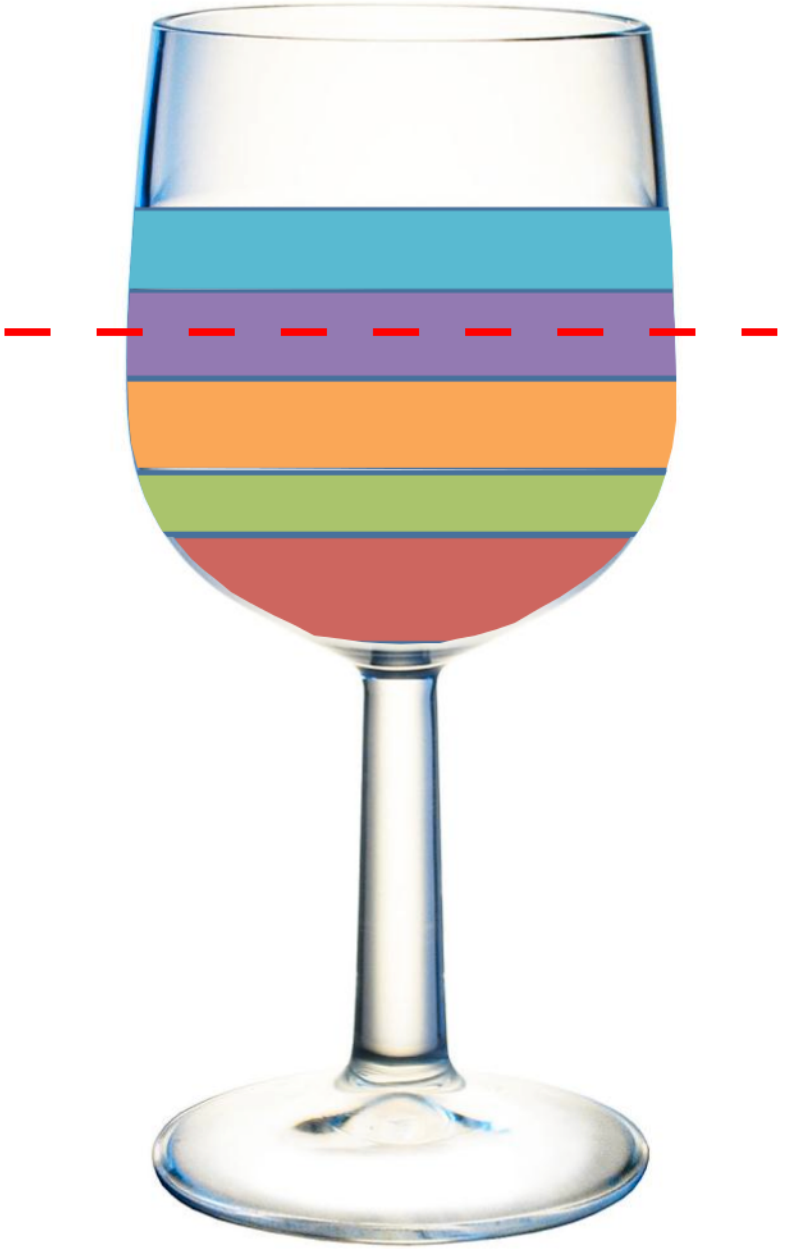
Introduction to continuous program improvement

Spring 2013

Your course



Lab Investigation

Problem Solving

Writing

Concept #2

Concept #1

The program

Your program

Identify:

1. **What things should a student be able to do when they finish the program?**
2. **For each of those things:**
   a. **Where do we develop that?**
   b. **Where do we assess that?**
3. **Assess and evaluate**
4. **Improve the program**

Do not have to assess in every course, but need to know how courses contribute to developing expectations.

What is the value of identifying learning outcomes/indicators?

A study synthesizing:

