EGAD Project

Using assessment data for program improvement

http://egad.engineering.queensu.ca

Engineering Graduate Attribute Development (EGAD) Project

WHO

Engineering educators and educational developers across Canada

MANDATE

Supported by national deans council and CEAB

Collect and develop resources and training

Run annual national workshops, and customized institutional workshops

Pilot and report on processes

egad.engineering.queensu.ca

NAVIGATION

A 5 Step Guide To Curriculum Development

1. Program Evaluation
2. Mapping the Curriculum
3. Collecting Data on Student Learning
4. Analyzing and Interpreting Data
5. Data-informed Curriculum Improvement

A 5 Step Guide To Curriculum Development

Welcome

The EGAD Project group has designed a 5 step guide which parallels the stages and steps involved when undertaking a systematic program review – particularly useful, we think, for faculty members, curriculum teams and others preparing for accreditation visits from the CEAB.

Each step consists of a learning module containing information relevant to some aspect of outcomes-based program review. The intention isn't to influence your institution's approach to program review but rather to highlight some of the key elements of a comprehensive review, highlighting the approaches and tools being used successfully by some of the schools across the country. And, using the CEAB accreditation questionnaire as a guide, we've also been very careful to use CEAB-compatible language and share processes that align well with what CEAB site teams are likely to be looking for.

Each learning module represents one phase of a 5-step data-informed approach to curriculum or program evaluation:

Outcomes-based assessment means…

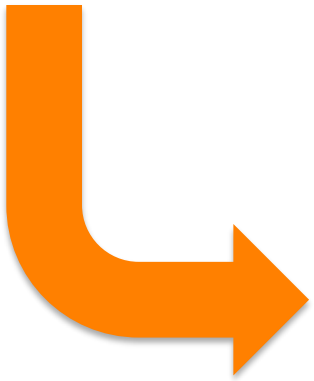
1. **Developing clear descriptions** of what students should be able to do in a course, program, or institution
2. **Measuring** student performance
3. **Using data** to improve quality of the learning environment

EGAD National Snapshot

Survey Description

33

Questions



8

Demographic

7

Open-response

22

Multiple-choice

Which activities for outcomes-based curriculum improvement have you completed or already have in place?

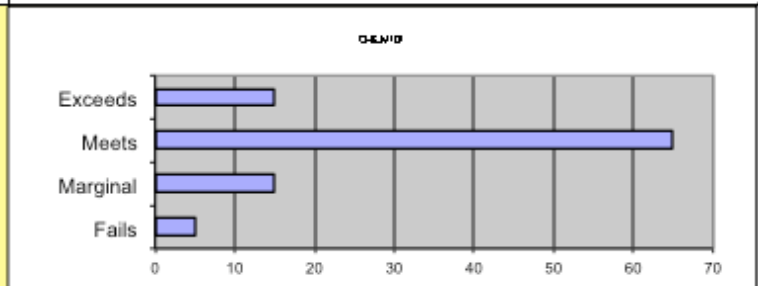
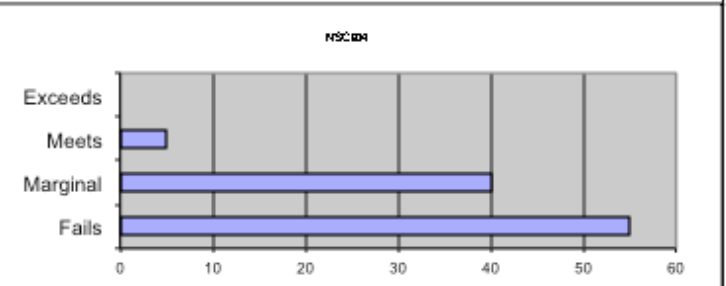
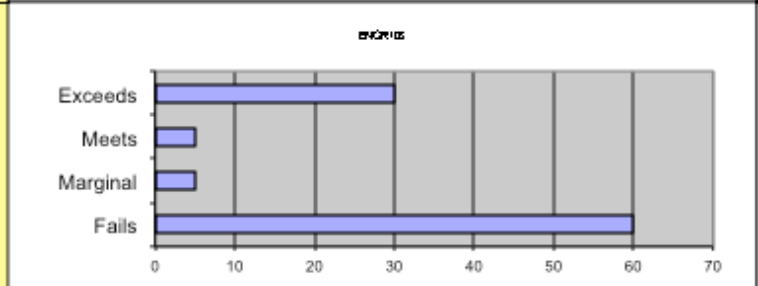
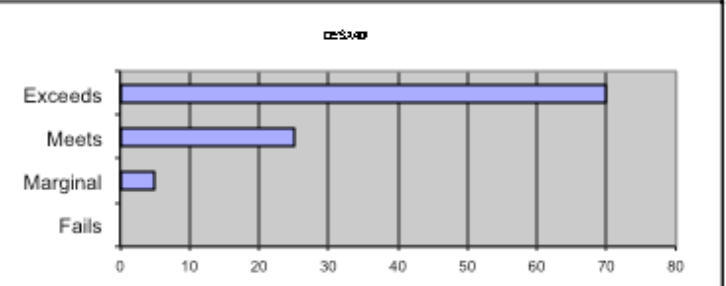
1. Identifying people to be involved
2. Established objectives and indicators
3. Mapped the curriculum
4. Faculty engagement activities
5. Assessment & data collection
6. Analysis & interpretation of data
7. Curriculum & program improvement
8. Closing the loop

PLANNING IMPROVEMENT USING DATA

Approaches to Analyzing data

- Look at data by indicator/attribute
- Aggregate indicators and plot
- Cross sectional comparison (e.g. 1st vs 4th year)
- Longitudinal
- Compare between institutions
- Compare special programs within institutions

CEAB reporting requirement

Table 3.1.4:	Examples of Assessment Results		
Graduate Attribute	Indicator	Results (add more columns as required)	
Knowledge base	*Recalls and describes fundamental concepts in chemistry*		
Problem analysis	*Creates process for solving problem including approximations and assumptions*		

Data sources

- In-course assessment (exams, reports, etc.)
- Program wide assessment (e.g. common rubrics)
- Standardized tests (concept inventory, etc.)
- Surveys: NSSE, exit surveys, alumni surveys
- Advisory board
- Retention/failure/withdrawal rates
- Research studies
- Employers
- Co-op/internship reports

Data sources

- **In-course assessment (exams, reports, etc.)**
- **Program wide assessment (e.g. common rubrics)**
- **Standardized tests (concept inventory, etc.)**
- Surveys: NSSE, exit surveys, alumni surveys
- Advisory board
- Retention/failure/withdrawal rates
- Research studies
- Employers
- Co-op/internship reports

Continuous Improvement Case Study

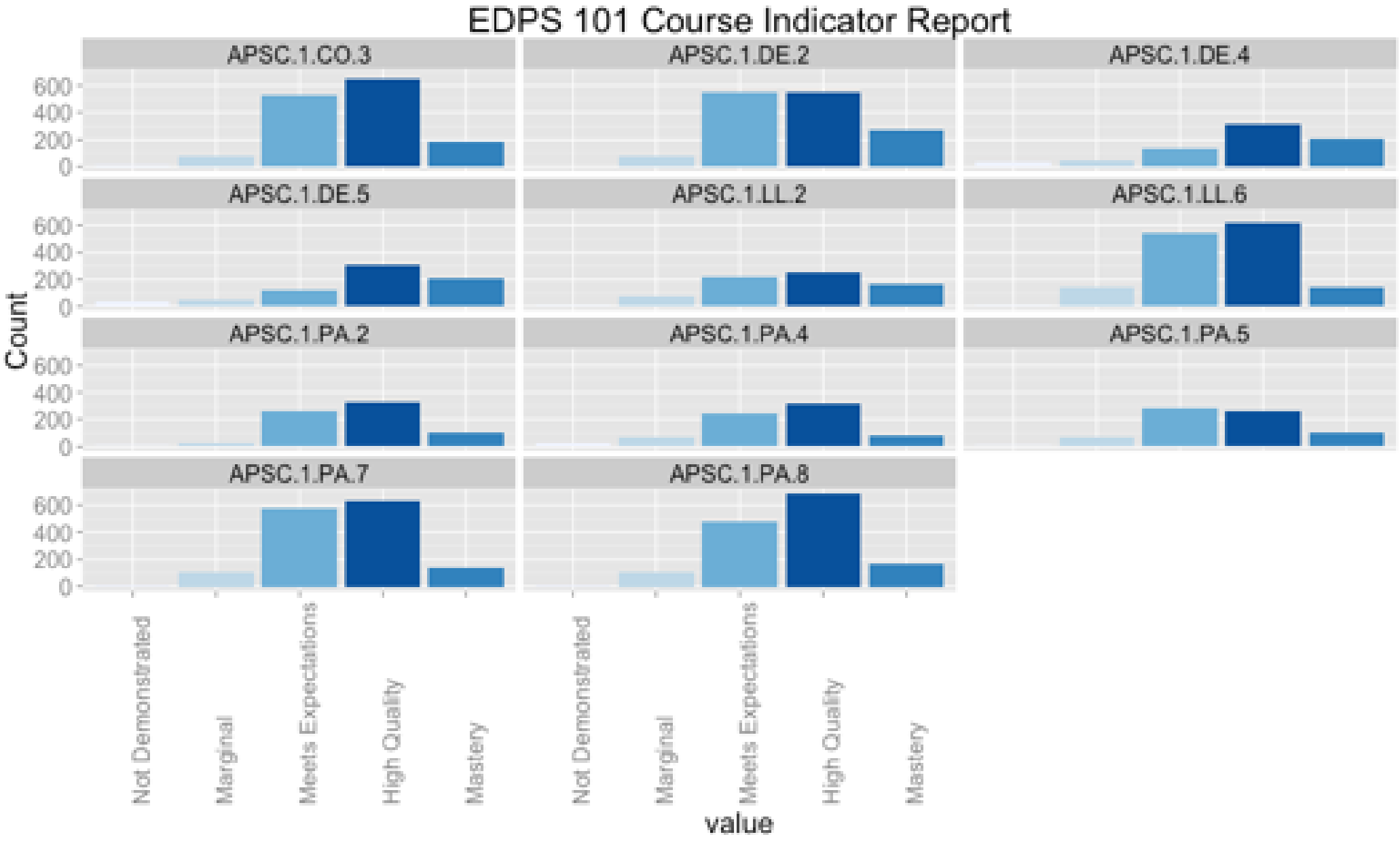
Case study context

All programs in an engineering faculty Drill down to **first year design course**	
Attributes	Problem analysis Communication Design Lifelong learning
Assessment	1. In-class assessment in first year design course 2. Data from other courses 3. Standardized test of critical thinking and writing of first and fourth year students 4. Program-wide rubrics used to score first and fourth year design reports

