CEEA Graduate Attribute Assessment Workshop

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Objectives

1. Understand expectations for graduate attribute assessment

2. Apply accepted assessment principles to CEAB graduate attribute requirements

3. Be able to create a process to generate data that can inform program improvement

Be able to use:

- Tools
- Technology
- Terminology
Administrative issues

Questions/issues/discussion?  →  Paper

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Summary 1-page handout for reference (terminology, process)

Active workshop - feel free to ask questions or comment throughout
“The institution must demonstrate that the graduates of a program possess the attributes under the following headings... There must be processes in place that demonstrate that program outcomes are being assessed in the context of these attributes, and that the results are applied to the further development of the program.”
Background

- Accreditation bodies in most industrialized countries use outcomes-based assessment to demonstrate their students' capabilities.
- *Washington Accord*: allows substantial equivalency of graduates from Australia, Canada, Hong Kong, Republic of Ireland, New Zealand, South Africa, United Kingdom, and United States, Japan, Singapore, Korea, and Chinese Taipei
- Discussions by CEAB and National Council of Deans of Engineering and Applied Science (NCDEAS) led to graduate attribute expectations in 2008
National Response

- Over the past year, NCDEAS and CEAB set up pilot projects running at:
  - Guelph University
  - UBC
  - University of Calgary
  - University of Toronto
  - Université de Sherbrooke
  - Queen's University (coordinating institution)
- Workshops run at NCDEAS, Queen's, Toronto, Dalhousie, CEEA 2010 Conference
National Response (cont’d)

• Engineering Graduate Attribute Development (EGAD) project formed by representatives from those schools

• Developing workshops, resources, processes to share with other schools
Graduate attribute assessment

*Outcomes* assessment is used to answer questions like:

What can students *do*?

How does their performance compare to our stated expectations?

It identifies gaps between our perceptions of what we teach and what knowledge, skills, and attitudes students develop *program-wide*. 
<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student pre-university background</td>
<td>Demonstrated abilities (cognitive, skills, attitudes)</td>
</tr>
<tr>
<td>Faculty education, professional status</td>
<td></td>
</tr>
<tr>
<td>Ongoing faculty development</td>
<td></td>
</tr>
<tr>
<td>Class sizes</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td></td>
</tr>
<tr>
<td>Campus resources</td>
<td></td>
</tr>
<tr>
<td>Contact hours</td>
<td></td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td></td>
</tr>
<tr>
<td>Support services</td>
<td></td>
</tr>
</tbody>
</table>
Outcomes assessment widely used

- Common in the Canadian primary, secondary, and community college educational systems
- National recommendations from provincial Ministers of Education, now *required* for all Ontario post-secondary programs: Undergraduate Degree-Level Expectations (OCAV UDLEs)
  - Depth and Breadth of Knowledge
  - Knowledge of Methodologies
  - Application of Knowledge
  - Communication Skills
  - Awareness of Limits of Knowledge
  - Autonomy and Professional Capacity
Good news:

Most programs probably already have people doing this on a small scale:

- Some instructors already use course learning outcomes
- Design course instructors often assess design, communications, teaming skills separately
- Rubrics are becoming common for assessing non-analytical outcomes

Can identify innovators and key instructors (e.g. project-based design courses, communications, economics)
Setting up a process

(without overwhelming faculty, irritating staff, and going deeper into debt)
CEAB graduate attributes (Sec 3.1)

Knowledge base

Problem analysis

Investigation

Use of engineering tools

Design

Individual and team work

Communication skills

Professionalism

Impact on society and environment

Ethics and equity

Economics and project management

Lifelong learning

Engineering science

Laboratory

Project/experiential
Questions for programs:

What are your program's specific and measurable expectations?

How will you measure the students against specific expectations?

Given requirements:
Assess in 12 broad areas (graduate attributes), and create a process for program improvement.

Processes in place for analyzing data and using it for improvement?

Where to measure the expectations (courses, internships, extra-curriculars...)?
Example of comprehensive curriculum design overview

by P. Wolf at U Guelph

Course development process

1. Identify course objectives and content
2. Create specific objectives for each class
3. Map to experiences (lectures, projects, labs, etc.)
4. Identify appropriate tools to assess (reports, simulation, tests, ...)
5. Student input
6. Course changes/Measure
7. Analyze and evaluate data
8. Course improvement
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Create Indicators
3. Map to courses/ experiences
4. Identify appropriate tools to assess (reports, simulation, tests, ...)
5. Course changes/ Measure
6. Stakeholder input
7. Analyze and evaluate data
8. Program improvement
Assessment principles (adapted from ABET)

- Assessment works best when the program has clear objectives.
- Assessment requires attention to both outcomes and program.
- Assessment should be periodic, not episodic
- Assessment should be part of instruction
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Create Indicators
3. Map to courses/ experiences
4. Identify appropriate tools to assess (reports, simulation, tests,...)
5. Stakeholder input
6. Course changes/ Measure
7. Analyze and evaluate data
8. Program improvement
Creating Program objectives

- CEAB graduate attributes
- Strategic plans
- Advisory boards
- Major employers of graduates
- Input from stakeholders
- Focus groups, surveys
- SWOT (strengths, weaknesses, opportunities, threats) analysis

What do you want your program to be known for?
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Create indicators
3. Map to courses/experiences
4. Stakeholder input
5. Course changes/Measure
6. Analyze and evaluate data
7. Program improvement
8. Identify appropriate tools to assess (reports, simulation, tests,...)
Why performance indicators?

Lifelong learning
An ability to identify and address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

Can this be directly measured?
Would multiple assessors be consistent?
How meaningful would the assessment be?

Probably not, so more specific measurable indicators are needed. This allows the program to decide what is important
Indicators: examples

**Lifelong learning**
An ability to identify and address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

**Graduate attribute**

The student:

- Critically evaluates information for authority, currency, and objectivity
- Develops a research plan to meet information needs
- Describes the types of literature of their field and how it is produced
- Uses information ethically and legally to accomplish a specific purpose
Establishing Indicators

- What specific things should students demonstrate?
- What do they need to be able to do?
- Are they measurable and meaningful?
- Can involve cognitive (recalling, analyzing, creating), attitudes, skills

Level of expectation
(“describes”, “compares”, “applies”, “creates”, etc.)