800 meta-analyses

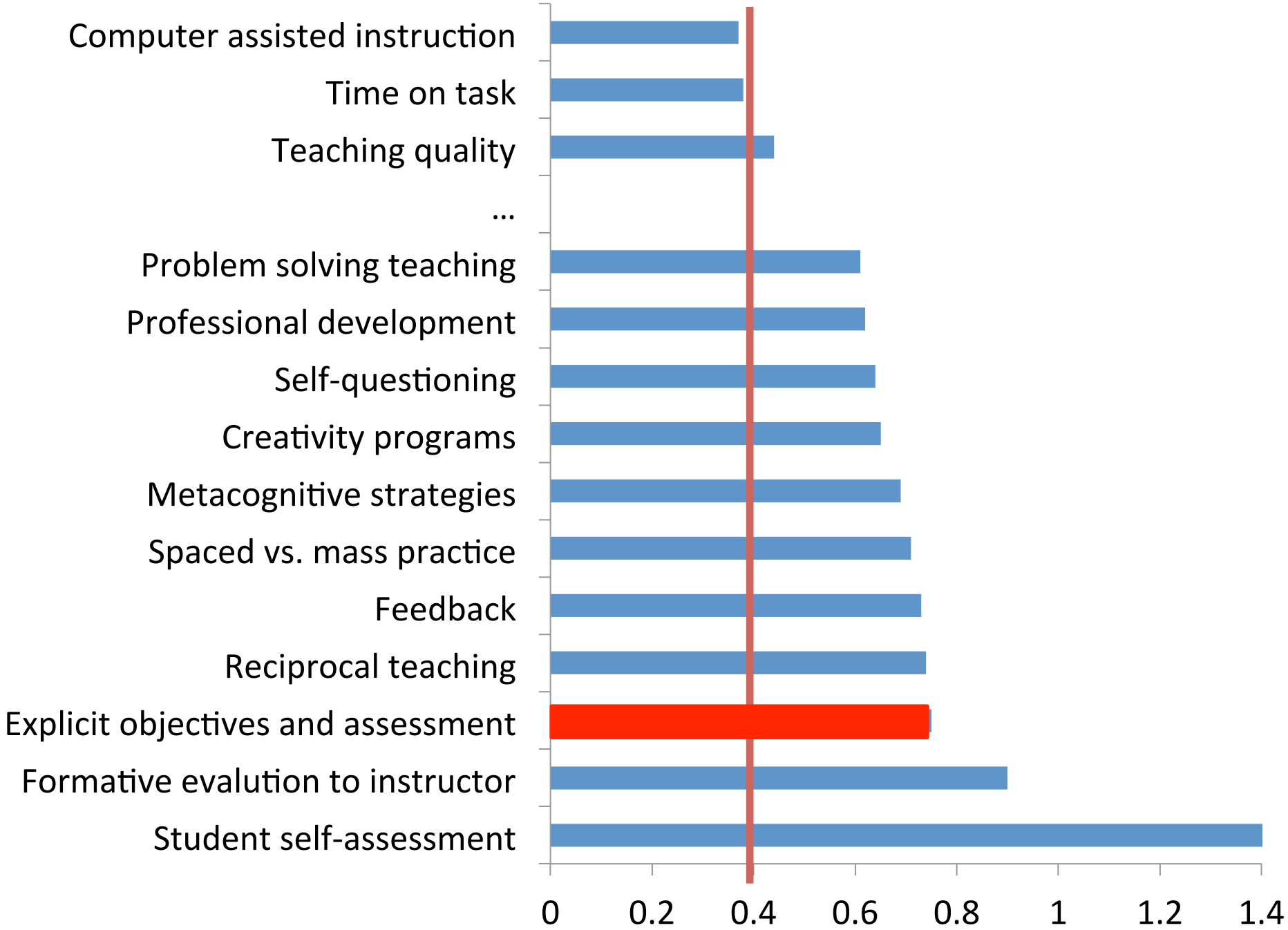
50,000+ studies

200+ million students

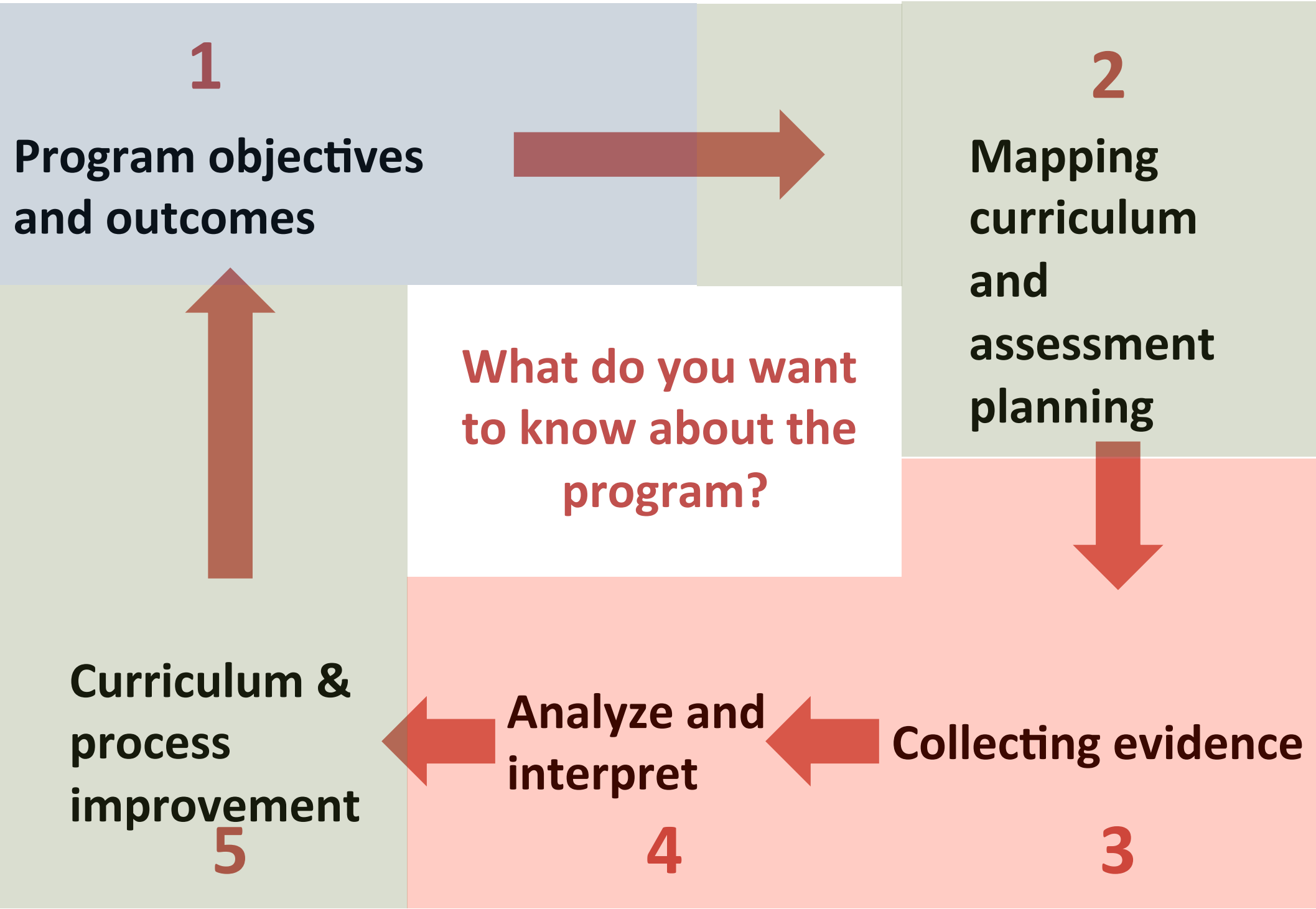
found that explicit outcomes and assessment has one of the largest effects on learning…

Hattie, J. (2009). The Black Box of Tertiary Assessment: An Impending Revolution. In L. H. Meyer, S. Davidson, H. Anderson, R. Fletcher, P.M. Johnston, & M. Rees (Eds.), Tertiary Assessment & Higher Education Student Outcomes: Policy, Practice & Research (pp.259-275). Wellington, New Zealand: Ako Aotearoa

Effect size (performance gain in σ)