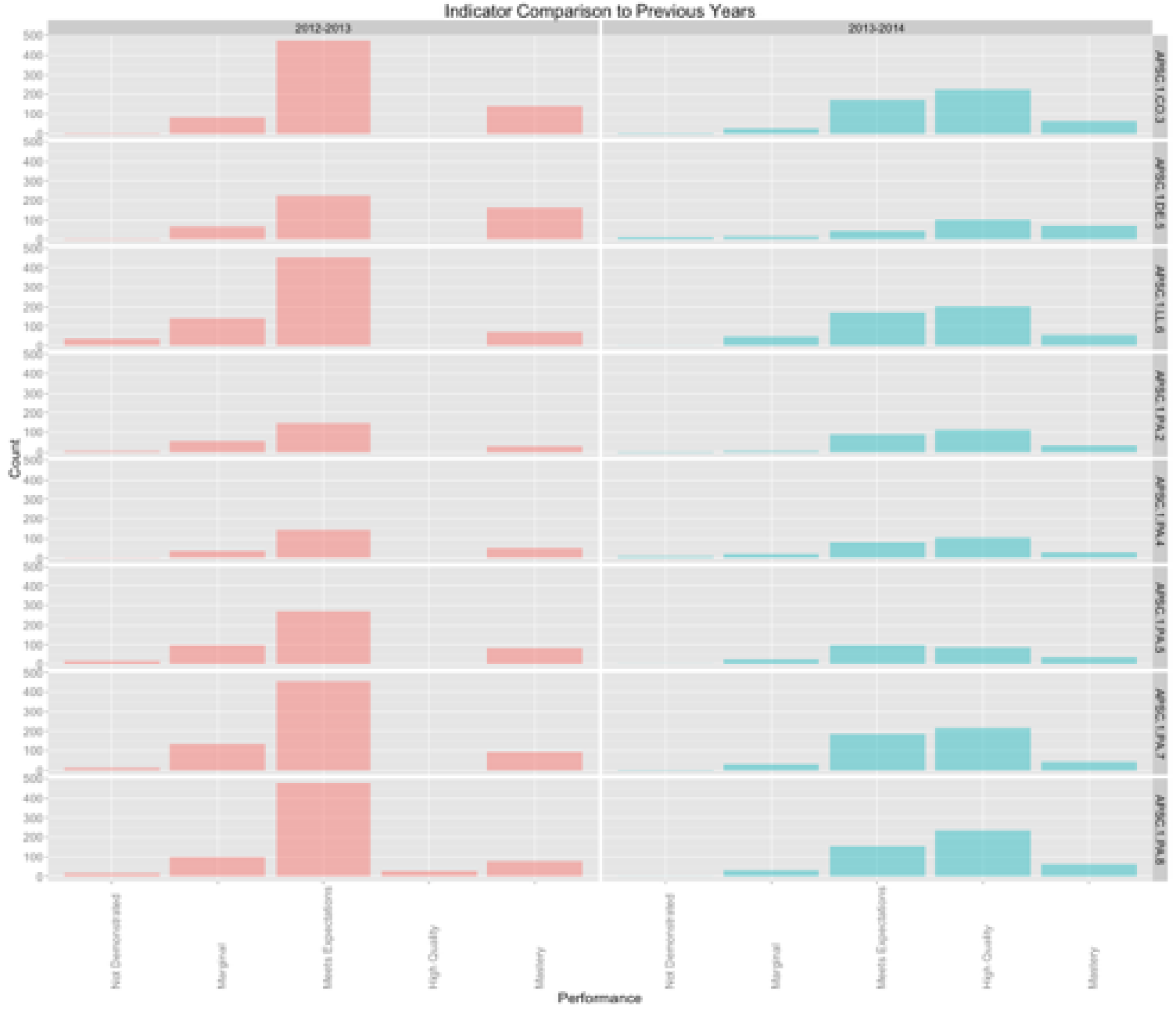
Assessment in the study

Attribute	Course level assessment	Program level assessment	
		Direct methods	Indirect methods
Problem analysis	Project 1 & 2	Standardized Instrument	Graduating student survey Faculty Survey
Design	Project 1 & 2	Standardized Instrument	Graduating student survey Faculty Survey
Communications	Project 1 & 2	Standardized Instrument Program-wide Rubric	NSEE Graduating student survey Faculty Survey
Lifelong learning	Project 1 & 2		NSEE Graduating student survey Faculty Survey