Critically evaluates information for authority, currency, and objectivity

Content area
Problematic criteria

What does the author mean? Students can state the laws? Plug numbers into equations? Apply laws to solve conceptual problems? ...

Content area

Learns static physics principles including Newtonian laws for linear motion
Creating
(design, construct, generate ideas)

Evaluating
(critique, judge, justify decision)

Analyzing
(compare, organize, differentiate)

Applying
(use in new situation)

Understanding
(explain, summarize, infer)

Remembering
(list, describe, name)

### Verbs for cognitive skills

<table>
<thead>
<tr>
<th>Define</th>
<th>Interpret</th>
<th>Analyze</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td>Compare</td>
<td>Hypothesize</td>
</tr>
<tr>
<td>State</td>
<td>Contrast</td>
<td>Evaluate</td>
</tr>
<tr>
<td>Recall</td>
<td>Solve</td>
<td>Justify</td>
</tr>
<tr>
<td>Identify</td>
<td>Estimate</td>
<td>Develop</td>
</tr>
<tr>
<td>Recognize</td>
<td>Explain</td>
<td>Create</td>
</tr>
<tr>
<td>Calculate</td>
<td>Classify</td>
<td>Extrapolate</td>
</tr>
<tr>
<td>Label</td>
<td>Modify</td>
<td>Design</td>
</tr>
<tr>
<td>Locate</td>
<td>Integrate</td>
<td>Critique</td>
</tr>
</tbody>
</table>

**Higher order skills**
<table>
<thead>
<tr>
<th>Knowing:</th>
<th>Define the concepts of engineering stress and engineering strain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding:</td>
<td>Explain Hooke’s Law in your own words and describe the conditions under which it is applicable.</td>
</tr>
<tr>
<td>Applying:</td>
<td>Utilize Poisson’s Ratio to calculate lateral strain given a longitudinal loading situation.</td>
</tr>
<tr>
<td>Analysing:</td>
<td>Discuss the specific characteristics of the microstructure that render the stress-strain behaviour of a polymeric material as brittle, plastic, or elastic.</td>
</tr>
<tr>
<td>Synthesizing:</td>
<td>Investigate recyclability/disposability issues relative to (a) metals, (b) glass, (c) polymers, and (d) composites.</td>
</tr>
<tr>
<td>Creating:</td>
<td>Argue the economic viability of the “green design” philosophy of product design.</td>
</tr>
</tbody>
</table>
Defining Indicators for your Program (10 min)

In groups of 2-4:

1. Select a graduate attribute
2. Independently create some indicators for that attribute that reflect your program objectives
3. Discuss indicators at your table. Are they measurable? Are they meaningful? Would the assessment of them be consistent from one rater to another?
Follow-up to identifying Indicators

Any points for discussion?
Resources on Indicators

- EC2000, ABET 2009
- UK-SPEC, Engineering Subject Centre Guide
- Engineers Australia
- CDIO
- Foundation Coalition
- UDLEs
- Discipline-specific (Civil Engineering Body of Knowledge, IET criteria for electrical and computer engineering, etc.)

Note: Indicators may also be known as:
- Assessment criteria
- Performance criteria
- Outcomes
- Competencies
- Objectives

Many linked at:
http://bit.ly/9OSODq (case sensitive, no zeros)
Program-wide assessment process flow

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2. Identify indicators
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Performance indicator mapping

First year courses
- Design
- Physics
- Calculus
- Chemistry
- etc.

Design project course
- Assignment 1
  - Indicator 1
  - Indicator 2
  - Indicator 3
- Assignment 2
  - Indicator 1
  - Indicator 4
  - Indicator 5
- Team proposal
  - Indicator 1
  - Indicator 6
  - Indicator 7
  - etc.
Where can we assess students?

- Courses
- Co-ops/internships
- Co-curricular activities (competitive teams, service learning, etc.)
- Exit or alumni surveys/interviews
- ...

Assessment Mapping

- Mapping process focuses on where students should be *assessed*, not on every course where material is *taught*

- In a typical program the courses involved in *assessing* students are a small subset of courses. This might include a few courses from areas including:
  - Engineering science
  - Laboratory
  - Complementary studies
  - Project/experiential based
Example: ABET recommends mapping tables

<table>
<thead>
<tr>
<th>Assessment Criteria</th>
<th>Development</th>
<th>Assessment Method</th>
<th>Measurement</th>
<th>Time measured</th>
<th>Assessment coordinator</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produces research information for the team</td>
<td>ME113, EM213, ME213, ME235, ME333, ME412</td>
<td>Portfolios Peer Evaluations, Faculty Evaluations</td>
<td>ME 213 ME412</td>
<td>ME 213 Even ME412 Odd</td>
<td>Even – Armaly Odd - Richards</td>
<td>Curriculum Committee</td>
</tr>
<tr>
<td>Demonstrates understanding of team roles when assigned</td>
<td>ME113, EM213, ME213, ME235, ME333, ME412</td>
<td>Peer Evaluations, Faculty Evaluations</td>
<td>ME 213 ME412</td>
<td>ME 213 Even ME412 Odd</td>
<td>Even – Armaly Odd - Richards</td>
<td>Curriculum Committee</td>
</tr>
<tr>
<td>Shares in the work of the team</td>
<td>ME113, EM213, ME213, ME235, ME333, ME412</td>
<td>Peer Evaluations, Faculty Evaluations</td>
<td>ME 213 ME412</td>
<td>ME 213 Even ME412 Odd</td>
<td>Even – Armaly Odd - Richards</td>
<td>Curriculum Committee</td>
</tr>
<tr>
<td>Demonstrates good listening skills</td>
<td>ME113, EM213, ME213, ME235, ME333, ME412</td>
<td>Peer Evaluations, Faculty Evaluations</td>
<td>ME213 ME412</td>
<td>ME 213 Even ME412 Odd</td>
<td>Even – Armaly Odd - Richards</td>
<td>Curriculum Committee</td>
</tr>
</tbody>
</table>
Curriculum mapping

• Can be useful to survey instructors to find out where attributes are Introduced, Developed, or Utilized (ITU) in courses – may be surprised what is already in the program!