Example process

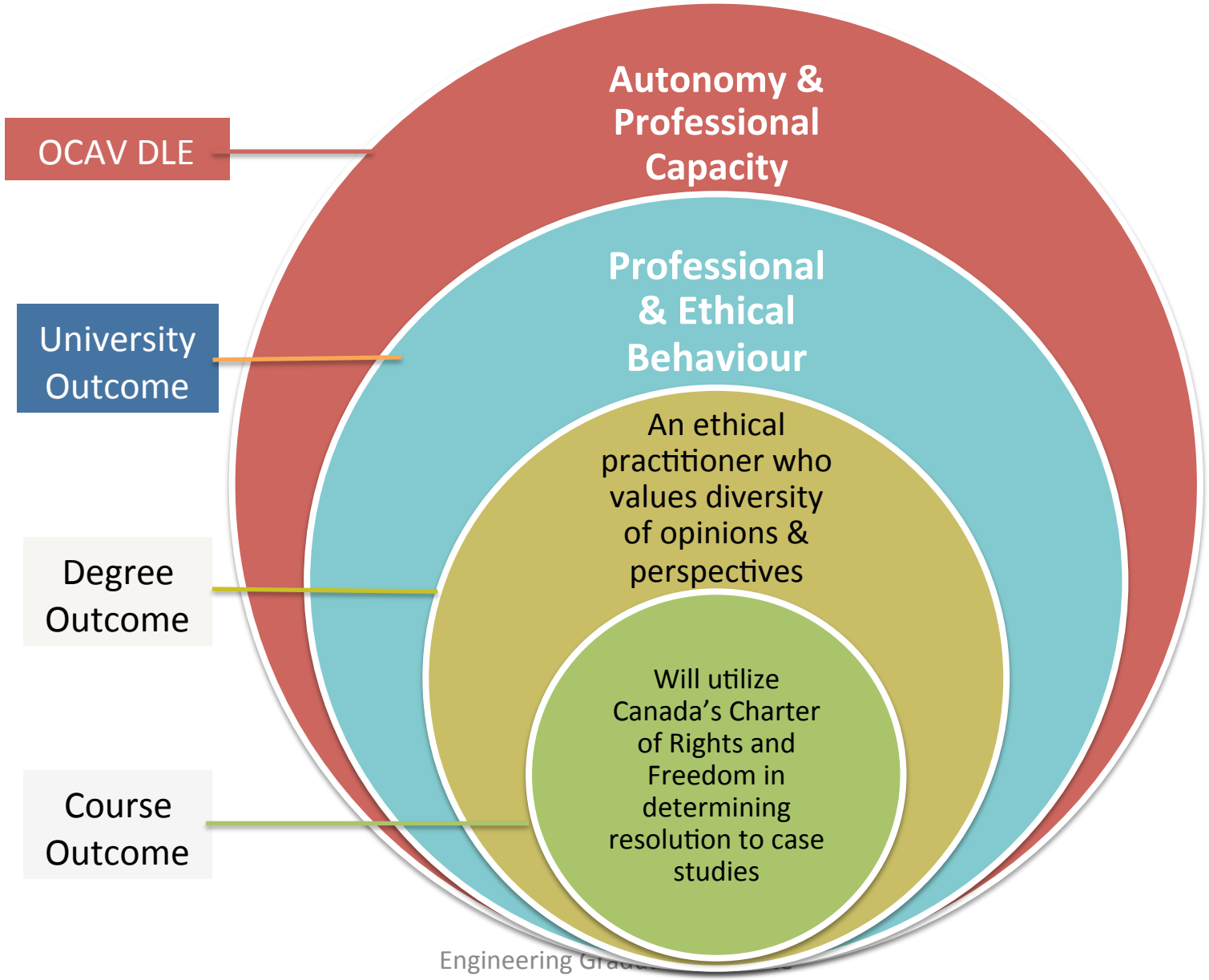


Nomenclature

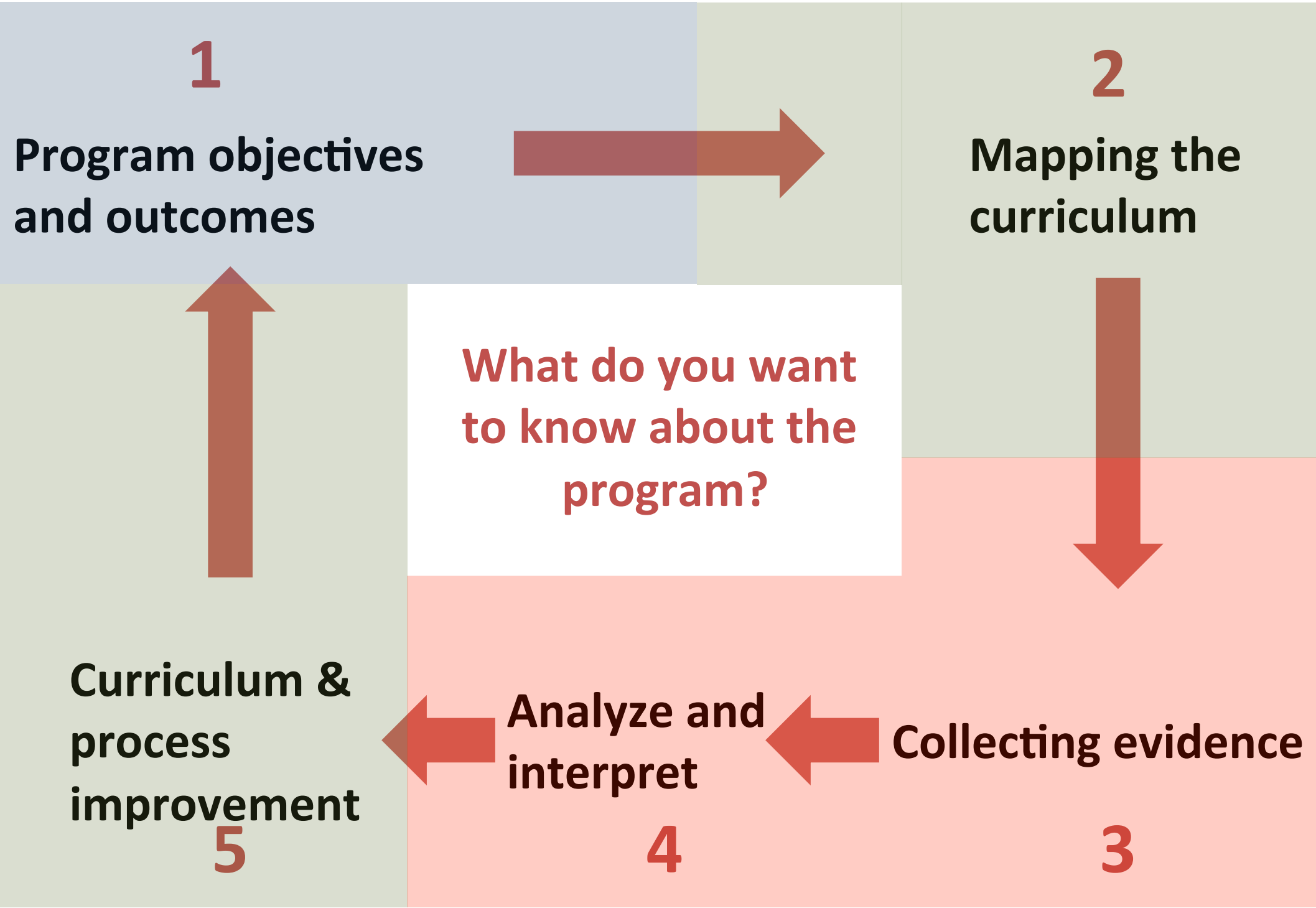
Learning outcome: what students should be able to do at the end of an experience (course, program, etc.)

Synonyms: indicator, competency, performance criteria

Embedded outcomes



Example process



Impact of internship?

Differences between program options?

Impact of particular stream of courses?

Special students (transfer/twinning)?

What do you want to know about the program?

Particular skill set?

Longitudinal development over 4 years?

STEP 0: WHAT DO YOU WANT TO KNOW? (want information, not lots of data!)

1

Program objectives and outcomes

Key program objectives

What are your program's goals & objectives?

New certificate/ twinning programs

Enhance recruitment

Improve collaboration with industry

Objectives in strategic plan?

STEP 1: Objectives and indicators

Learning outcome collections

- AAC&U Essential learning outcomes and VALUE rubrics
- Lumina Degree Qualifications Profile
- OCAV UDLEs
- HEQCO Tuning Sector-wide outcomes
- Disciplinary requirements (nursing, engineering, business, medicine, …)
- Institutional outcomes (e.g. Guelph)

OCAV UDLEs (provincial)

- Depth and Breadth of Knowledge
- Knowledge of Methodologies
- Application of Knowledge
- Communication Skills
- Awareness of Limits of Knowledge
- Autonomy and Professional Capacity

Critical and Creative Thinking Rubric

Adapted from the AACU LEAP rubrics, the Bases of Competence skills, and the University of Guelph Learning Outcomes

UNIVERSITY of GUELPH

CHANGING LIVES IMPROVING LIFE

Definition

Critical and creative thinking is a concept in which one applies logical principles, after much inquiry and analysis, to solve problems in with a high degree of innovation, divergent thinking and risk taking. Those mastering this outcome show evidence of integrating knowledge across disciplinary boundaries. Depth and breadth of understanding of disciplines is essential to this outcome.

	Introduce 1	Reinforce 2	Master 3
Inquiry and Analysis *A systematic process of exploring issues, objects and works through the collection and analysis of evidence that result in informed conclusions or judgments*	Asks appropriate questions and finds evidence related to inquiry of material with a critical eye.	Asks in-depth and specific questions regarding the material, including reliability of the source, and evaluates it critically. Includes evidence to back up statements.	Not only asks specific and in-depth questions, but also explores further possibilities with the aid of quality research. Asks and attempts to answer many questions from a critical perspective.
Problem Solving *Is a process in which one works through a series of operations to come to a conclusion*	Identifies issues and creates a plan to manage the problem.	Identifies and solve issues in a creative manner. Considers and rejects less acceptable approaches to solving the problem and creates and follows a plan.	Sets out to solve issues in creative ways that will not only solve a current issue, but also looks to the future to prevent similar problems. Evaluates the appropriateness of different approaches to solving problems; devises arguments using these methods and articulates reasons for choosing the solution
Creativity *Involves the ability to adapt to situations of change, to initiate change and to take intellectual risks*	Recognizes creative solutions to problems and seeks for beneficial future changes.	Shows a creative mind that is also able to look at long-terms goals. Considers change in an innovative way.	Exemplifies the capacity to think in untested and innovative directions and take intellectual risks.
Depth and Breadth of Understanding *Demonstrates detailed knowledge in one or more disciplines and integrates knowledge across disciplinary boundaries*	Applies basic concepts to specific disciplines.	Extracts and integrates information and perspectives from a variety of disciplines.	Gathers, reviews, evaluates and interprets information; compares the merits of alternate hypotheses in many different disciplines. Demonstrates mastery of a body of knowledge and critically evaluates the limits of their own knowledge and how these limits influence analyses.