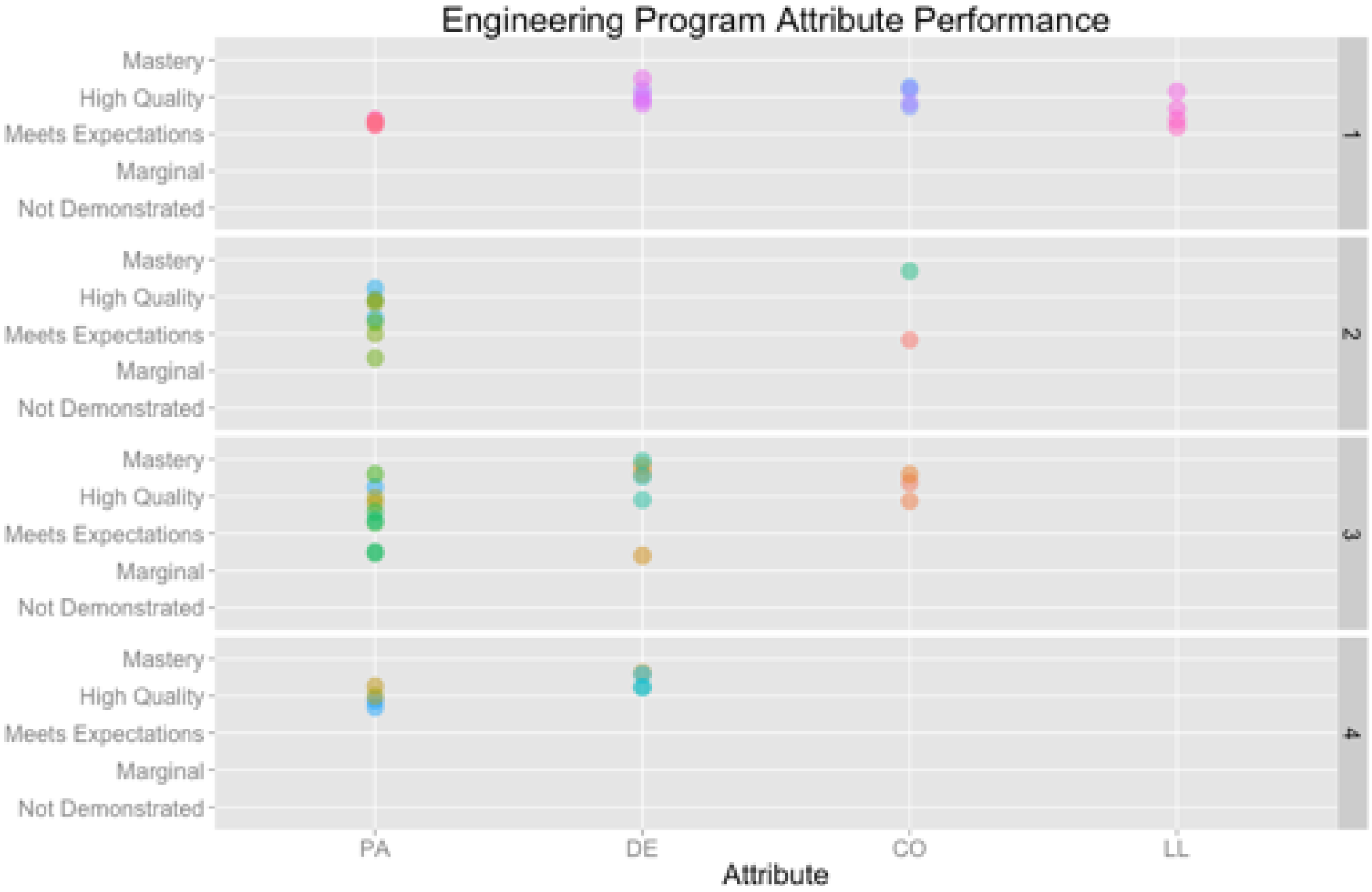
1. Course data



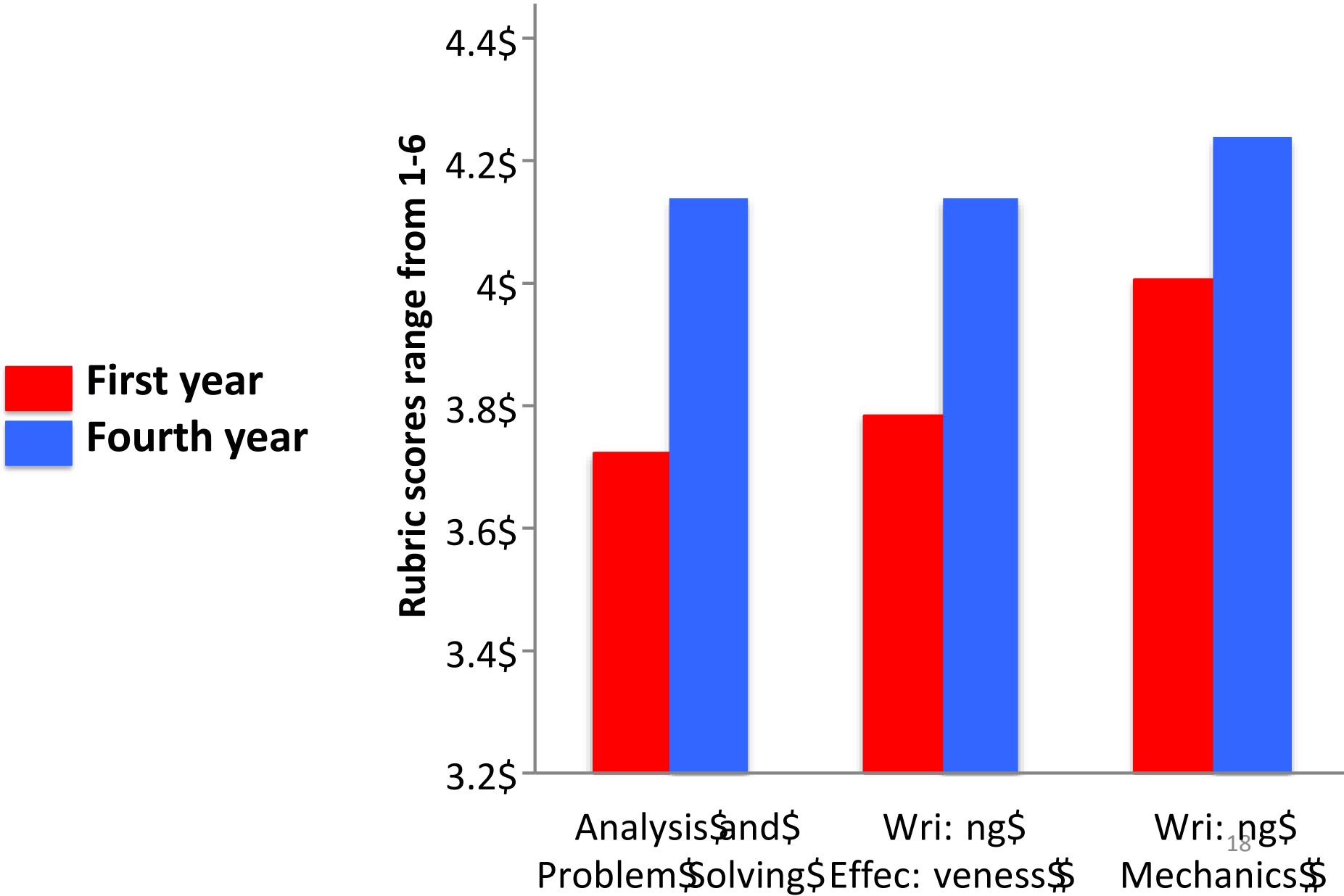
1. Course data over time



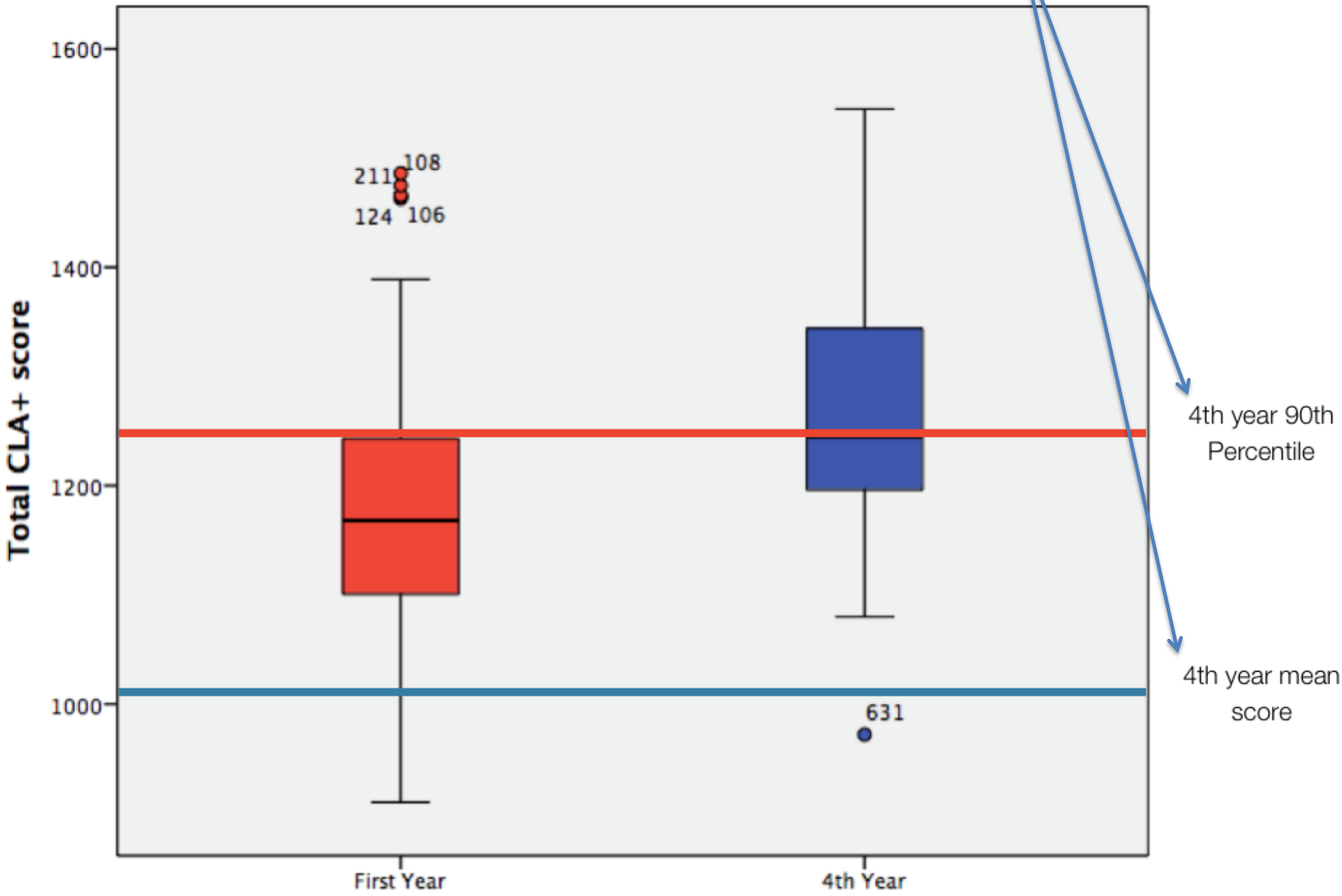
2. Data from 1st-4th yr courses



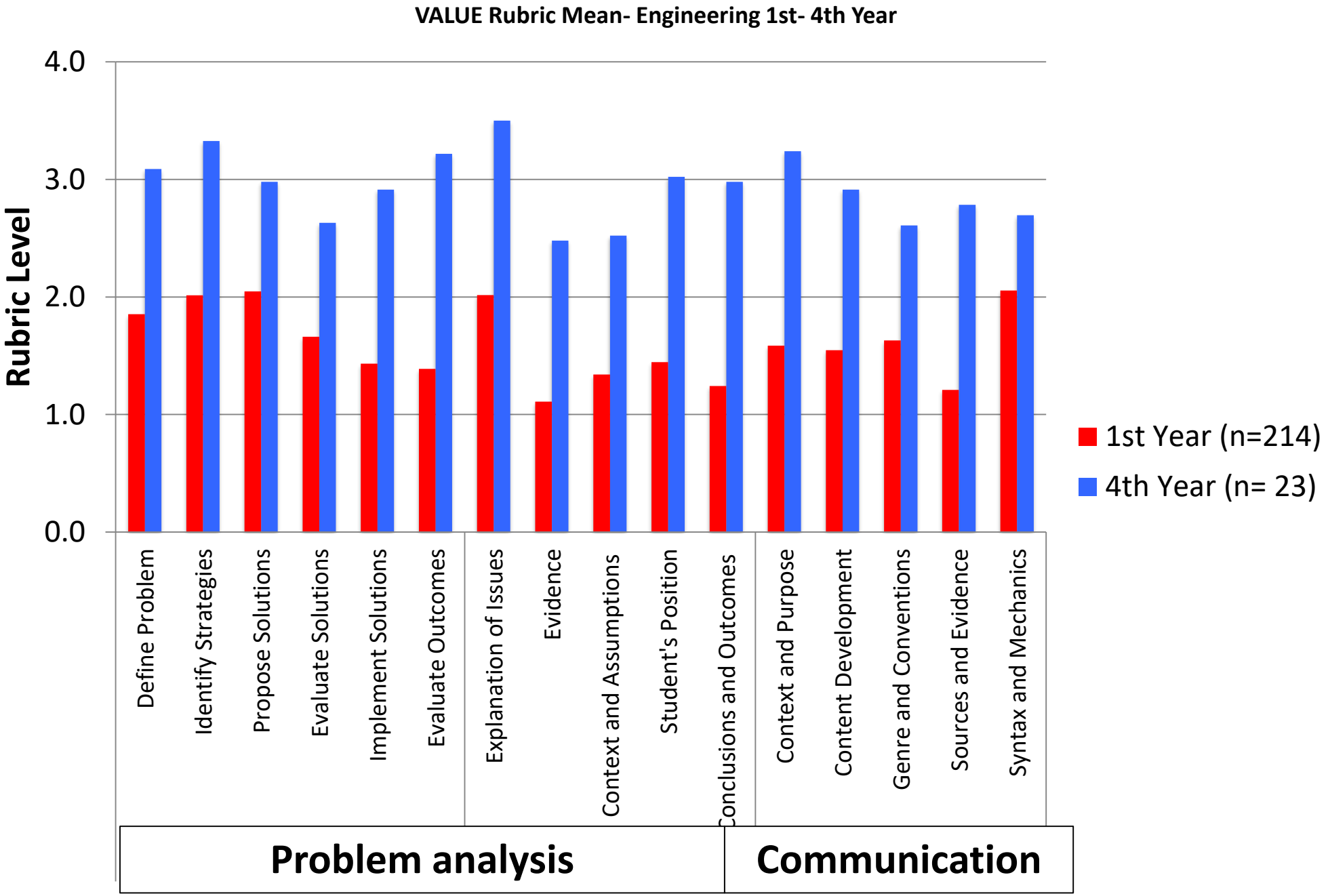
3. Standardized test of critical thinking and Communication (Collegiate Learning Assessment)



3. Standardized test results vs. other universities



4. Design reports scored using program-wide rubrics



TASK: Case study

DURATION: 30 MINUTES

Your team is the **curriculum committee** tasked with reviewing data from your program. Currently focusing on **problem analysis (PA), design (DE), communications (CO), lifelong learning (LL)**.

1. Assess quality and quantity of data
2. Make recommendation to the course/program, and process.

TASK: Case study

DURATION: 30 MINUTES

Phase 1: Review context (pages 3-6)

Phase 2: Break up the data between team members, for example:

- first year course assessment (pages 7-8)
- overall course-based program assessment (page 9)
- standardized instrument (pages 10-11)
- program-wide rubrics (page 12)

Phase 3: Address questions

1. Is there enough data, and do you trust it?
2. What improvements would you recommend to the course/program, and process?