• U Guelph developing Currickit: Curriculum Mapping Software

• U Calgary using the CDIO syllabus
3.1.1 Knowledge base for engineering
3.1.2 Problem Analysis
3.1.3 Investigation
3.1.4 Design
3.1.5 Use of engineering tools
3.1.6 Individual and team work
3.1.7 Communication skills
3.1.8 Professionalism
3.1.9 Impact of eng on society & environment
3.1.10 Ethics and equity
3.1.11 Economics and project management
3.1.12 Life-long learning

Number of Courses

1st Year 2nd Year 3rd Year 4th Year
CEAB Graduate Attributes Taught² (Mechanical Engineering)

Number of Courses

- 3.1.1 Knowledge base for engineering
- 3.1.2 Problem Analysis
- 3.1.3 Investigation
- 3.1.4 Design
- 3.1.5 Use of engineering tools
- 3.1.6 Individual and team work
- 3.1.7 Communication skills
- 3.1.8 Professionalism
- 3.1.9 Impact of engineering on society & environment
- 3.1.10 Ethics and equity
- 3.1.11 Economics and project management
- 3.1.12 Life-long learning

Legend:
- 1st Year
- 2nd Year
- 3rd Year
- 4th Year

June 7, 2010

Graduate Attribute Assessment Workshop Nov 2010
Program-wide assessment process flow

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Program improvement
How to measure the students against specific expectations?

- **Direct measures** – directly observable or measurable assessments of student learning
  - E.g. Student exams, reports, oral examinations, portfolios, etc.

- **Indirect measures** – opinion or self-reports of student learning or educational experiences
  - E.g. grades, student surveys, faculty surveys, focus group data, graduation rates, reputation, etc.
### Assessment tools

<table>
<thead>
<tr>
<th>Local written exam</th>
<th>External examiner</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. question on final)</td>
<td>(e.g. Reviewer on design projects)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standardized written exam</th>
<th>Oral exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. Force concept inventory)</td>
<td>(e.g. Design projects presentation)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance appraisal</th>
<th>Oral interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. Lab skill assessment)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Surveys and questionnaires</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. Emergency simulation)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behavioural observation</th>
<th>Focus group</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. Team functioning)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Portfolios</th>
<th>Archival records</th>
</tr>
</thead>
<tbody>
<tr>
<td>(student maintained material addressing outcomes)</td>
<td>(registrar's data, previous records, ...)</td>
</tr>
</tbody>
</table>
Instructors: “We do assess outcomes – by grades”

Student transcript

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Circuits I</td>
<td>78</td>
</tr>
<tr>
<td>Electromagnetics I</td>
<td>56</td>
</tr>
<tr>
<td>Signals and Systems I</td>
<td>82</td>
</tr>
<tr>
<td>Electronics I</td>
<td>71</td>
</tr>
<tr>
<td>Electrical Engineering Laboratory</td>
<td>86</td>
</tr>
<tr>
<td>Engineering Communications</td>
<td>76</td>
</tr>
<tr>
<td>Engineering Economics</td>
<td>88</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Electrical Design Capstone</td>
<td>86</td>
</tr>
</tbody>
</table>

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.
External assessment tools

- Concept inventories (Force Concept Inventory, Statics concept inventory, Chemistry Concept Inventory, ...)

- Surveys of learning, engagement, etc.
  - National Survey of Student Engagement (National data sharing, allowing internal benchmarking), E-NSSE
  - Course Experience Questionnaire
  - Approaches to Studying Inventory
  - Academic motivation scale
  - Engineering attitudes survey
Targets and thresholds

• Need to be able to explain what level of performance is expected of students

• Useful to consider the minimum performance expectation (threshold) and what a student should be able to do (target)

• Rubrics can be very useful
### Rubrics

<table>
<thead>
<tr>
<th>Scales Dimensions</th>
<th>Not demonstrated</th>
<th>Marginal</th>
<th>Meets expectations</th>
<th>Exceeds expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension 1: Information</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
</tr>
<tr>
<td>Dimension 2: Design</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
</tr>
<tr>
<td>Dimension 3: Communications</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
<td>Descriptor</td>
</tr>
</tbody>
</table>

- Improve inter-rater reliability
- Describe expectations for instructor and students
Rubric example

<table>
<thead>
<tr>
<th>APSC-XXX (2010-2011)</th>
<th>Example assessment overview for an assignment (e.g. final report)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part I: Criteria for CEAB accreditation and assignment grade</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 (not demonstrated)</td>
</tr>
<tr>
<td><strong>Information Management</strong></td>
<td></td>
</tr>
<tr>
<td>3.04-FY4: Gathers info</td>
<td>No significant information used, not cited; blatant plagiarism.</td>
</tr>
<tr>
<td><strong>Project Management</strong></td>
<td></td>
</tr>
<tr>
<td>3.11-FY1: Manage time and money</td>
<td>No useful timeline or budget; missed meetings; inappropriate safety considerations</td>
</tr>
<tr>
<td><strong>Design process</strong></td>
<td></td>
</tr>
<tr>
<td>3.04-FY1: Uses process</td>
<td>No discussion of design process.</td>
</tr>
<tr>
<td><strong>Design Evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>3.04-FY7: Compares solution</td>
<td>No mention of functional specifications</td>
</tr>
<tr>
<td><strong>Sustainability</strong></td>
<td></td>
</tr>
<tr>
<td>3.09-FY4: Sustainability in decisions</td>
<td>No consideration of societal or ecological impact.</td>
</tr>
</tbody>
</table>

- Creating defined levels ("scales") of expectations reduces variability between graders, makes expectations clear to students
Rubric types