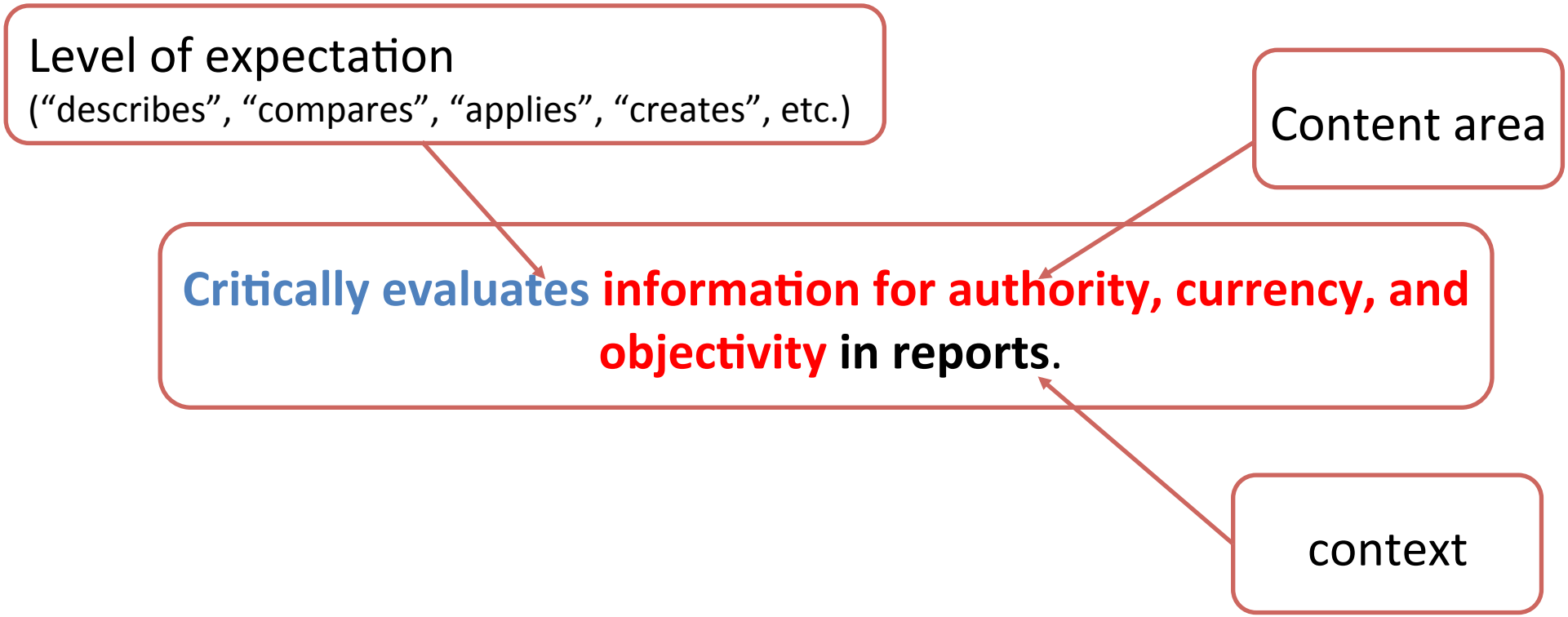
Characteristics of qualification levels (Two-year Diploma, Three-year Diploma, Bachelor's Degree, Master's Degree)

PROCESSES AND SCOPE | REQUIRED KNOWLEDGE BASE | INTERDEPENDENCE | INNOVATION | AUTONOMY

Competencies and learning outcomes

	COMPETENCIES	SUB-COMPETENCIES		
1	KNOWLEDGE	1.1 Theory and Concepts 1.2 Numeracy	1.3 Limits of Knowledge and Qualification 1.4 Multidisciplinary	1.5 Breadth of Knowledge
2	CRITICAL AND CREATIVE THINKING	2.1 Critical Thinking 2.2 Creativity	2.3 Problem Identification 2.4 Problem Solving	2.5 Compares and Contrasts Risks and Benefits 2.6 Evaluation
3	COMMUNICATIONS	3.1 Reading Comprehension 3.2 Effective Writing	3.3 Listening Comprehension 3.4 Presentation Skills	3.5 Effective Oral Communication Skills 3.6 Graphical Communications
4	SOCIAL RESPONSIBILITY	4.1 Ethical Principles and Guidelines 4.2 Social Awareness / Impact	4.3 Professional and Legal Responsibilities 4.4 Health and Safety	4.5 Environment and Sustainability
5	PERSONAL AND INTERPERSONAL	5.1 Diversity and Respect 5.2 Teamwork	5.3 Personal Reflection 5.4 Self-direction and Independent Work	5.5 Lifelong Learning
6	PRACTICE AND METHODS	**LIFE AND HEALTH SCIENCE** 6.1 Investigation / Research Methods 6.2 Resource Material 6.3 Formatting / Referencing 6.4 Practice 6.5 Ethical Research 6.6 Interdisciplinary Practice 6.7 Resource Management 6.8 Relevance of Research 6.9 Information Management	**PHYSICAL SCIENCE** 6.1 Tools, Instruments, and Equipment (Hardware and Software) 6.2 Design 6.3 Uncertainty 6.4 Troubleshooting 6.5 Models 6.6 Resource Management	**SOCIAL SCIENCE** 6.1 Information Management and Assessment 6.2 Ethics of Research 6.3 Research Methods 6.4 Methods of Analysis 6.5 Relevance of Research

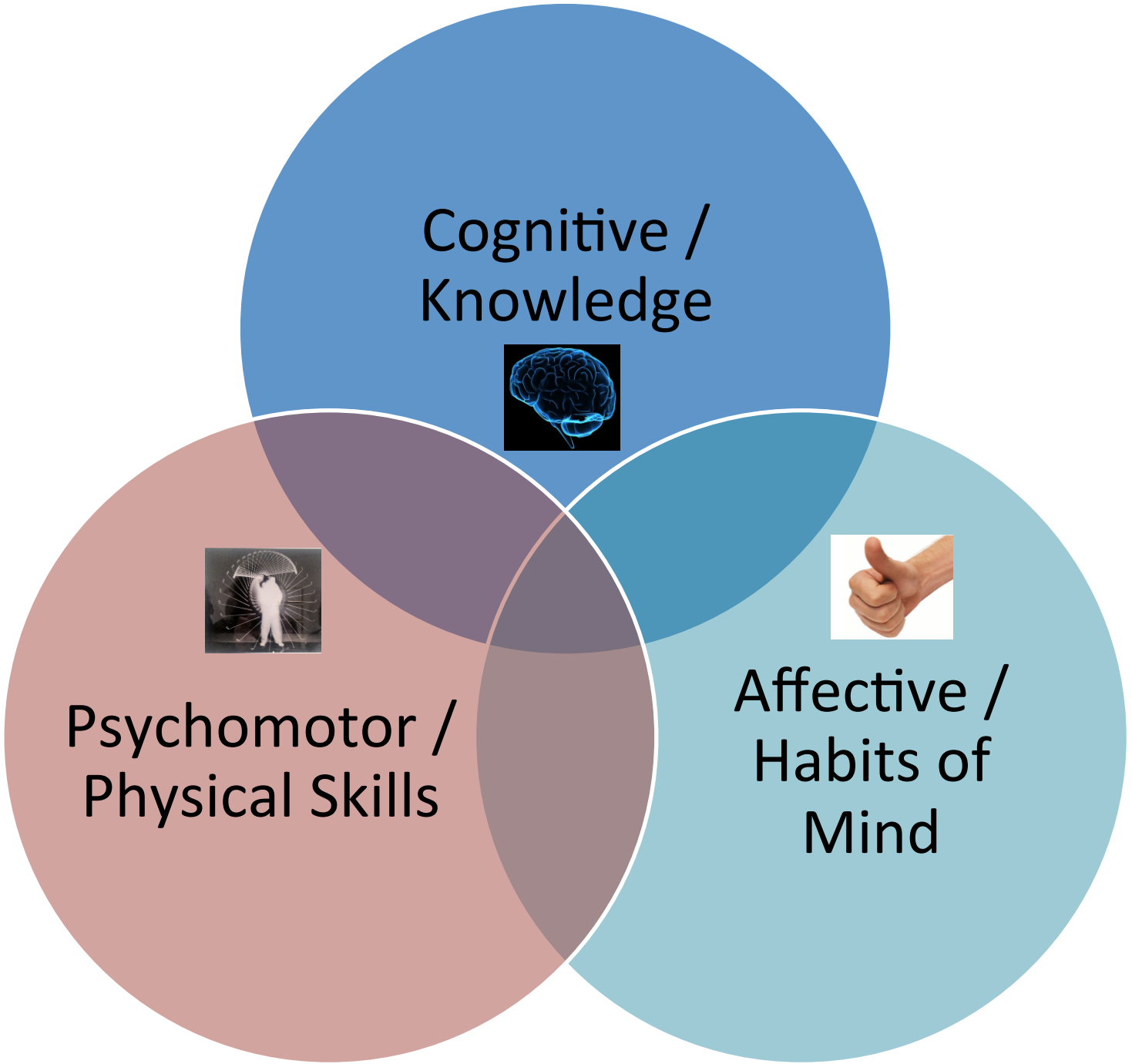
Establishing learning outcomes (indicators)



Indicators should be measureable and meaningful

Indicators should have: content, context, and verb

Indicators should be useful to YOU to help students.



(Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive Domain New York, Longmans, Green, 1956.)