PA=Problem analysis

DE=Design

CO=Communication

LL=Lifelong learning

TASK: Debrief case study

DURATION: 10 MINUTES

1. Is there enough data, and do you trust it?
2. What improvements would you recommend to the course/program, and process?

EGAD Project

Using assessment data for program improvement

http://bit.ly/EGADCU

- Order of attributes, common format
- Definitions – what do acronyms mean
- What are expectations
- Interpreting too many plots, different formats
- What are targets in the plot
- CEAB – targets/thresholds
- Team vs indiidual – context
- Exam vs report, rubric – all the context in the same place as the plot
- Std deviation, p values between

Areas for improvement

- Problem analysis, specifically effective argumentation and self-evaluation. First year students are at least on par with students other programs in those areas, and considerably better than many other institutions. However, it is still an area of relative weakness.
- Communications: Communication skill development was weak in early iterations of the program first year. The program was overhauled, including greater clarity about written communication format, more frequent and rich feedback, and direct instruction. Syntax and mechanics better than sources and evidence. This is an area for development in future years.

Assessment for Course and Program Improvement

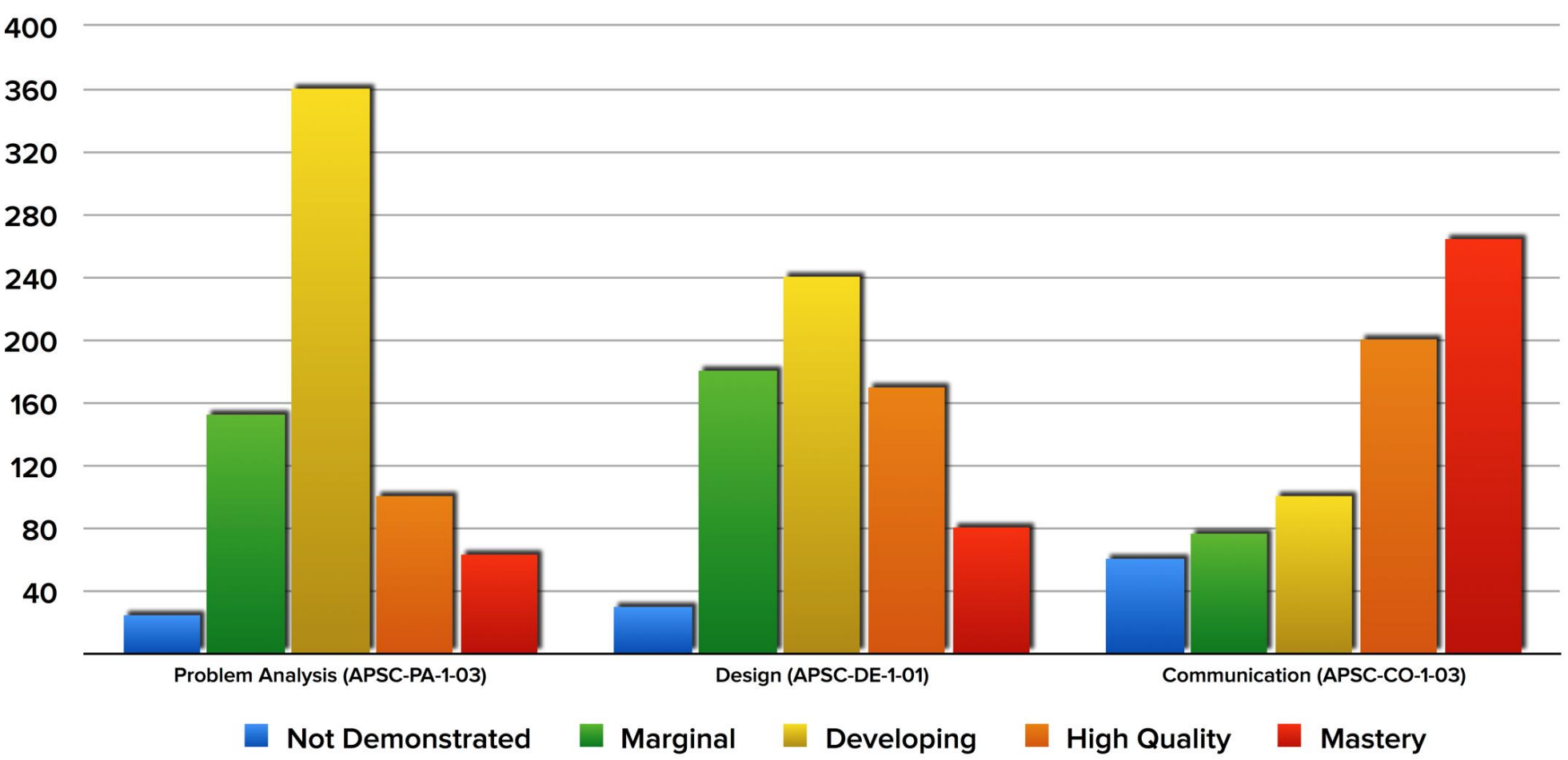
Brian Frank, Queen's University
EGAD Project

Example: First year design course

APSC 100 Course Outcomes	1. Apply a general process for solving complex problems. (APSC-DE-1-01) 2. Select and apply appropriate quantitative model and analysis to solve problems. 3. Effectively communicate following a prescribed format, using standard grammar and mechanics. (APSC-CO-1-03) 4. Apply concepts including occupational health and safety principles, economics, law, and equity to engineering problems. (APSC-IM-1-03) 5. Apply critical and creative thinking principles to solve contextualized problems. (APSC-PA-1-03) 6. Apply a numerical modelling tool to create a model used to solve complex problems		
	Teaching	**Activity**	**Assessment**
Week 1	**Motivation:** course overview and structure	Critical Thinking Pre-test	Word/Excel assignment (CLO 3)
Week 2	**Models:** Mini MEA1 **Goal:** what is a model (drawing, text, equations describing behaviour), and using MATLAB script as part of a model	Intro to MATLAB: Starting MATLAB, variables, operations, plotting, scripts, and publishing a MATLAB script.	Mini MEA1 to be done by end of lecture (CLO 2,5,6)
Week 3	**Argumentation:** analyze past assignments for effective argumentation **Goal:** Create argument related to MEA1. Process for creating reports	Conditional statements	
Week 4	**Complex problem solving:** Complex problem solving process. **Goal:** Identify stakeholders and asking relevant questions for MEA1	Curve fitting and interpolation	MEA 1 Draft Submission (CLO 1,2,3,5,6)

First year design course project rubric

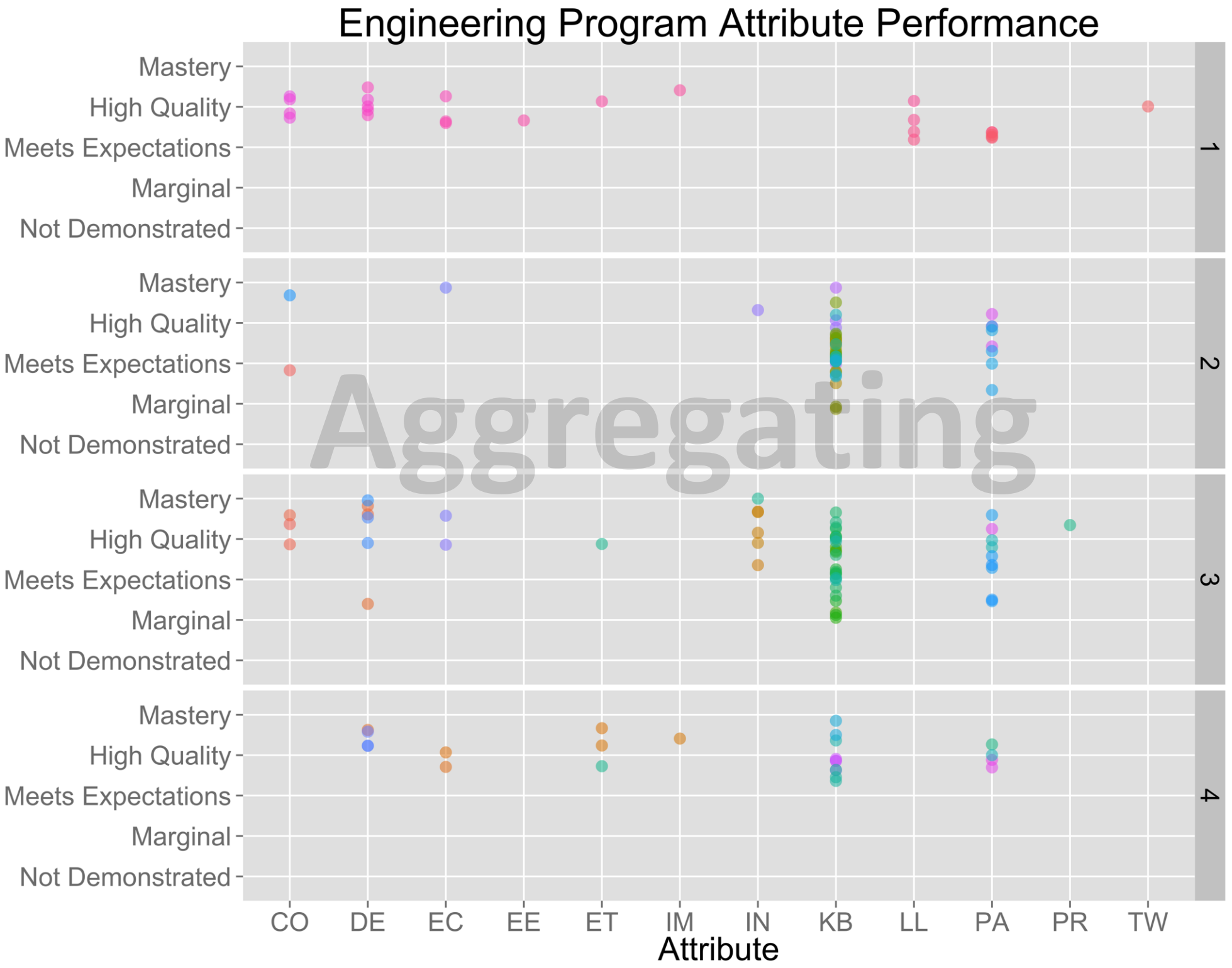
	Not Demonstrated	Marginal	Developing	Expectation	Outstanding
	0-3	4	5	6	7-8
Problem Definition	Problem not defined, little useful information, or information directly copied.	Some important information or biases not identified, or trivial/incorrect information included.	Problem definition is clear but missing some elements.	Clearly defines scope of problem, stakeholders, and required goals. Summarizes and assesses credibility of information used.	**Meets expectations and**: Includes information from authoritative sources to inform process, model, and conclusions.
Proposed Process (APSC-DE-1-01)	No or inadequate process described	Process identified misses critical factors; some assumptions left unidentified or unjustified.	Process is clear but missing some elements	Creates justified process for solving problem, including tests/investigation, supported by information.	**Meets expectations and:** Comprehensive process described with multiple possible approaches described and compared.
Model	No analysis, or model/ analysis selected is inappropriate, or can't draw conclusions	Model used has significant errors or uses inappropriate assumptions.	Model has minor errors or unsupported approximations or assumptions	Creates and applies quantitative model using supported analysis, approximations and assumptions.	**Meets expectations and:** Sophisticated model used incorporating several effects; uncertainty in model's input variables shown by range of output values
Conclusions	No evaluation of solution.	Superficial evaluation of solution and superficial recommendations to prevent future failures	Most of the elements under "expectation" met, but not all	Evaluates validity of results and model for, drawing well-supported conclusions about causes of failure and supported recommendations for to prevent future failures.	**Meets expectations and:** Quantifies possible error/ uncertainty in model conclusions and provides multiple thoughtful recommendations prevent future failures.
Argumentation (APSC-PA-1-03)	Unsupported or trivial arguments	Arguments weak overall	Arguments include some but not all critical elements	Makes claims supported by data and backing, with appropriate qualifiers	**Meets expectations and:** Claims supported by authoritative backing and comprehensive description of context in which they apply.
Communication (APSC-CO-1-03)	Report difficult to understand	Understandable but not formatted following guidelines; many grammatical errors	Clearly formatted following guidelines but obviously needs proofreading	Concise and clearly formatted following guidelines with few grammatical errors	**Meets expectations and:**Varied transitions, attractively formatted, no grammatical errors

