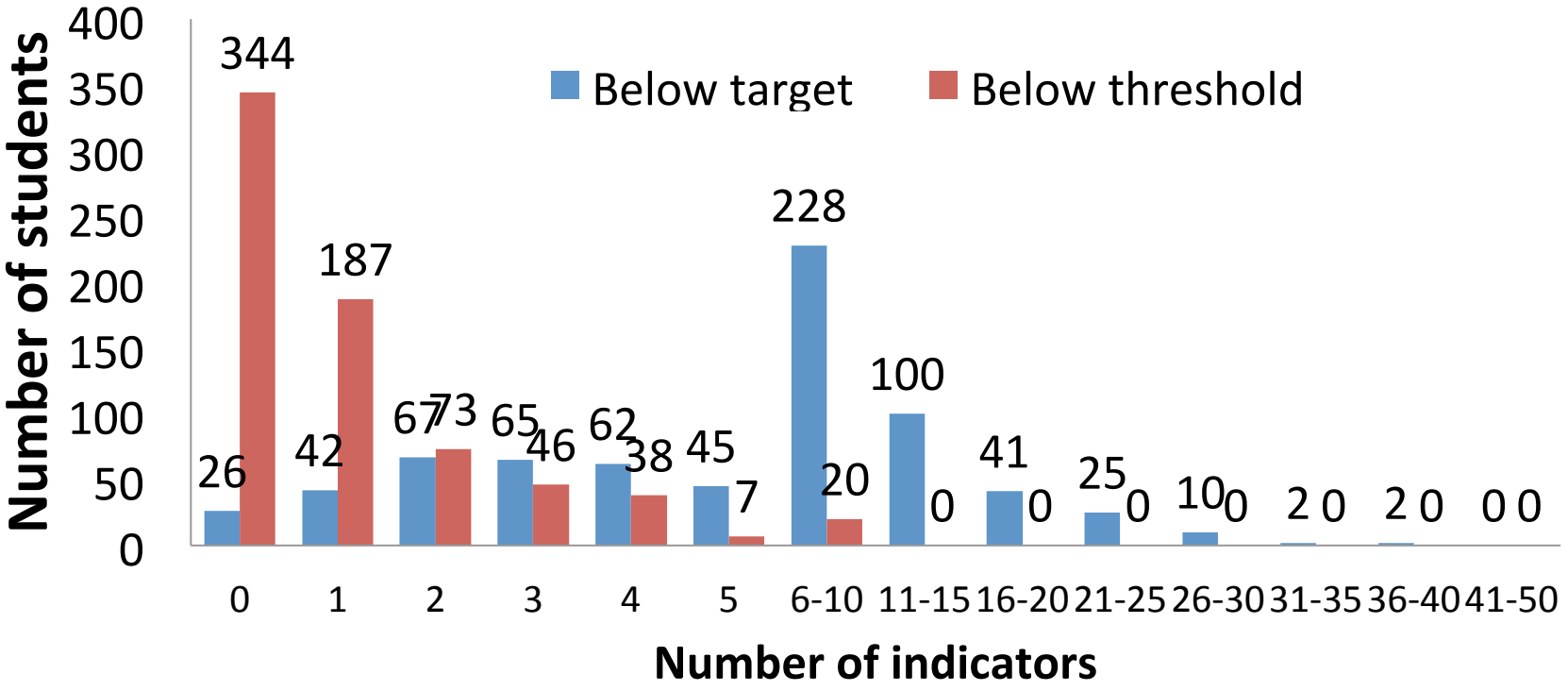
3.12-FY5 Identifies appropriate technical literature and other information sources to meet a need

3.12-FY6 Critically evaluates the procured information for authority, currency, and objectivity.

Could look for trends over a semester (Queen's)…



Could look at performance by student (Queen's)

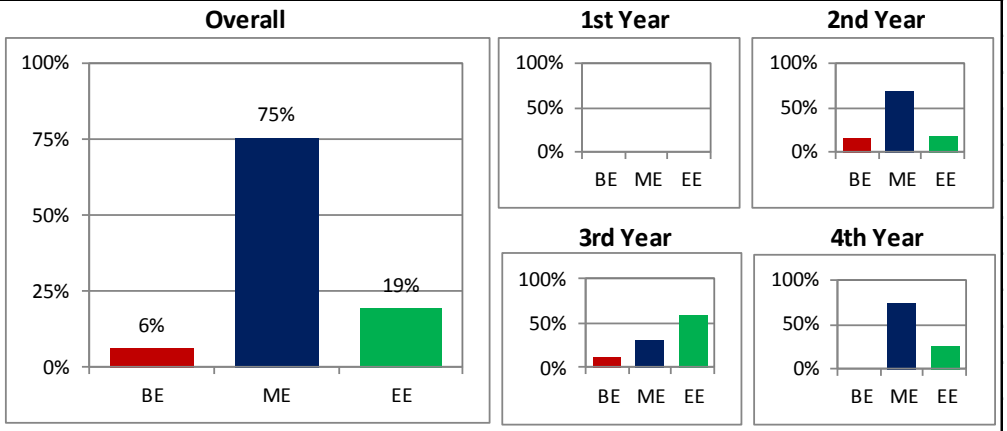


Histograms / Summary for Design (UBC)

Attribute 4: Design

An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.

Below Expectations: 6%
Meets Expectations: 75%
Exceeds Expectations: 19%



Indicator Summary	Courses and elements assessed
4.4 Solution Generation Produce a variety of potential design solutions suited to meet functional specifications	MECH 223 Formal report 1 & 2 MECH 223 Oral presentation 1 & 2 MECH 45X Concept selection report
4.5 Solution Evaluation Perform systematic evaluations of the degree to which several design concept options meet project criteria	MECH 223 Formal report 1 & 2 MECH 223 Oral presentation 1 & 2 MECH 45X Concept selection report
4.6 Detailed Design Apply appropriate engineering knowledge, judgement, and tools, in creating and analyzing design solutions criteria	MECH 223 Formal report 1 & 2 MECH 325 Assignments 1-5 MECH 45X Preliminary design report

E.g. Queen's changes informed by data

Based on evaluation of the data, the following changes are planned:

- The existence and importance of attributes for engineering practice will be communicated and used more extensively, and linked to learning objectives in courses.
- At the first year level, the program is being revised in the areas including making effective arguments, evaluating complex problem solutions against objectives, written communications, and evaluating information.
- At the second year level, more emphasis will be placed on summarizing important information clearly and concisely, effectively participating in informal small group discussions, and on risk assessment and project planning.
- A 4-year sequence of courses in engineering design and practice is being developed to develop and assess attributes in broad integrative experiences, like team projects, that emulate professional practice.

END OF WORKSHOP 3B