Activities in the workshop:

Developing or adapting outcomes

Tool: existing learning outcomes

	Diploma	Bachelor	Masters
Knowledge	…	…	…
Critical think	…	…	…
Writing	…	…	…
Interpersonal	…	…	…

Aligning outcomes and curriculum

Tool: Curriculum mapping

	Course 1	Course 2	Course 3
Outcome 1	X		X
Outcome 2		X	
Outcome 3	X		

Aligning outcomes within a course

Tool: Course planning table

PHYS101 Course Outcomes: Students will:
1. Describe motion of…
2. Predict the behaviour…

	Teaching	Activity	Assess
Week 1	…	…	
Week 2	…	…	
Week 3	…	…	

Scoring performance

Tool: Rubrics

	Marginal	Meets	Exceeds
Outcome 1	…	…	
Outcome 2	…	…	
Outcome 3	…	…	

Group working time (10 min)

1. Review the provided outcomes, and adapt 2-3 specifically to your program
   - *What learning activity will you use to assess?*
   - *How will they be assessed?*
   - *Are there a few assessment points distributed through your program?*

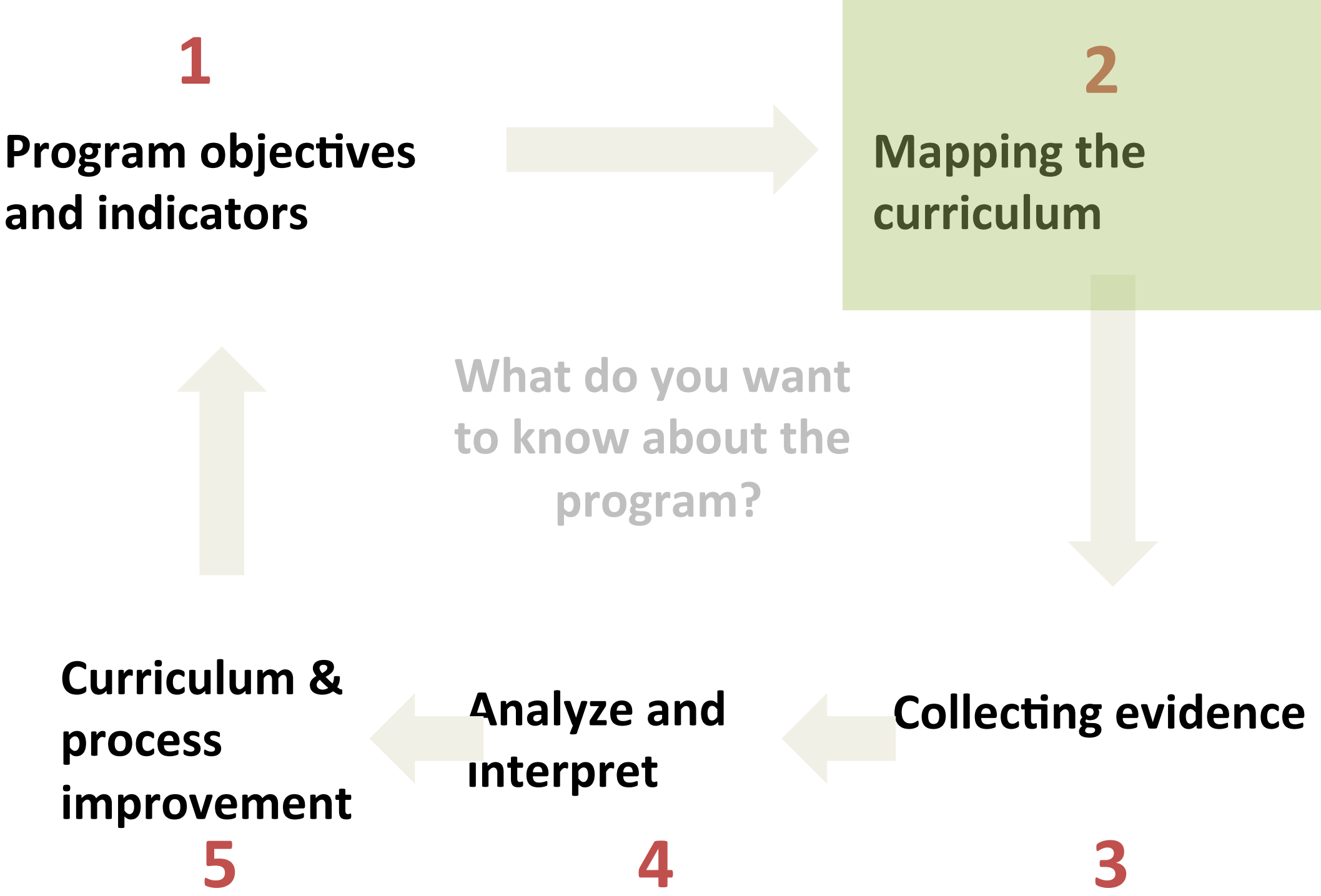
   – Sources: existing course learning outcomes, UDLEs, sample materials

Demonstrate the ability to identify and credibly communicate engineering knowledge.

- Recognize and explain context of a particular engineering design or solution in relation to past and current work as well as future implications.
- Recognize credible evidence in support of claims, whether the evidence is presented in written, oral or visual form (reading).
- Formulate, in written, visual and/or spoken form, credible and persuasive support for a claim.
- Organize written or spoken material– to structure overall elements so that their relationship to a main point and to one another is clear.

Demonstrate the ability to formulate and interpret a model.

- Choose a model (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy.
- Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
- Formulate the model in engineering terms.
- Interpret modeling results of processes or systems using scientific and engineering principles.



STEP 2: Mapping the curriculum

Curriculum Mapping

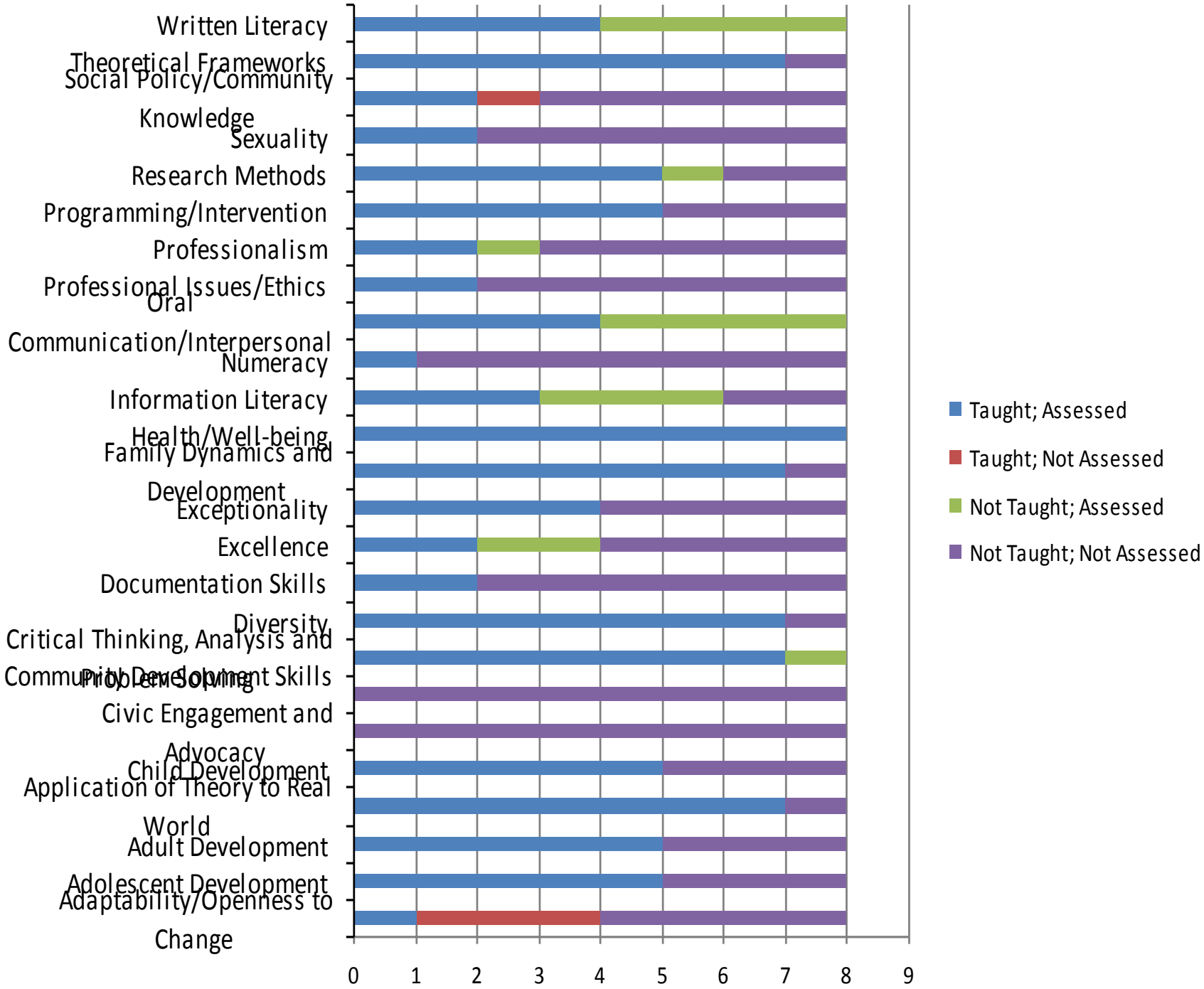
Where are attributes/ learning outcomes developed?