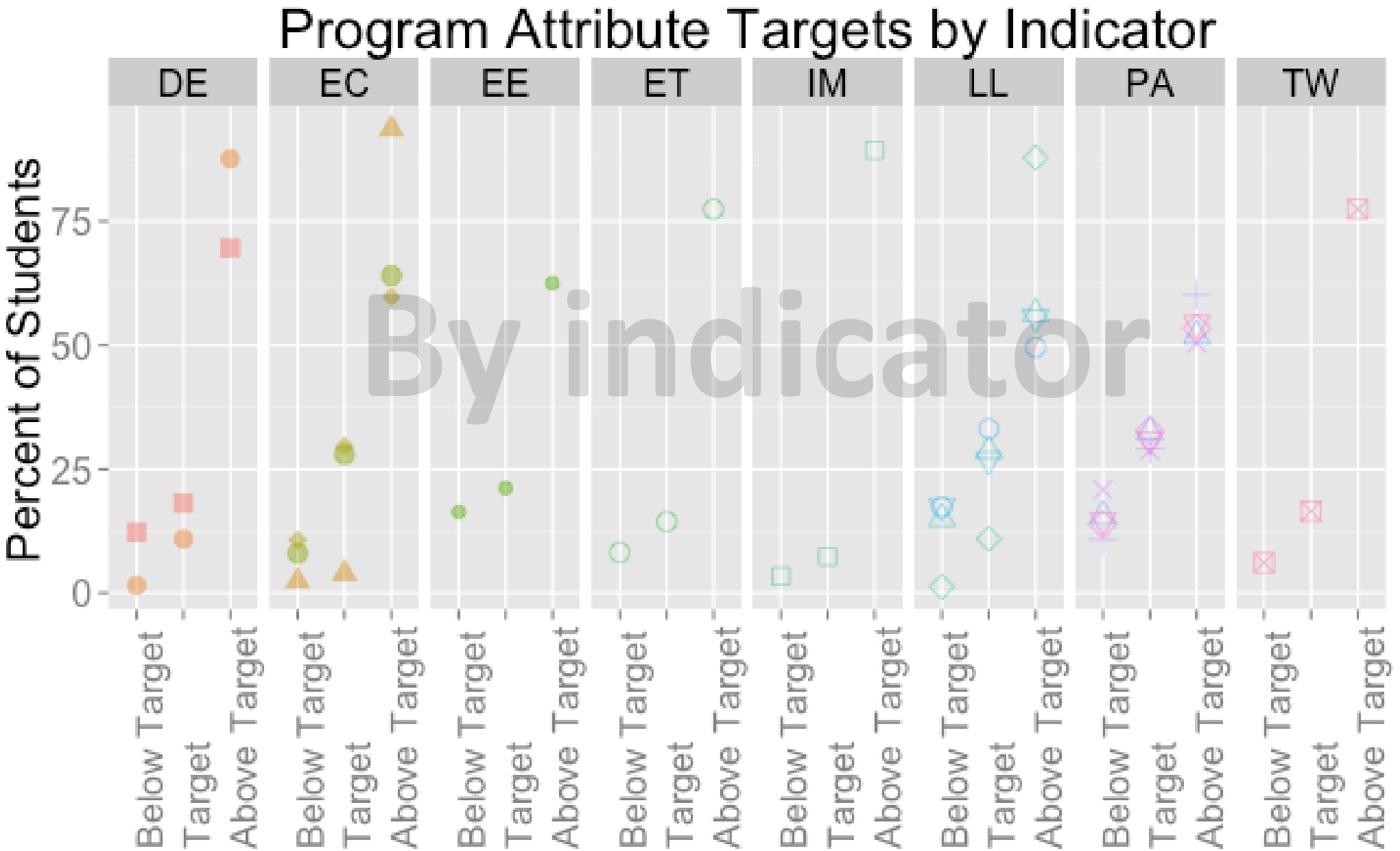


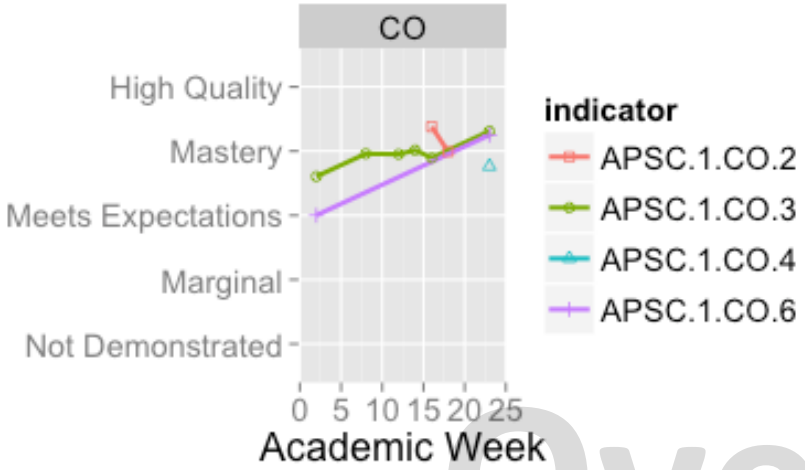
	Not Demonstrated (0-3)	Marginal (4)	Developing (5)	High Quality (6)	Mastery (7-8)
Problem Analysis (APSC-PA-1-03)	Unsupported or trivial arguments	Arguments weak overall	Arguments include some but not all critical elements	Makes claims supported by data and backing, with appropriate qualifiers	**Meets expectations and:** Claims supported…
Design (APSC-DE-1-01)	No or inadequate process described	Process identified, misses critical factors.	Process is clear but missing some elements	Creates justified process for solving problem..	**Meets expectations and:** Comprehensive process…
Communication (APSC-CO-1-03)	Report difficult to understand	Understandable but not formatted…	Clearly formatted following guidelines …	Concise and clearly formatted….	**Meets expectations and:**Varied transitions…

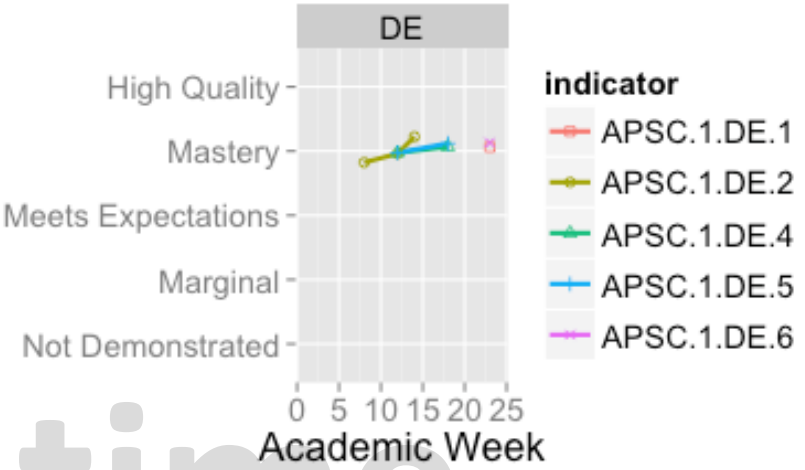
What to look for in assessment tools

1. **Workload:** Results in a feasible workload for students and graders
2. **Generalizability:** Results are representative of entire program/class
3. **Content:** The assessment tool is clearly aligned with the outcome
4. **Reliability:** Results will be consistent between graders, or if tested again
5. **Actionable:** Provides useful information related to educational experience that can be used for course and/or program improvement

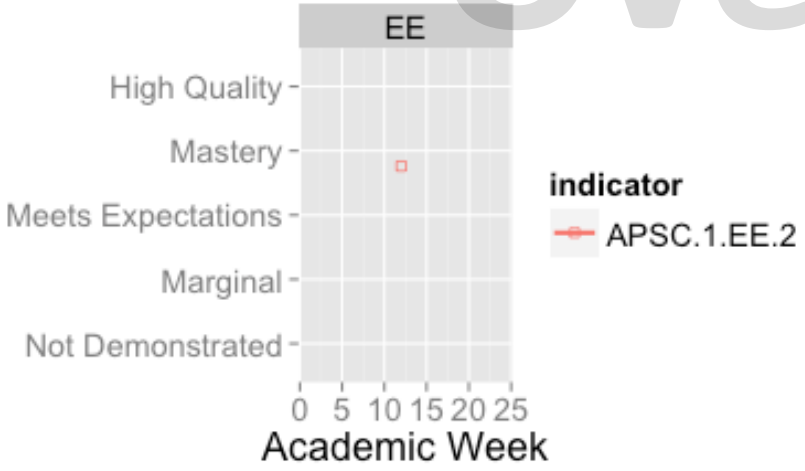

Engineering Program Attribute Performance
Mastery
High Quality
Meets Expectations
Marginal
Not Demonstrated
1
2
3
4
Aggregating
CO
DE
EC
EE
ET
IM
IN
KB
LL
PA
PR
TW
Attribute