- Holistic: assess a work as a whole, rather than by components
  - more appropriate when performance tasks require students to create some sort of response and where there is no definitive correct answer (Nitko 2001)
  - Often faster to use, but provide less feedback
- Analytic: assess a work by multiple components
  - preferred when a fairly focused type of response is required; may be one or two acceptable responses and creativity is not an essential feature of the students' responses (Nitko 2001)
  - Slower to use, but often more defensible in engineering context
### Example: Analytic rubric

#### Part I: Criteria for CEAB accreditation and assignment grade

<table>
<thead>
<tr>
<th>Criteria</th>
<th>1 (not demonstrated)</th>
<th>2 (marginal)</th>
<th>3 (meets expectations)</th>
<th>4 (outstanding)</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Management</td>
<td>No significant information used, not cited; blatant plagiarism.</td>
<td>Insufficient usage; improper citations.</td>
<td>Gathers and uses information from appropriate sources, including applicable standards, patents, regulations as appropriate, with proper citations</td>
<td>Uses information from multiple authoritative, objective, reliable sources; cited and formatted properly</td>
<td>1/4</td>
</tr>
<tr>
<td>Project Management</td>
<td>No useful timeline or budget; missed meetings; inappropriate safety considerations</td>
<td>Poor timeline or budget; infrequent meetings; minor safety problems</td>
<td>Plans and efficiently manages time and money; regular meetings; safety considerations are clear</td>
<td>Efficient, excellent plan presented; detailed budget; potential risks foreseen and mitigated.</td>
<td>1/4</td>
</tr>
<tr>
<td>Design process</td>
<td>No discussion of design process.</td>
<td>Generic design process described.</td>
<td>Describes design process used to design system, component, or process to solve open-ended complex problem.</td>
<td>Develops appropriate design process for project needs, with plans for analyzing progress and revising as needed</td>
<td>1/4 x 2 = 1/8</td>
</tr>
<tr>
<td>Design Evaluation</td>
<td>No mention of functional specifications</td>
<td>Functional specifications are mentioned in parallel to design solution</td>
<td>Compares the design solution against the problem objective</td>
<td>Prioritizes functional specifications with justification of level of consideration in design solution</td>
<td>1/4</td>
</tr>
<tr>
<td>Sustainability</td>
<td>No consideration of societal or ecological impact.</td>
<td>Some sustainable considerations mentioned but no clear evidence of impact on decision making.</td>
<td>Incorporates sustainability considerations in decision making (societal and ecological)</td>
<td>Well-reasoned analysis of societal and ecological factors, with risks mitigated where possible</td>
<td>1/4</td>
</tr>
</tbody>
</table>
Task: Assessment tools (5 min)

• Take some assessment criteria developed by group previously:
  • Determine three ways that they could be assessed (a list of assessment tools are on summary sheet), at least one done using a direct assessment tool
  • If any are difficult to measure, consider whether the criteria should be modified
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Identify indicators
3. Map to courses/experiences
   - Identify appropriate tools to assess (reports, simulation, tests,...)
4. Stakeholder input
5. Course changes/Measure
6. Analyze and evaluate data
7. Program improvement
Principles of Measurement

- Not required to measure every criteria every year. Could measure in years of accreditation cycle as follows:
  - **Design**: Years 1, 4
  - **Communications**: Years 2, 5
  - **Knowledge**: Years 3, 6...

- No requirement to assess every student – appropriate sampling may be appropriate for some assessment measures

- Assessment is for the *program*
Is this data useful?

- Validity: how well an assessment measures what it is supposed to
  - Direct measures vs. indirect
  - Authentic assessment (emulating professional practice)
- Reliability: the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects;
  - the repeatability of the measurement
  - a measure is considered reliable if a person's score on the same test given twice is similar
  - Estimated by test/retest, or internal consistency using multiple methods to assess same criteria
Data gathering and storage

- Modern learning management systems are able to link outcomes to learning activities
- E.g. Moodle, Blackboard, Desire2Learn
- Reports, assignments, quizzes in the LMS can be linked to outcomes and simultaneously graded for course marks and assessment criteria
Case study: Assessment on exam

- Exam based questions can be a non resource-intensive method of assessing for some outcomes
- Appropriate for “knowledge”, “problem analysis”
- Can be used as “easy wins” for some things
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Identify indicators
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5. Course changes/Measure
6. Stakeholder input
7. Analyze and evaluate data
8. Program improvement
Now that we have data... analyze and evaluate

Could do:

- Longitudinal comparison of students
- Histogram of results by level (did or did not meet expectations)
- Analysis of which areas are weakest
- Triangulation: examination of correlation between results on multiple assessments of the same indicator (e.g. compare focus group data with exam results)
Results: example
Program-wide assessment process flow

1. Identify major objectives (including graduate attributes)
2. Identify indicators
3. Map to courses/experiences
4. Identify appropriate tools to assess (reports, simulation, tests, ...)
5. Course changes/Measure
6. Stakeholder input
7. Analyze and evaluate data
8. Program improvement
Program improvement

- Changes in existing courses
- New courses.streams (Queen's is going through this)
- New approaches (service learning, co-ops, case-study, problem-based learning, ...)