Where are learning outcomes assessed?

- This is important to ensure
  1. The program deliberately develops the outcomes
  2. The program assesses outcomes in appropriate times/courses
  3. Targeted program improvements can be made

Example mapping

KSV Taught Assessed All 2000 Level Courses



Example: Mapping to Courses (UBC)

Course	Number	1 Knowledge Base	2 Problem Analysis	3 Investigation	4 Design	5 Engineering Tools	6 Individual / Team Work	7 Communication	8 Professionalism	9 Impact of Engineering	10 Ethics / Equity	11 Econ. / Project Management	12 Life-long Learning
APSC	150	I	I		I	I	I		I	U	I		I
MATH	100	E	U	I				U		I			I
MATH	101	E	U	I				U		I			I
MATH	152	E	I	E		E							I
PHYS	153	E	E	E	I	I	E	U	U	U	U	I	U
PHYS	170	E	E	U	I	U	I	I					
APSC	201	U	E	U	U	U	E	E	E		E	I	U
MATH	253	E	E	I	E		I	U		I	U		U
MATH	256	E	E	U	I	I							
MECH	220	E	I	U	U	E	U	I	I	I	I		I
MECH	221	E	E	E	I	E	U	U	I	I	I		I
MECH	222	E	E	E	U	E	U	U	I	I	I	I	I
MECH	223	E	E	E	E	E	E	U	U	E	I	E	I

Current CEAB Documentation: IDA

- Introduce - Develop - Apply/use

CEAB graduate attribute content** (content code):	**1 KB**	**2 PA**	**3 Inv.**	**4 Des.**	**5 Tools**	**6 Team**	**7 Comm.**	**8 Prof.**	**9 Impacts**	**10 Ethics**	**11 Econ.**	**1 L**

** Enter content code most appropriate for each attribute

Content level codes: N/A = not applicable; I = introduced; D = developed; A = applied;
ID = introduced & developed; IA = introduced & applied; DA = developed & applied;
IDA = introduced, developed & applied

Breakout: Assessment planning activity

At your table, identify the stakeholders

What would you ask them?

How would you ask them?

How often would you ask them?

Ways of assessing ("assessment tools")

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

Group working time (15 min)

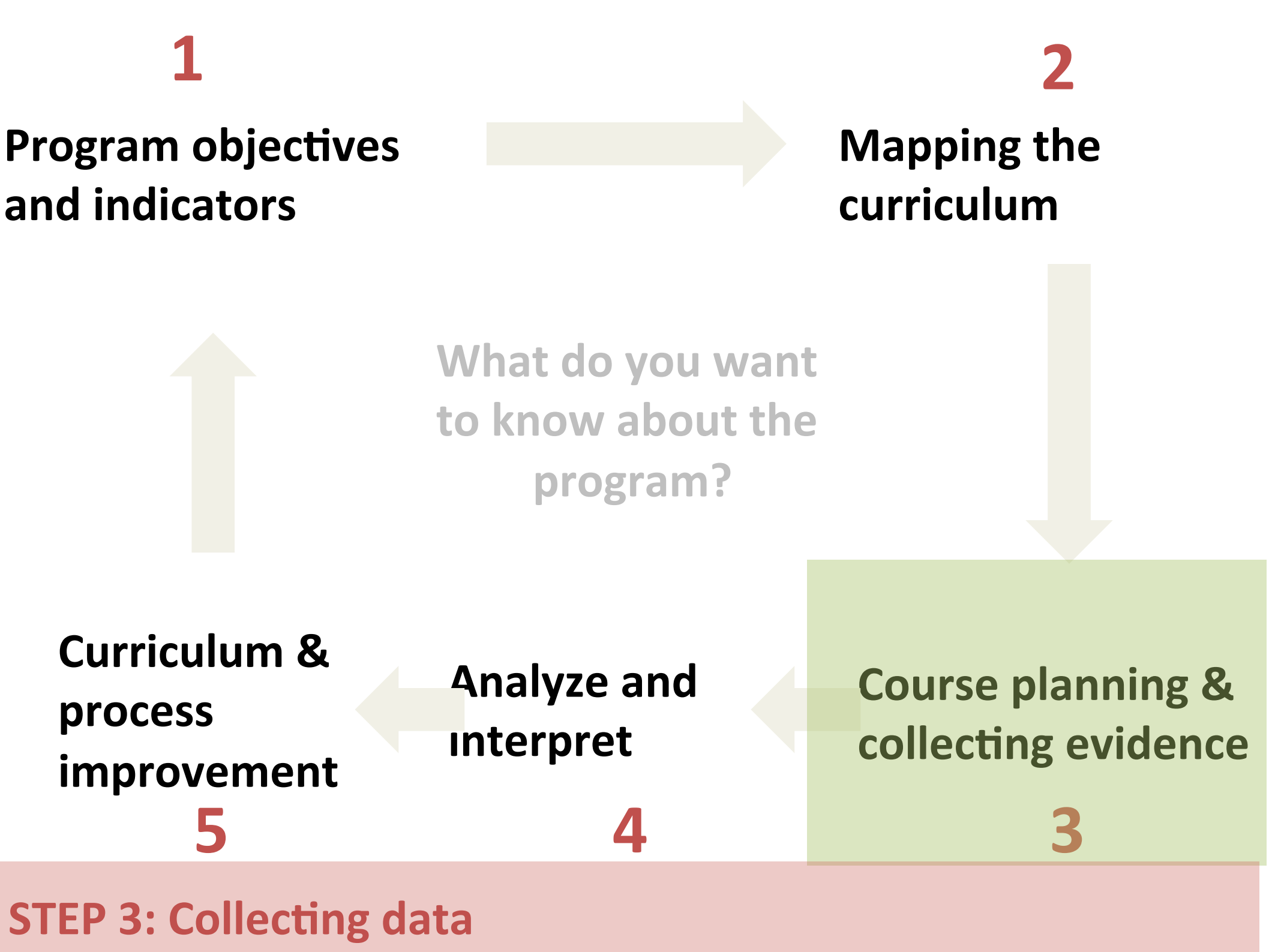
In your group work on a curriculum map of a few "typical" courses in your program