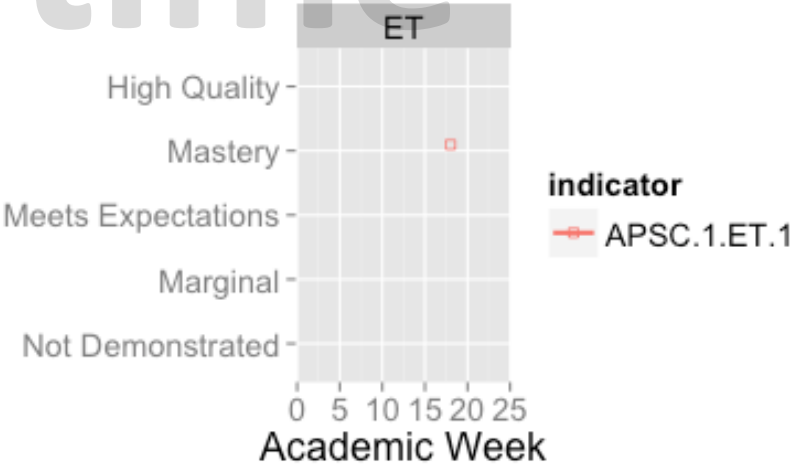

Program Attribute Targets by Indicator
DE
EC
EE
ET
IM
LL
PA
TW
Percent of Students
0
25
50
75
Below Target
Target
Above Target
By indicator

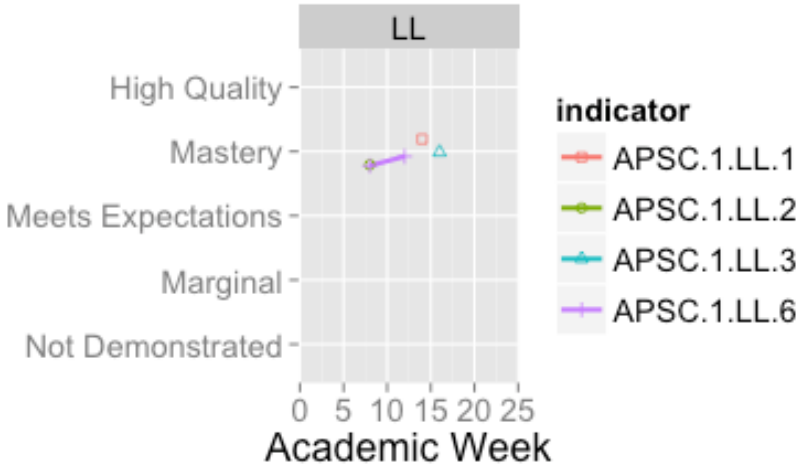

CO
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.CO.2
APSC.1.CO.3
APSC.1.CO.4
APSC.1.CO.6

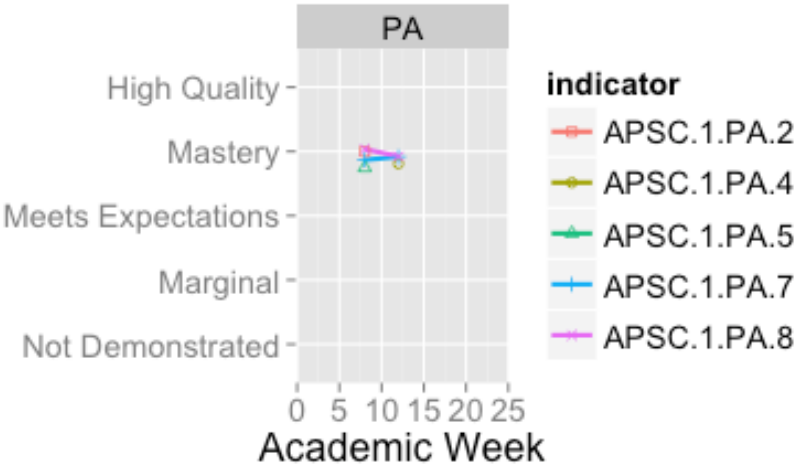

DE
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.DE.1
APSC.1.DE.2
APSC.1.DE.4
APSC.1.DE.5
APSC.1.DE.6