## Faculty buy-in to process

<table>
<thead>
<tr>
<th>Scenario 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructors of certain courses assigned assessment criteria and rubrics to be used in their classes that were developed by {X} and {Y} from other universities/countries.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructors asked to be part of a committee, with facilitator, to answer the question “what do we want our students to be able to do, and how do we assess it”, and to establish a process.</td>
</tr>
</tbody>
</table>
Faculty buy-in

- Blindly using other group's criteria may not be appropriate
- Often takes some time to understand rationale for criteria
- Going through process of developing criteria aids in using it
- Even if the list of criteria is similar, the faculty buy-in and comfort with using is not
Anecdotal info from US experience

- Takes about 18 months to setup assessment process
- Faculty reaction skeptical to negative at first, but after 4-5 years value often perceived in outcomes assessment
- Capitalize on what you're already doing: innovators, first adopters, experimenters, and pick battles that are (a) necessary, and (b) you can win
- Go for early wins
- Don't generate reams of data that you don't know what to do with: create *information*, not *data*
Technology support:
Learning management systems and outcomes
Learning management systems

- Blackboard: measurement instruments, reporting and tracking
- Desire2Learn: “Competencies” tools
- Sakai: outcomes, portfolio strength
- Moodle: outcomes
  - Show how outcomes managed in Moodle
### Selected assessment criteria ("outcomes")

**Queen's identifiers for assessment criteria**

<table>
<thead>
<tr>
<th>Full name</th>
<th>Short name</th>
<th>Scale</th>
<th>Items</th>
<th>Edit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE2D - Teamwork</td>
<td>TE2D</td>
<td>1-4 Outcome Scale</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TE2E - Teamwork</td>
<td>TE2E</td>
<td>1-4 Outcome Scale</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TE2F - Teamwork</td>
<td>TE2F</td>
<td>1-4 Outcome Scale</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>LL4A - Lifelong Learning</td>
<td>LL4A</td>
<td>1-4 Outcome Scale</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>LL4B - Lifelong Learning</td>
<td>LL4B</td>
<td>1-4 Outcome Scale</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Moodle online assignments

APSC-100 was developed to encourage a sense of curiosity about engineering work, and to develop professional skills used by engineers. The Design Module (Module 1) is designed around open-ended design problems that complement the science and mathematics content of other courses.
This section can only be completed after you have attended Clinic-1

1. Write a two page response including the following sections:

a) How could you improve the performance in your Clinic-1 team’s wind turbine design by improving the design process used? Be sure to consider the following aspects of the design process: problem definition, information gathering, initial plan, budget, multiple idea generation, idea selection, preliminary design, assembly, testing and team dynamics.

b) How will you use what you learned in clinic-1 in the semester-long team project? Apply steps from part 1 to create a plan/process to solve your semester long design problem.

**Assignment Submission:**

Create and save a document with the title “Individual Assignment”

Click on "Upload", and specify the location of the file

*Please note that submitting an assignment late without prior permission of your Project Manager will impact your professionalism grade for the course.

Upload a file (Max size: 50MB)

[Upload this file]
<table>
<thead>
<tr>
<th>First name / Surname</th>
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<th>Comment</th>
<th>Last modified (Student)</th>
<th>Last modified (Teacher)</th>
<th>Status</th>
<th>Final grade</th>
<th>Outcome</th>
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<td></td>
<td></td>
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<td>TE2D - Teamwork</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>TEZE - Teamwork</td>
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<td></td>
<td>4 - outstanding</td>
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<td></td>
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<tr>
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<td></td>
<td>3 - meets expectations</td>
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<td>LL4A - Lifelong Learning</td>
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<td></td>
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<td>4 - outstanding</td>
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<td>2 - marginal pass</td>
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<td></td>
<td></td>
<td>TE2F - Teamwork</td>
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</table>
### Outcome grading - popup

#### Moodle Grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Final grade:</th>
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<tbody>
<tr>
<td>TE2D - Teamwork</td>
<td>3 - meets expectations</td>
</tr>
<tr>
<td>TE2E - Teamwork</td>
<td>2 - marginal pass</td>
</tr>
<tr>
<td>TE2F - Teamwork</td>
<td>3 - meets expectations</td>
</tr>
<tr>
<td>LL4A - Lifelong Learning</td>
<td>4 - outstanding</td>
</tr>
<tr>
<td>LL4B - Lifelong Learning</td>
<td>2 - marginal pass</td>
</tr>
</tbody>
</table>

You did fairly well on this assignment. Check for typos next time.

---

**Test Student 1**
Wednesday, 31 March 2010, 05:41 PM

@indv_asgn_1_-student_1.docx
### Gradebook report by outcome

#### APSC100T : View: Grader report

**Separate groups: All participants**

<table>
<thead>
<tr>
<th>First name / Surname</th>
<th>Controls</th>
<th>Category total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR Test Student</td>
<td></td>
<td>16.00</td>
</tr>
<tr>
<td>Test Student1</td>
<td></td>
<td>14.00</td>
</tr>
<tr>
<td>Test Student2</td>
<td></td>
<td>14.00</td>
</tr>
<tr>
<td>Overall average</td>
<td></td>
<td>14.67</td>
</tr>
</tbody>
</table>
Moodle development

- Customizing Moodle for our purposes
  - Group upload/grading of assignments
  - Peer evaluation
  - Class response system ("clickers")
- Future collaboration
Graduating year process (September 2010)

- Forming group of capstone course instructors to look at sharing resources
- Develop discipline-specific expectations on top of program wide expectations
- Assess most professional skills in capstone courses
National Response

- Workshop at April 2010 NCDEAS meeting, updates from pilot project institutions
  - Decision to create a team of engineering educators and educational developers to work with NCDEAS and CEAB:
    - create guidelines, resources, rubrics
    - recommendations for small schools
    - training for CEAB accreditation teams
    - Work with small schools to develop processes suitable to limited resources
    - Educational technology recommendations
  - Peter Ostafichuk (UBC), Bob Brennan (Calgary), Peter Wolf (Guelph), Susan McCahan (Toronto), Brian Frank (Queen's), Sue Fostaty Young (Queen’s), Chris Watts (Dalhousie)
Conclusion

• National collaboration:
  • Resource sharing via web
  • Regional collaboration and workshops
  • Publication of processes/plans at Canadian Engineering Education Association (CEEA) conferences

• Training opportunities for curriculum chairs, etc.:
  • ABET Institute for Development of Excellence in Assessment Leadership
Discussion/questions?