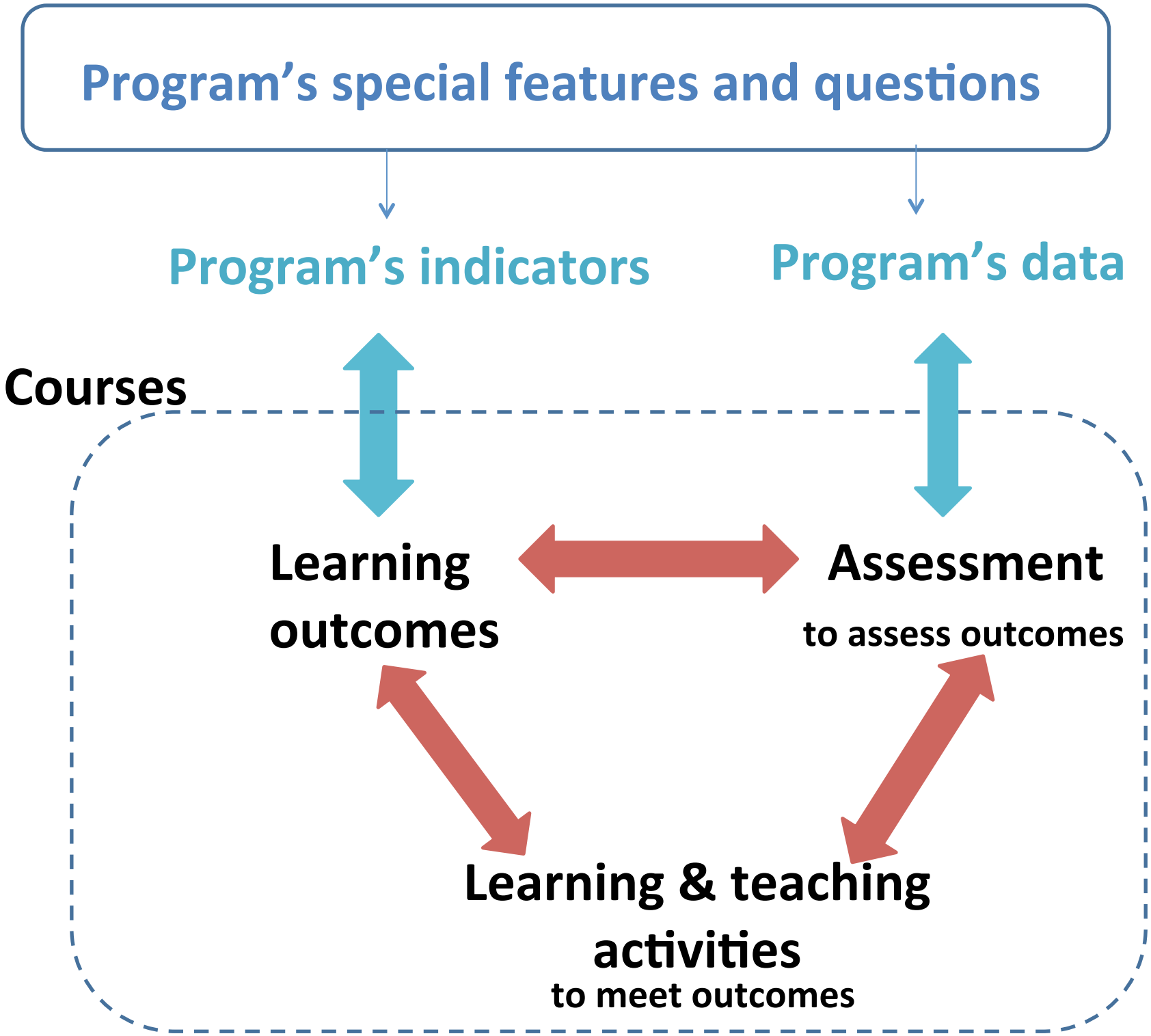
Sample assessment plan

Participants	Activity	Questions
Current Students	2 sets of 2 focus groups Set- 1st and 2nd year students Set - 3rd 4th year students	Potential questions: ▪ What knowledge, skills and values do you think are most important to graduates of the programme? (compare with the current outcomes) ▪ Describe your most enjoyable learning experiences at Guelph to date. ▪ Comments on other aspects of your Guelph experience (e.g. awards, academic support)? ▪ What would you change about the curriculum? ▪ Please suggest changes to help us improve the program: what would you add/drop from the curriculum? Other changes? ▪ What advice would you give to an incoming student?
Employers	Focus group	• What knowledge, skills and values do you look for when hiring? • How well do our graduates meet those KSAs • What kinds of work would someone with an undergraduate degree be doing in your organization? • What advise would you give a student coming into this program regarding their educational options? • Where do you see new employees in 5 years? What are their opportunities for advancement?

Sample assessment plan (cont'd)

Secondary Documents	Previous Review	• To provide an overview of "where we are" in relation to experiential insights gained from faculty and students.
Faculty	Web survey followed by a faculty retreat	• Web survey – Solicit feedback on current programme outcomes by faculty • Retreat – review results of survey • Based on faculty perspectives, develop a list of programme (a) strengths (b) weaknesses (c) opportunities (d) limitations? • Compare faculty SWOT with the other stakeholder SWOT • Develop an action plan


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


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

Course planning (example handout)

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)*

CHEE 321 2012-2013 || Module overview

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

1. Calculate operating parameters (size, flowrates, conversion, etc…) for isothermal and non-isothermal operation of ideal well-mixed batch and continuous reactors, and for ideal plug-flow reactors
2. Formulate a set of consistent material and energy balance equations to describe operation of batch, semi-continuous and continuous reactor systems with single or multiple reactions
3. Formulate an overall rate expression from a series of elementary mechanistic steps
4. Investigate the choice of reactor type and operating conditions on output such as reactant conversion, selectivity and yield.

Students are expected to augment lecture material through reading of associated sections of the textbook, and to practice execution of course principles by completing posted problem sets

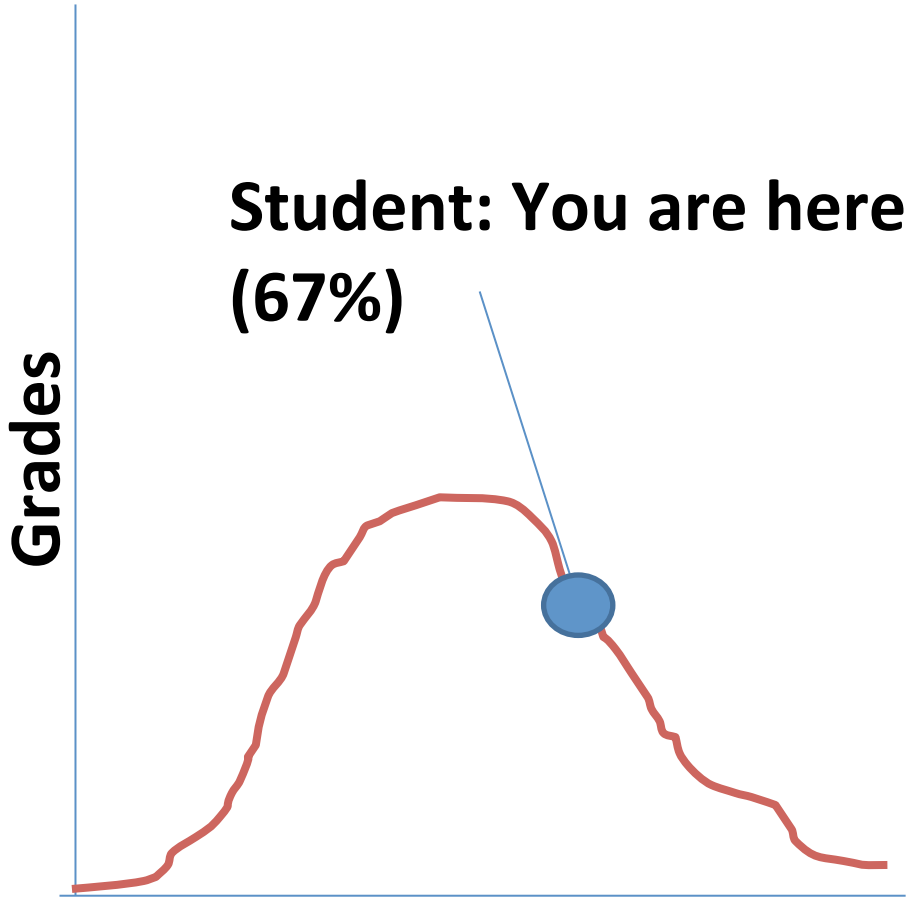
Module	Lecture approach and content	Tutorial approach and content	Assessment (CLO, and % of course grade)
Module 1 (Wks 1-2)	**Reactions and the GMBE** • Reaction Rates, Rate Laws and Stoichiometry • The General Mole Balance Equation (GMBE) and Ideal Reactors • Estimating Rates from Experimental Data	Worked examples, based on lecture material A set of practice problems is also posted (unmarked)	Material is included on mid-term (CLO1)
Module 2 (Wks 3-5)	**Isothermal Reactors: Single Reaction in Batch, CSTR, PFR** • Solving Problems using Stoichiometric Tables • Levenspiel Plots (Reactor Sizing) and Multiple Reactors • Reversible Reactions	Worked examples, based on lecture material A set of practice problems is also posted (unmarked)	Material is included on mid-term (CLO1) Design assignment 1 (10%, CLO1, CLO4)
Midterm	**Covers Modules 1 and 2**		***Midterm exam:*** *2-3 questions will target CLO1, worth 20% of course grade*
Module 3 (Wks 6-8)	**NonIsothermal Reactor Design** • Forms of the Energy Balance (EB); Isothermal and Adiabatic • CSTR with the EB; multiple steady-states	Worked examples, based on lecture material A set of practice problems is also posted	Material is included on final (CLO1, CLO2)

Group working time (15 min)

In your group select one course as the context for assessing some outcomes.