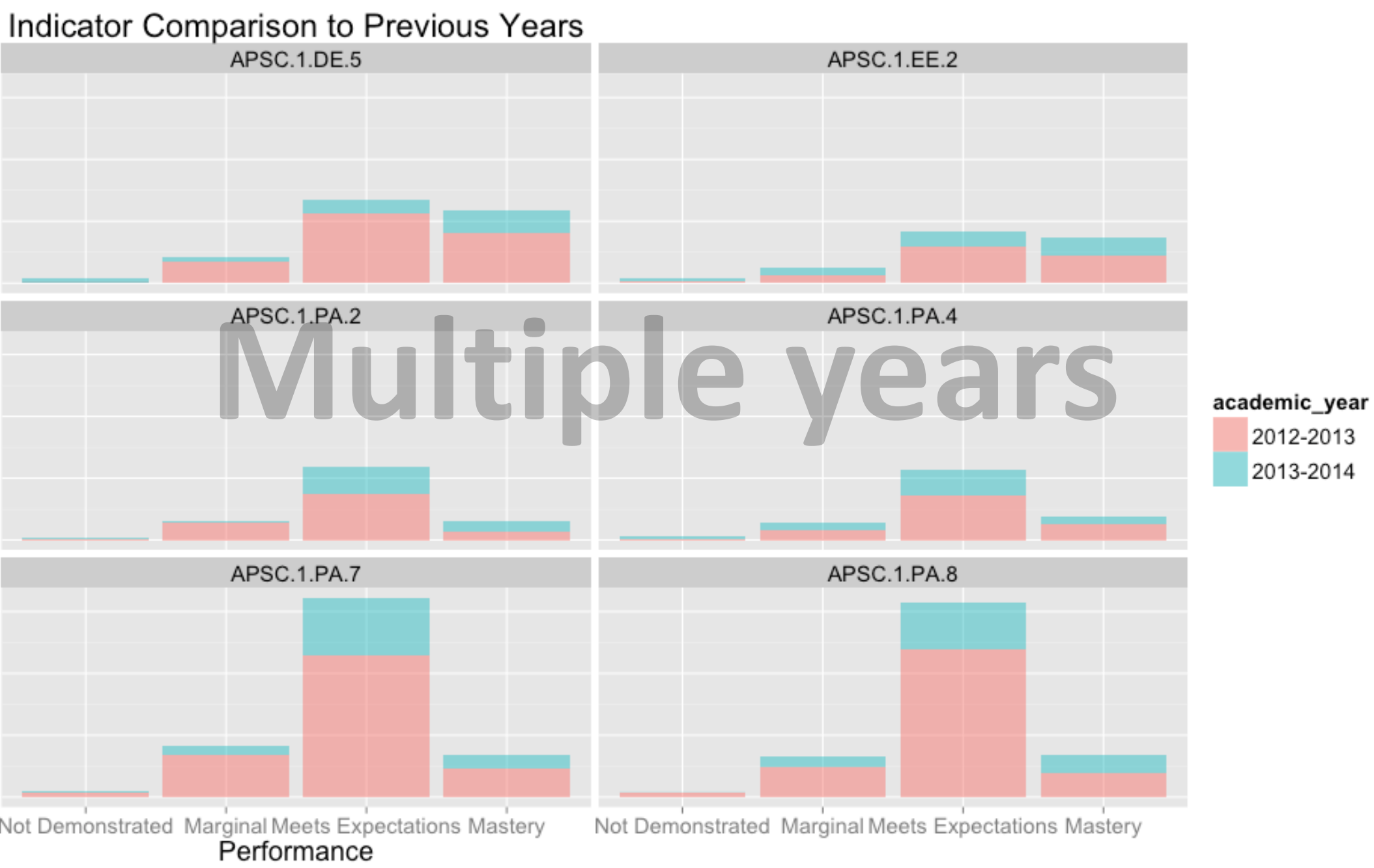
Over time

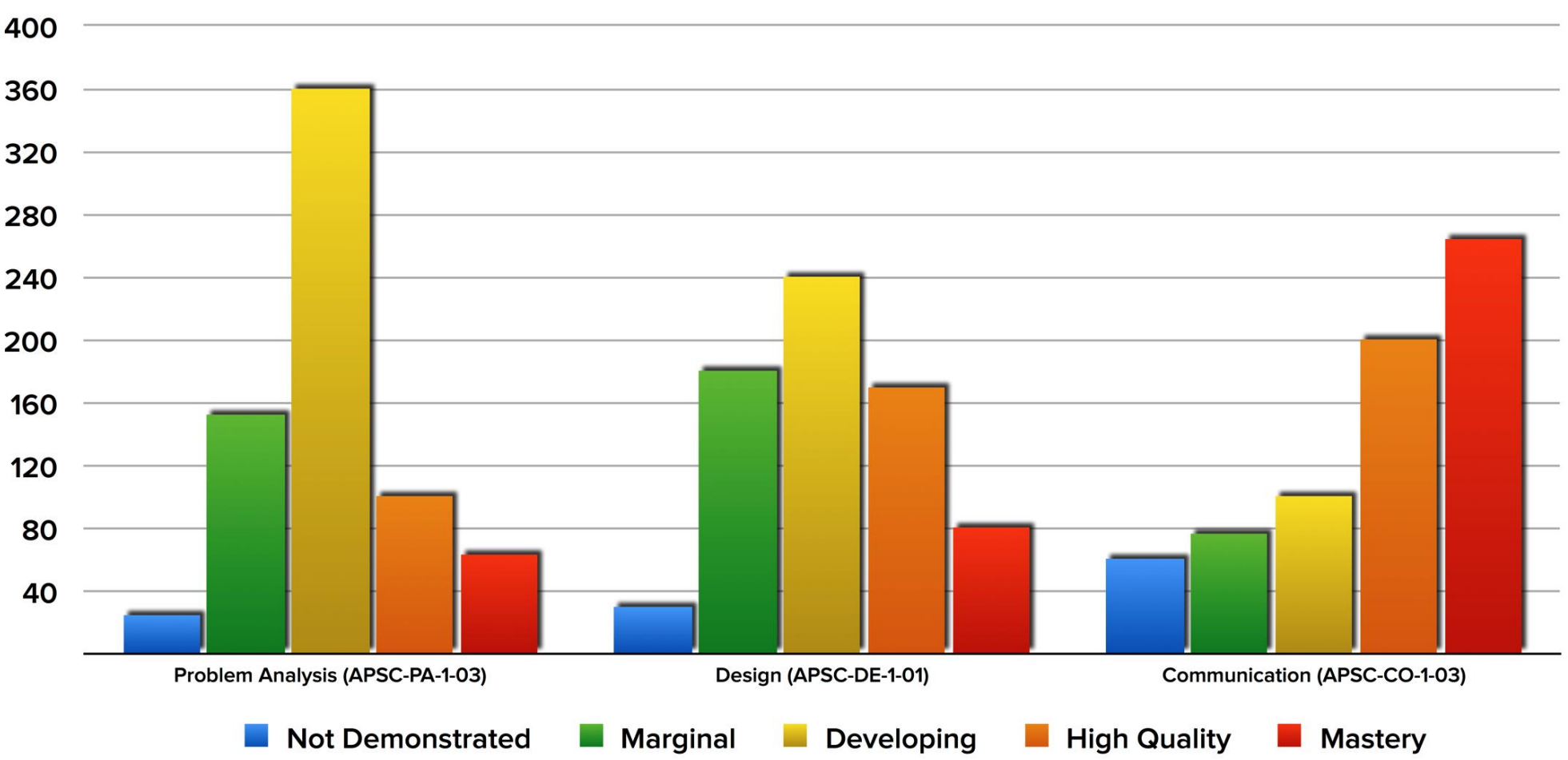

EE
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.EE.2


ET
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.ET.1


LL
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.LL.1
APSC.1.LL.2
APSC.1.LL.3
APSC.1.LL.6

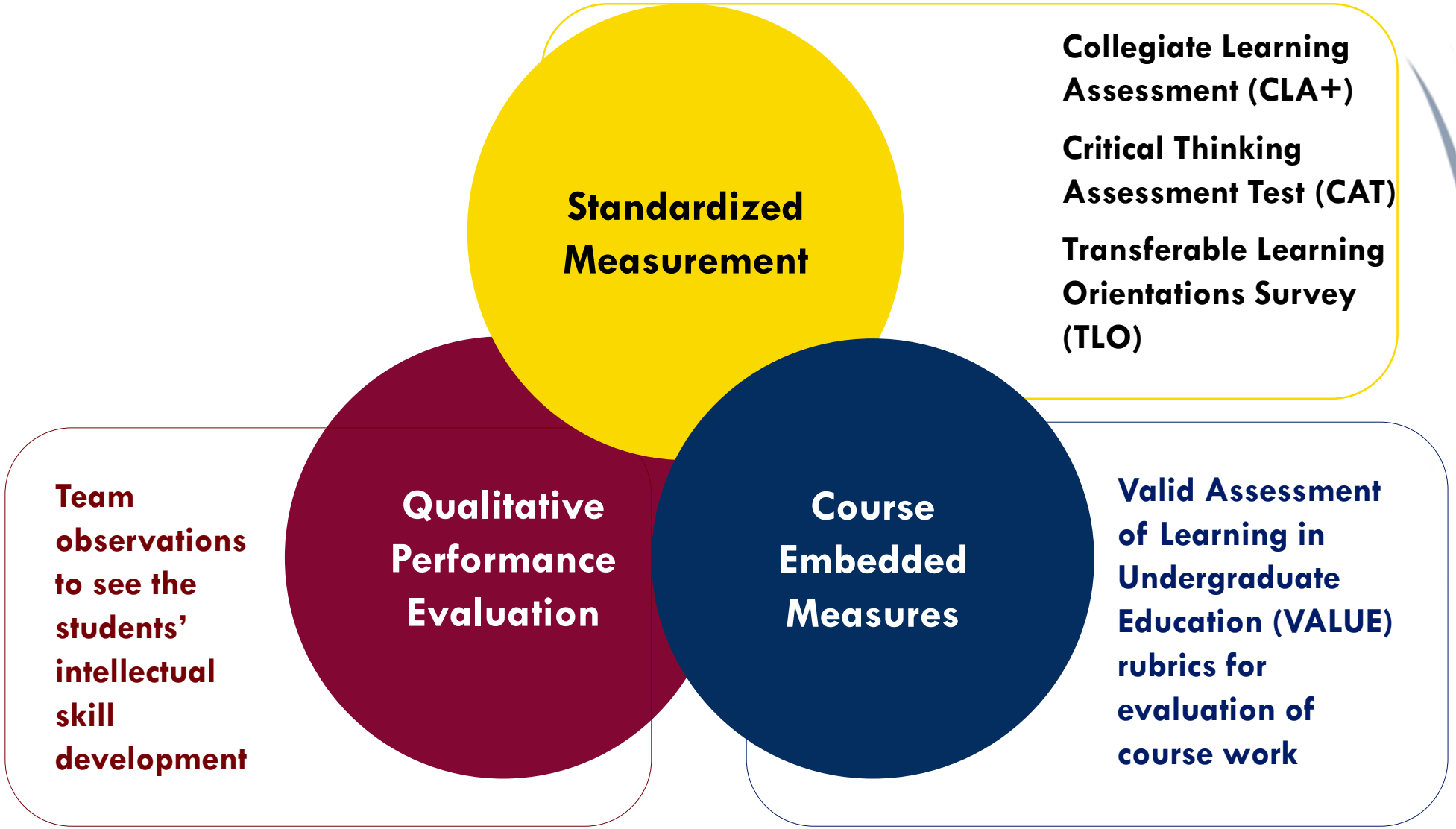

PA
High Quality
Mastery
Meets Expectations
Marginal
Not Demonstrated
0 5 10 15 20 25
Academic Week
indicator
APSC.1.PA.2
APSC.1.PA.4
APSC.1.PA.5
APSC.1.PA.7
APSC.1.PA.8


Indicator Comparison to Previous Years
APSC.1.DE.5
APSC.1.EE.2
APSC.1.PA.2
APSC.1.PA.4
APSC.1.PA.7
APSC.1.PA.8
Multiple years
academic_year
2012-2013
2013-2014
Not Demonstrated
Marginal
Meets Expectations
Mastery
Performance



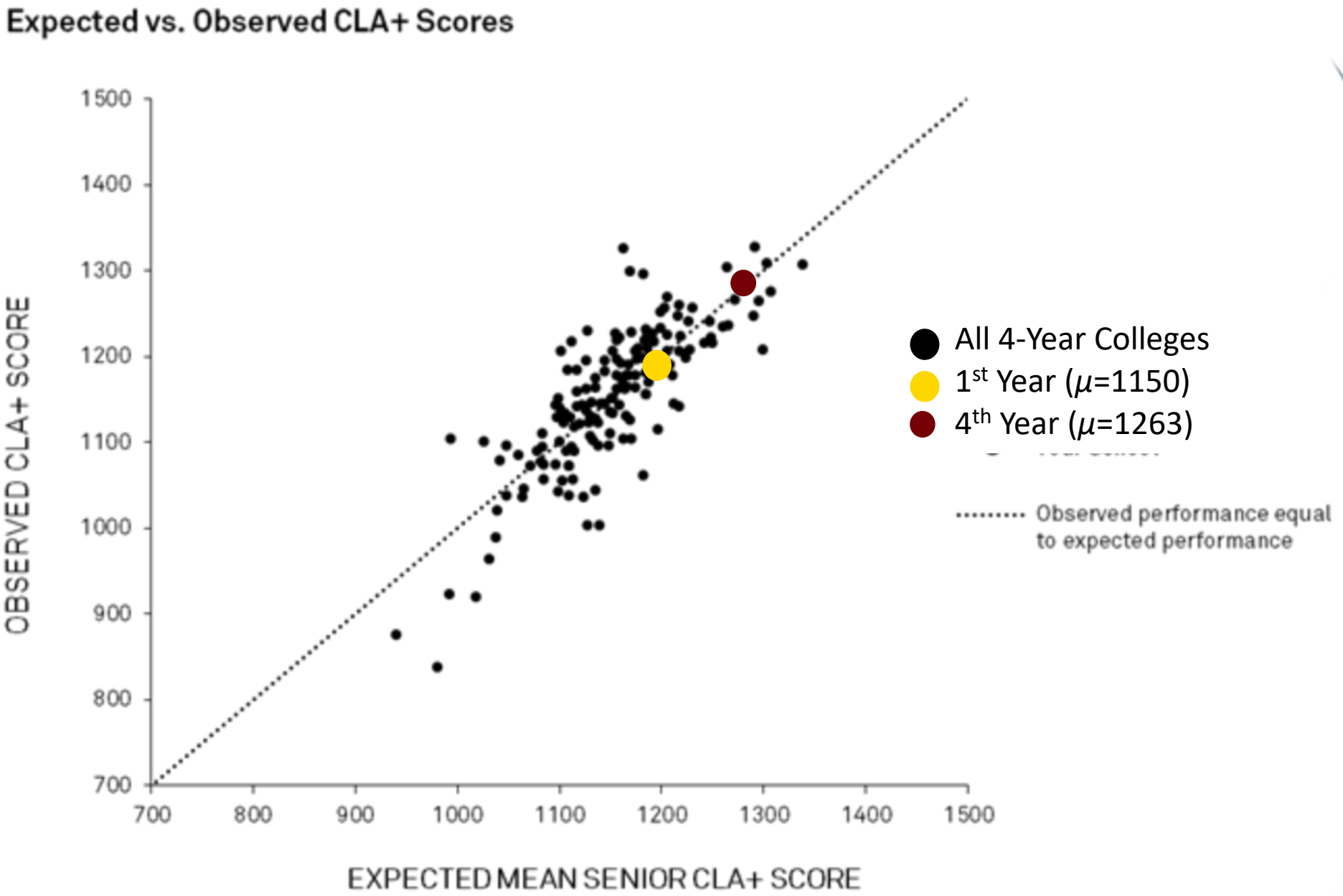
	Not Demonstrated (0-3)	Marginal (4)	Developing (5)	High Quality (6)	Mastery (7-8)
Problem Analysis (APSC-PA-1-03)	Unsupported or trivial arguments	Arguments weak overall	Arguments include some but not all critical elements	Makes claims supported by data and backing, with appropriate qualifiers	**Meets expectations and:** Claims supported…
Design (APSC-DE-1-01)	No or inadequate process described	Process identified, misses critical factors.	Process is clear but missing some elements	Creates justified process for solving problem..	**Meets expectations and:** Comprehensive process…
Communication (APSC-CO-1-03)	Report difficult to understand	Understandable but not formatted…	Clearly formatted following guidelines …	Concise and clearly formatted….	**Meets expectations and:**Varied transitions…

Triangulation: Can we trust the data?