Brian Frank

brian.frank@queensu.ca
Graduate Attribute Assessment:
Year 1 Pilot at Queen's University

Brian Frank
Director (Program Development)
Faculty of Engineering and Applied Science
Queen's University

June 7, 2010
“The institution must demonstrate that the graduates of a program possess the attributes under the following headings... There must be processes in place that demonstrate that program outcomes are being assessed in the context of these attributes, and that the results are applied to the further development of the program.”
Graduate attributes

Knowledge base
Problem analysis
Investigation
Use of engineering tools

Design
Individual and team work
Communication skills
Professionalism
Impact on society and environment
Ethics and equity
Economics and project management
Lifelong learning

Engineering science
Laboratory
Project/experiential
Queen's Engineering: Long-term goals

Specific
Establish criteria that are meaningful and measurable (directly or indirectly)

Triangulated
Criteria measured using multiple methods or events to assess validity

Leveled
Graduate attributes measured at multiple times in students' program with leveled expectations

Multi-use
Satisfy expectations of both CEAB and province (OCAV UDLEs)
Queen's University process

- **Spring 2009**: Gather relevant resources (e.g. research, other accreditation guidelines)

- **Summer 2009**: Working groups of faculty, students, topical experts created specific program-wide assessment criteria (next slide)

- **Summer 2009**: Setup learning management system (Moodle) to manage assessments

- **Sept-April 2009**: Piloting assessment in first year
Working groups

- Queen's process is driven by faculty for improving the program, not just for accreditation purposes

- “What do we want our students to be able to do, and what data would we like to have to improve the program?”

- Asked instructors, undergraduate chairs, topical experts to participate in creating assessment criteria, including some “skeptics”

- 7 working groups formed, covering 12 graduate attributes

- Working groups met for 1 hour 3-4 times, developed initial assessment criteria
Graduate attribute

Communication (4)

An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>First year</th>
<th>Middle years</th>
<th>Graduating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO1: Written</strong></td>
<td><em>Identifies and repeats standard formats; recalls and reproduces standard grammar and mechanics (EC2000)</em>&lt;br&gt;<em>Summarizes and paraphrases written work accurately with appropriate citations</em></td>
<td><em>Employs writing process to produce a variety of documents using appropriate format, grammar, mechanics, and citation styles for technical and non-technical audiences&lt;br&gt;Cites evidence to construct and support an argument</em>&lt;br&gt;<em>Reads and responds to technical and non-technical written instructions appropriately</em></td>
<td><em>Constructs effective arguments and draws conclusions using evidence (5a)</em>&lt;br&gt;<em>Writes and revises documents using appropriate discipline-specific conventions</em>&lt;br&gt;<em>Adapts format, content, organization, and tone for various audiences (EC2000)</em>&lt;br&gt;<em>Demonstrates accurate use of technical vocabulary</em></td>
</tr>
<tr>
<td><strong>CO2: Oral</strong></td>
<td><em>Delivers clear and organized formal presentation following established guidelines</em></td>
<td><em>Delivers persuasive and professional formal presentations adapted to the needs of the audience&lt;br&gt;Listsens and responds to verbal questions and</em></td>
<td><em>Elicits and uses information and viewpoints from others&lt;br&gt;Presents instructions and information clearly and concisely (link to team work)</em></td>
</tr>
</tbody>
</table>
Assessment criteria mapping

First year courses
- Design
- Physics
- Calculus
- Chemistry
- etc.

Design project course
- Assignment 1
  - Criteria 1
  - Criteria 2
  - Criteria 3
- Assignment 2
  - Criteria 1
  - Criteria 4
  - Criteria 5
- Team proposal
  - Criteria 1
  - Criteria 6
  - Criteria 7
- etc.
Course implementation

- Criteria compared to first year design and professional skill course (APSC-100), and course deliverables adapted to meet objectives
- Assessment criteria entered into Moodle, linked to assignment submissions
- When students uploaded assignments/reports, grading was automatically tied to outcomes in Moodle (discussed later)
- Two first year engineering science and math courses assessed on final exams
### Linking outcomes to courses

<table>
<thead>
<tr>
<th>CEAB #</th>
<th>Attribute</th>
<th>Category</th>
<th>Code</th>
<th>Assessment Criteria</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Process overview</td>
<td>FYDE1</td>
<td>Iterates steps in a defined design process to design system, component, or process</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Process overview</td>
<td>FYDE1</td>
<td>Iterates steps in a defined design process to design system, component, or process</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Problem definition</td>
<td>FYDE2a</td>
<td>Accurately identifies and describes the presented problem</td>
<td>Team assignment 1</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Problem definition</td>
<td>FYDE2b</td>
<td>Identifies customer and user needs</td>
<td>Team assignment 1</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Problem definition</td>
<td>FYDE2c</td>
<td>Gathers and uses information from appropriate sources, including applicable standards, patents,Team Proposal</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Problem definition</td>
<td>FYDE2c</td>
<td>Gathers and uses information from appropriate sources, including applicable standards, patents</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Conceptual design</td>
<td>FYDE3</td>
<td>Produces a variety of potential design solutions suited to meet functional Specifications</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Conceptual design</td>
<td>FYDE3</td>
<td>Produces a variety of potential design solutions suited to meet functional Specifications</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Preliminary design</td>
<td>FYDE4a</td>
<td>Performs systematic evaluations of the degree to which several design concept options meet project criteria</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Preliminary design</td>
<td>FYDE4a</td>
<td>Performs systematic evaluations of the degree to which several design concept options meet project criteria</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Preliminary design</td>
<td>FYDE4b</td>
<td>Feasible proposal for implementation and testing</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Preliminary design</td>
<td>FYDE4b</td>
<td>Feasible proposal for implementation and testing</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.04</td>
<td>Design</td>
<td>Evaluation</td>
<td>FYDE7</td>
<td>Compares the design solution against the functional specifications (AECS)</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2a</td>
<td>Recognizes a variety of working and learning preferences</td>
<td>Peer/individual evaluation</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2a</td>
<td>Recognizes a variety of working and learning preferences</td>
<td>Team assignment 1</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2b</td>
<td>Applies principles of conflict management to resolve team issues</td>
<td>Peer/individual evaluation</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2c</td>
<td>Assumes responsibility for own work; is self directed (6ai)</td>
<td>Peer/individual evaluation</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2d</td>
<td>Describes own temperament</td>
<td>Individual assignment 1</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Teamwork</td>
<td>FYTE2e</td>
<td>Analyzes impact of own temperament on group work</td>
<td>Individual assignment 1</td>
</tr>
<tr>
<td>3.06</td>
<td>Teamwork</td>
<td>Leadership</td>
<td>FYTE3</td>
<td>Exercises initiative and contributes to team goal-setting</td>
<td>Peer/individual evaluation</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1a</td>
<td>Identifies and repeats standard formats</td>
<td>Written</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1b</td>
<td>Recalls and reproduces standard grammar and mechanics</td>
<td>Written</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1c</td>
<td>Summarizes and paraphrases written work accurately with appropriate citations</td>
<td>Team assignment 2</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1c</td>
<td>Summarizes and paraphrases written work accurately with appropriate citations</td>
<td>Written</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1c</td>
<td>Summarizes and paraphrases written work accurately with appropriate citations</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Written</td>
<td>FYCO1c</td>
<td>Summarizes and paraphrases written work accurately with appropriate citations</td>
<td>Team Final</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Oral</td>
<td>FYCO2</td>
<td>Delivers clear and organized formal presentation following established guidelines</td>
<td>Oral</td>
</tr>
<tr>
<td>3.07</td>
<td>Communications</td>
<td>Graphical communications</td>
<td>FYCO3</td>
<td>Uses figures and tables appropriately to compliment text. Standard conventions employed.</td>
<td>Written</td>
</tr>
<tr>
<td>3.08</td>
<td>Professionalism</td>
<td>Professionalism</td>
<td>FYPR1a</td>
<td>Demonstrates punctuality, responsibility and appropriate communication etiquette</td>
<td>Peer/individual evaluation</td>
</tr>
<tr>
<td>3.08</td>
<td>Professionalism</td>
<td>Professionalism</td>
<td>FYPR1b</td>
<td>Participates actively in meetings, helps to generate ideas</td>
<td>Peer/individual evaluation</td>
</tr>
</tbody>
</table>
Specific examples

- Professional skills assessment using rubric
- Communication skills assessment using rubric
- Knowledge assessment on calculus exam
- Problem analysis assessment on chemistry exam
Example 1. Professional skills assessment on an assignment

<table>
<thead>
<tr>
<th>Assignment</th>
<th>1 (fail)</th>
<th>2 (below expectations)</th>
<th>3 (meets expectations)</th>
<th>4 (outstanding)</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Plan – Economic Analysis (EC1a)</td>
<td>No mention of economic principles</td>
<td>Discusses economic principles in a broad or general way without relating to the actual project</td>
<td>Applies basic principles which may include one time/recurring costs, return on investment</td>
<td>Outlines a basic business plan considering: value of money in decision making, triple bottom line, decommissioning</td>
<td></td>
</tr>
<tr>
<td>Project Plan – Timeline (EC2c)</td>
<td>Plan does not refer or map out a timeline for the project</td>
<td>Plan has a general outline of milestones with some reference to duration</td>
<td>Plan maps out project with clear milestones and delegation.</td>
<td>Gantt chart with clear plan including consideration for item dependencies as well as room for readjustment and remedial action</td>
<td></td>
</tr>
<tr>
<td>Project Plan – Scope (EC2b)</td>
<td>Scope of project is not defined.</td>
<td>Project scope not appropriate for available resources and project objectives.</td>
<td>Establishes appropriate project scope, after consultation with client, based on available resources.</td>
<td>Project scope definition clearly defended by economic analysis, available time and skills, and linked to project timeline.</td>
<td></td>
</tr>
<tr>
<td>Background Research – Use of researched material (CO1)</td>
<td>Insufficient content to assess summary of work. Summary misinterprets researched material.</td>
<td>Records information from few resources. Misses significant points of view.</td>
<td>Summarizes and paraphrases written work accurately.</td>
<td>Synthesizes main ideas to construct new concepts. Summarizes the leading thoughts in the field and gives a broader picture of the problem.</td>
<td></td>
</tr>
<tr>
<td>Background Research – Analysis of sources (LL2)</td>
<td>Presents information that is not relevant. Accepts all information found. Does not check for timeliness.</td>
<td>Presents only relevant information. Information presented is form reliable sources and is timely in nature.</td>
<td>Presents information that has clearly been critically evaluated based on authority, currency and objectivity (3C) LL2</td>
<td>Describes professional-grade sources and reputable experts in technical, regulatory, and social aspects.</td>
<td></td>
</tr>
<tr>
<td>Background Research – Citations (LL3)</td>
<td>No way to check validity of information.</td>
<td>Inconsistent use of citation guidelines; some information sources ambiguous</td>
<td>Clear attribution of all sources, including graphics, using a single citation style LL3</td>
<td>Outstanding range of sources cited properly.</td>
<td></td>
</tr>
</tbody>
</table>

Assignment uses program-wide assessment criteria as expectations for grades. Allow simultaneous grading for (1) course and (2) graduate attribute assessment.
Example 2. Communication assessment on a report

<table>
<thead>
<tr>
<th>Context</th>
<th>Logical argument. Appropriate tone (3rd person, passive voice, professional).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Problem definition. Process overview (DE1) Conceptual Design (DE3) Preliminary Design (DE4)</td>
</tr>
<tr>
<td>Coherence and Format</td>
<td>Sequence, appropriate transitions. Formatting (page numbering, table of contents, headings). Conciseness.</td>
</tr>
<tr>
<td>Graphical communications</td>
<td>Figures, tables, lists</td>
</tr>
<tr>
<td>Correctness</td>
<td>Grammar, punctuation, spelling, units of measure, acronyms (CO1b)</td>
</tr>
<tr>
<td>Referencing</td>
<td>(CO1c) Summarizes and paraphrases work accurately with appropriate citations</td>
</tr>
<tr>
<td>1 (fail)</td>
<td>Tone and style informal (colloquialisms, first person). Unsupported or erroneous statements.</td>
</tr>
<tr>
<td>2 (below expectations)</td>
<td>Unclear problem definition. Linear process. No design plan</td>
</tr>
<tr>
<td>3 (meets expectations)</td>
<td>Clear problem definition. Iterates defined design process. Produces a variety of potential designs. Systematic evaluations of design concept options</td>
</tr>
<tr>
<td>4 (outstanding)</td>
<td>Employs design methodology, and appropriate tools and resources. Applies creative approaches to identify and develop alternative concepts and procedures</td>
</tr>
<tr>
<td>Mark</td>
<td>0/4</td>
</tr>
</tbody>
</table>