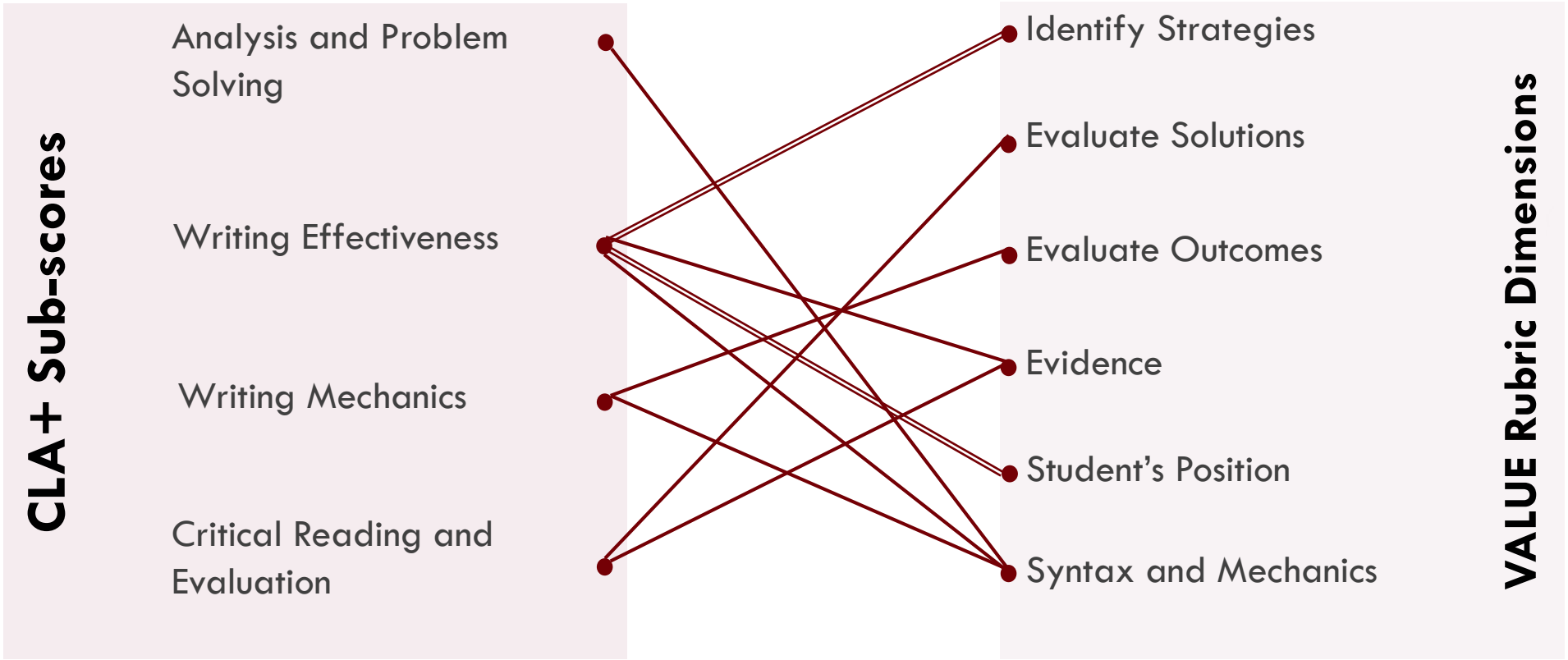


Collegiate Learning Assessment (CLA+)

Standardized instrument of Critical thinking & written communication



Triangulation: Standard instrument and program-wide rubric



Key: Two courses $p < .05$

One course $p < .01$

Note: Correlations for one course at the p<.05 level not displayed

Code for analyzing data

All the plots using our data were generated using relatively few lines of code using R Project, an open source statistical computing package.

Code will be available on EGAD webpage

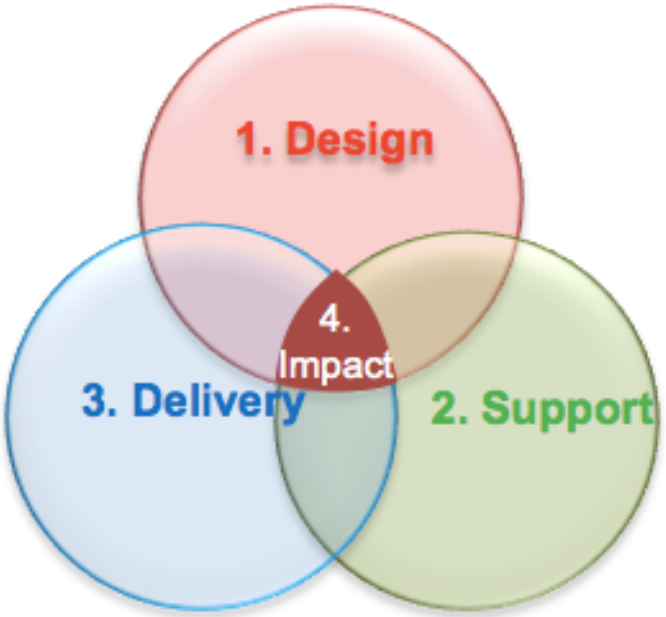
USING DATA FOR PROGRAM IMPROVEMENT

Attribute	Course level assessment	Program level assessment			
		Direct methods (SI=standardized instrument, VALUE=program wide rubric)	Survey items relevant to specific attributes	General student survey of learning environment	Faculty survey
Knowledge base	Shown in curriculum map in Section 2.	SI	NSSE integrative subscale	Targeted survey and focus group for graduating students	Faculty survey of behaviours and perceptions about learning, graduate attribute development
Problem analysis		SI, VALUE			
Investigation			NSSE deep learning sub scale		
Design		SI			
Engineering tools					
Communications		SI, VALUE	NSSE questions on communication		
Professionalism					
Individual and teamwork		SI	NSSE questions on teaming		
Impact of engineering					
Ethics and equity					
Economics					
Lifelong learning		SI	NSSE reflective learning sub scale		

UWS Academic Quality & Standards Framework for Learning and Teaching

3. Delivery standards

- Staff accessibility, responsiveness and skills
- Consistency and quality of delivery of support systems
- Consistency of delivery of design features



2. Support standards

- Orientation
- Library
- Learning Guide Standards
- vUWS & ICT standards
- Staff selection & training
- Peer support
- First year adviser
- Learning support standards

1. Course design standards

- Relevance
- Active Learning including eLearning
- Theory-practice links
- Expectations clear
- Direction & unit links clear
- Capabilities that count are the focus
- Learning pathways are flexible
- Assessment is clear, relevant, reliably marked with helpful feedback
- Staff are capable, responsive & effective teachers
- Support is aligned
- Access is convenient

4. Impact – Academic Learning Standards

- Validation
- Retention
- Assessment Quality
- Progression
- Employability
- Further study

http://www.uws.edu.au/__data/assets/pdf_file/0004/182686/Diagrams_2.3_and_3.2.pdf

Guide to evaluating a continuous program improvement process

CEAB requires programs to report on a continuous program improvement process, which includes the following descriptions:

1. *Indicators* **describing specific abilities expected of students**
2. *Curriculum map* **describing where attributes are developed and assessed in the program**
3. *How indicators are assessed* **(reports, exams, oral presentations, demonstrations, etc.)**
4. **Student assessment, evaluation of data collected and** *analysis of student performance* **relative to program expectations**
5. *Actions taken or planned* **to improve program as a result of the data gathered**
6. Future plans **for improving the process**

The rubric below lists some specific characteristics of a program's improvement process to be evaluated. These characteristics are divided into five themes reflecting elements in a continuous program improvement process. Within each theme are specific characteristics to consider; most of these are linked to one of the numbered CEAB requirements above by square brackets (e.g. [1] refers to the requirement for "*Indicators* describing specific abilities expected of students" above). Note that characteristics described in the "Exemplary" column are not required for accreditation, but rather describe an outstanding process.

Theme	Characteristic	Description		
		Exemplary (exceeds requirements)	**Acceptable**	**Developing**
Program Context	Program Objectives	The program has identified key objectives for itself, and has identified questions it hopes to investigate as a result of the process.	*This is not required.*	*This is not required.*
Data Collection Plan	**Planning for Data Collection**			
	Characteristic	**Exemplary (exceed requirements)**	**Acceptable**	**Developing**
	[2] Curriculum map quality	Comprehensive description and evaluation of how attribute is currently assessed and developed in the program	Tabular description of where indicators and attributes are developed and assessed within a program	Initial curriculum map where indicators and attributes are developed with certain departments within a program.
	Stakeholder involvement	Comprehensive group of stakeholders are involved in process (faculty, staff, students, alumni, advisory board, etc.)	Stakeholders are consulted about process.	Stakeholder involvement is planned but not implemented.
	Indicators & Data Collection Procedure			
	Characteristic	**Exemplary (exceed requirements)**	**Acceptable**	**Developing**
	[1] Indicator standards	Indicators describe high but achievable expectations of students	Indicators describe acceptable expectations of students	Indicators describe arbitrary standards or unattainable or simplistic expectations.
	[1] Indicator breadth	Indicators collectively encompass a comprehensive range of expectations to demonstrate attributes.	Indicators encompass a sufficient range of expectations to demonstrate attributes	Indicators encompass a limited range of expectations to demonstrate attributes
	[1] Indicator measurability / utility	Indicators are measurable, and observable, link to corresponding attributes and program objectives, and address research questions identified	Indicators are measureable and observable with an adequate link to corresponding attributes or program objectives	Indicators may not be measurable or observable; or minimal link to corresponding attributes or program objectives
	[3] Assessment measure validity	Multiple measures are used to assess some indicators to evaluate validity (triangulation).	Direct measures are used when possible supplemented by indirect measures.	Many indicators are assessed using measures with questionable validity, or primarily indirect measures are used.
	[3] Assessment measure utility	Assessment measures are clearly useful for program improvement, and include standardized assessment measures to allow benchmarking against other programs	Assessment measures are clearly useful for program improvement.	Assessment measures are vaguely described, and are insufficient to support conclusions about student performance.

Program improvement process