Report requirements use **program-wide assessment criteria** as expectations for grades. Allow simultaneous grading for (1) course and (2) graduate attribute assessment.
Technology support:
Learning management systems and outcomes
Learning management systems

- Blackboard: measurement instruments, reporting and tracking
- Desire2Learn: “Competencies” tools
- Sakai: outcomes, portfolio strength
- Moodle: outcomes
  - Show how outcomes managed in Moodle
### Selected assessment criteria ("outcomes")

Queen's identifiers for assessment criteria

<table>
<thead>
<tr>
<th>Full name</th>
<th>Short name</th>
<th>Scale</th>
<th>Items</th>
<th>Edit</th>
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<tbody>
<tr>
<td>TE2D - Teamwork</td>
<td>TE2D</td>
<td>1-4 Outcome Scale</td>
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<td>TE2E</td>
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<tr>
<td>TE2F - Teamwork</td>
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<td>LL4A</td>
<td>1-4 Outcome Scale</td>
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</tr>
<tr>
<td>LL4B - Lifelong Learning</td>
<td>LL4B</td>
<td>1-4 Outcome Scale</td>
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</tbody>
</table>
Moodle online assignments

APSC-100 was developed to encourage a sense of curiosity about engineering work, and to develop professional skills used by engineers. The Design Module (Module 1) is designed around open-ended design problems that complement the science and mathematics content of other courses.
Assignment upload

*This section can only be completed after you have attended Clinic-1

1. Write a two page response including the following sections:

a) How could you improve the performance in your Clinic-1 team's wind turbine design by improving the design process used? Be sure to consider the following aspects of the design process: problem definition, information gathering, initial plan, budget, multiple idea generation, idea selection, preliminary design, assembly, testing and team dynamics.

b) How will you use what you learned in clinic-1 in the semester-long team project? Apply steps from part 1 to create a plan/process to solve your semester long design problem.

**Assignment Submission:**

Create and save a document with the title “Individual Assignment”

Click on "Upload", and specify the location of the file

*Please note that submitting an assignment late without prior permission of your Project Manager will impact your professionalism grade for the course.*
## Outcome grading for assignments

<table>
<thead>
<tr>
<th>First name / Surname</th>
<th>Grade</th>
<th>Comment</th>
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<th>Last modified (Teacher)</th>
<th>Status</th>
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<td>TE2F - Teamwork</td>
</tr>
</tbody>
</table>
Outcome grading - popup

You did fairly well on this assignment. Check for typos next time.
Gradebook report by outcome

### Gradebook Report

#### Separate groups: All participants

<table>
<thead>
<tr>
<th>First name</th>
<th>Surname</th>
<th>Controls</th>
<th>TE2D - Teamwork</th>
<th>TE2E - Teamwork</th>
<th>TE2F - Teamwork</th>
<th>LL4A - Lifelong Learning</th>
<th>LL4B - Lifelong Learning</th>
<th>Individual Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR Test 1</td>
<td>Student</td>
<td>3 - meets expectations</td>
<td>3 - meets expectations</td>
<td>4 - outstanding</td>
<td>1 - not demonstrated</td>
<td>4 - outstanding</td>
<td>4 - outstanding</td>
<td>4 - outstanding</td>
</tr>
<tr>
<td>Test Student 1</td>
<td>3 - meets expectations</td>
<td>2 - marginal pass</td>
<td>3 - meets expectations</td>
<td>4 - outstanding</td>
<td>2 - marginal pass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Student 2</td>
<td>2 - marginal pass</td>
<td>2 - marginal pass</td>
<td>3 - meets expectations</td>
<td>3 - meets expectations</td>
<td>4 - outstanding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall average</td>
<td>3 - meets expectations</td>
<td>3 - meets expectations</td>
<td>2 - marginal pass</td>
<td>4 - outstanding</td>
<td>3 - meets expectations</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Moodle development

- Customizing Moodle for our purposes
  - Group upload/grading of assignments
  - Peer evaluation
  - Class response system ("clickers")
- Future collaboration
Example 3: Knowledge assessment

- Calculus instructor asked questions on exam that specifically targeted 3 assessment criteria 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 3: Knowledge assessment

- Calculus exam organized to allow three criteria to be assessed independently:
  - Students asked to create equation(s) that model a physical system.
  - Students asked to solve a mathematical expression ("typical" mathematics)
  - Interpret the meaning of an equation that models a physical system
- Marks on those questions used to assess student ability to meet expectations.
Example 4: Problem analysis assessment

- Chemistry instructor asked questions that specifically targeted outcomes for Problem analysis
  - “Makes valid assumptions and grounded approximations based on available information in solving under-defined problems”
- Students asked to solve enthalpy change question, with explicit assumption
- Afterward 2 multiple choice questions asked how valid the assumption was
- 10% below expectations, 40% met expectations, 43% exceeded expectations
Use to evaluate how well students meet expectations and to improve program
Resources/time commitment

- Creating assessment criteria: 7 committees of approximately 5 people who each met about 4 times
- Mapping criteria to a course and creating rubrics for assessment: ~10 hours
- Large scale curricular changes: ~10 person committee, most of whom had 1 course relief bought out by dean
- Coordination (resource gathering, planning, curricular planning): ~40% of a position
Graduating year process (September 2010)

- Forming group of capstone course instructors to look at sharing resources
- Develop discipline-specific expectations on top of program wide expectations
- Assess most professional skills in capstone courses
Conclusion

- Resources
- Assessment criteria
- Technology support