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

Norm referenced evaluation

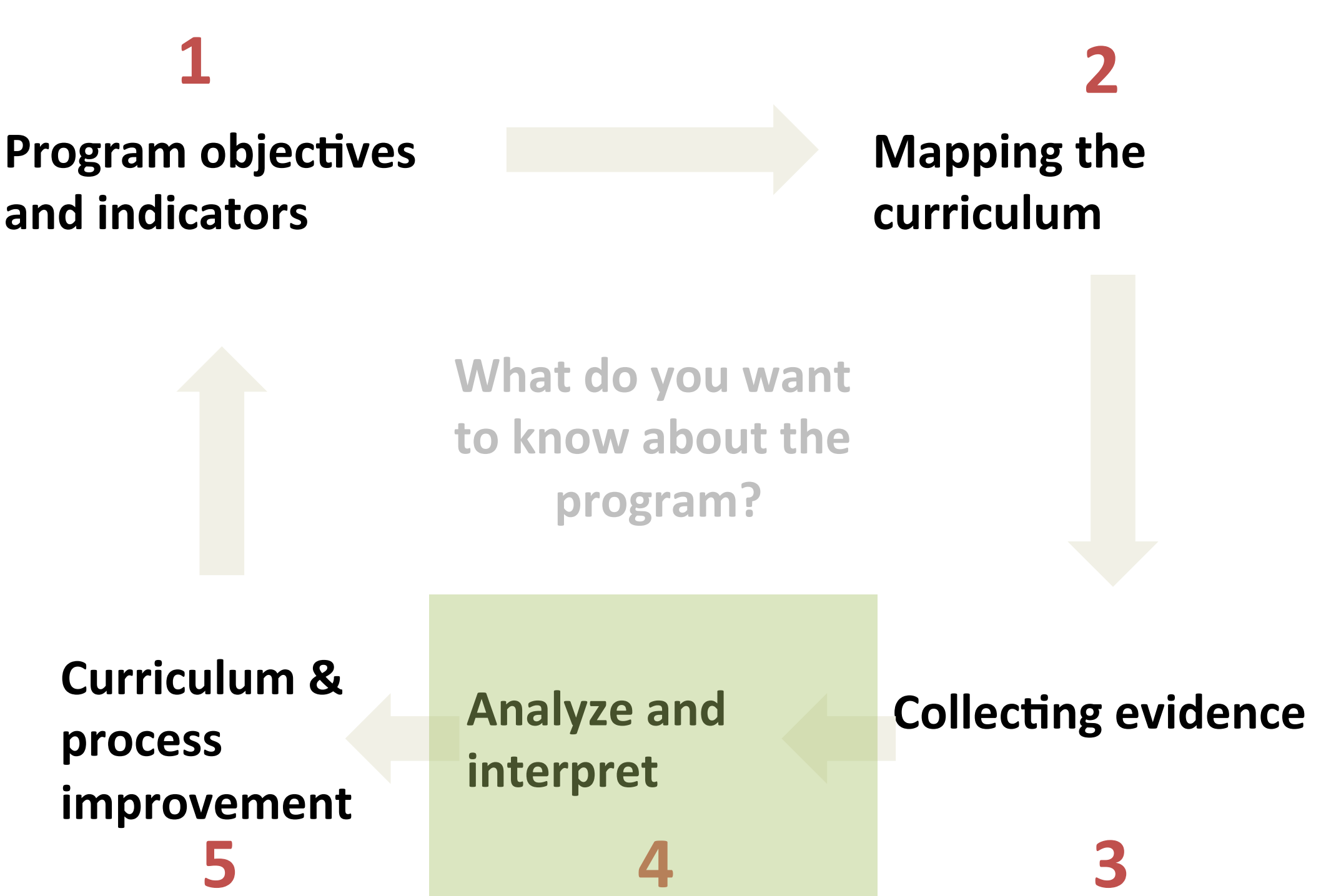


Used for large scale evaluation to compare students against each other

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.

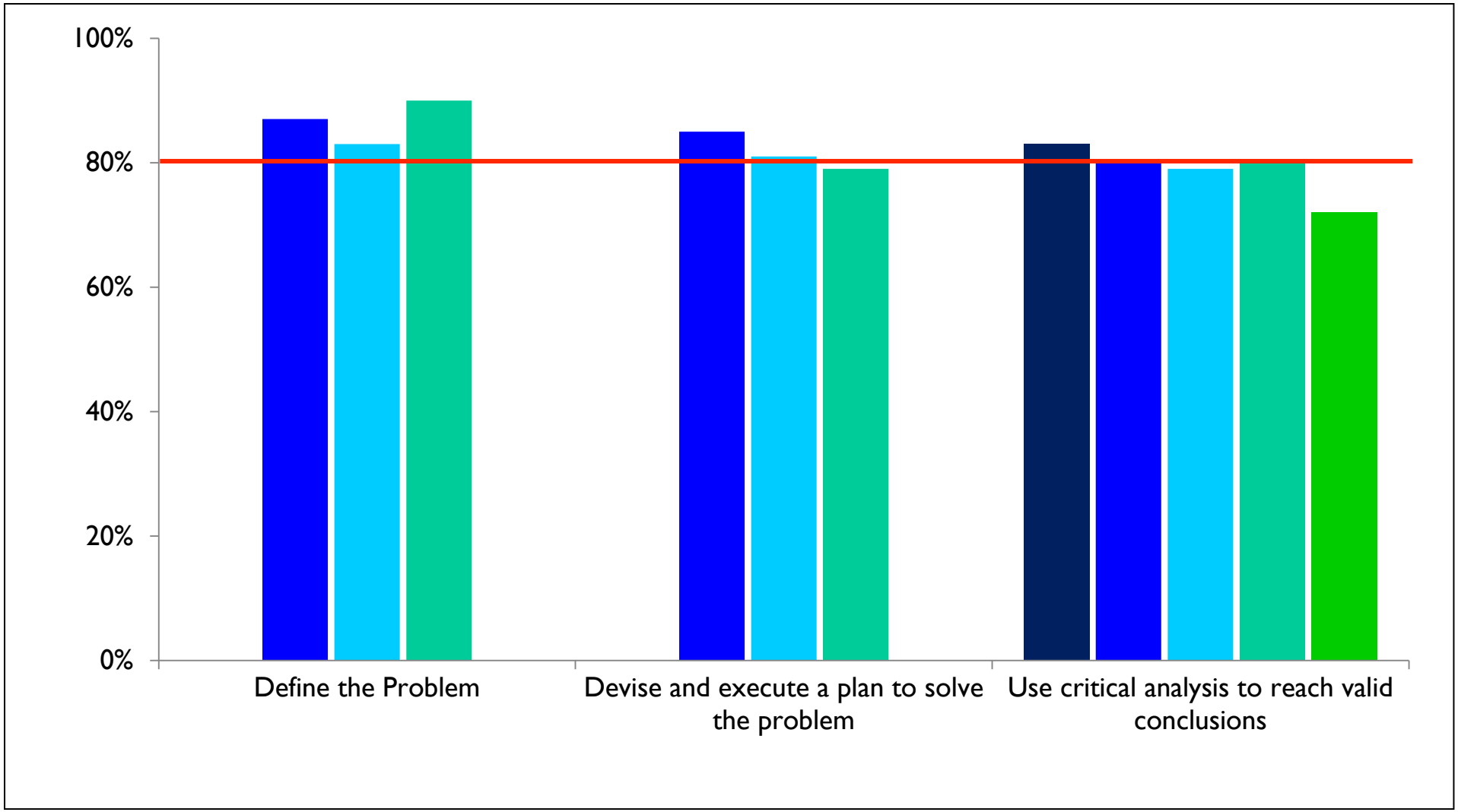
Used to evaluate students against stated criteria



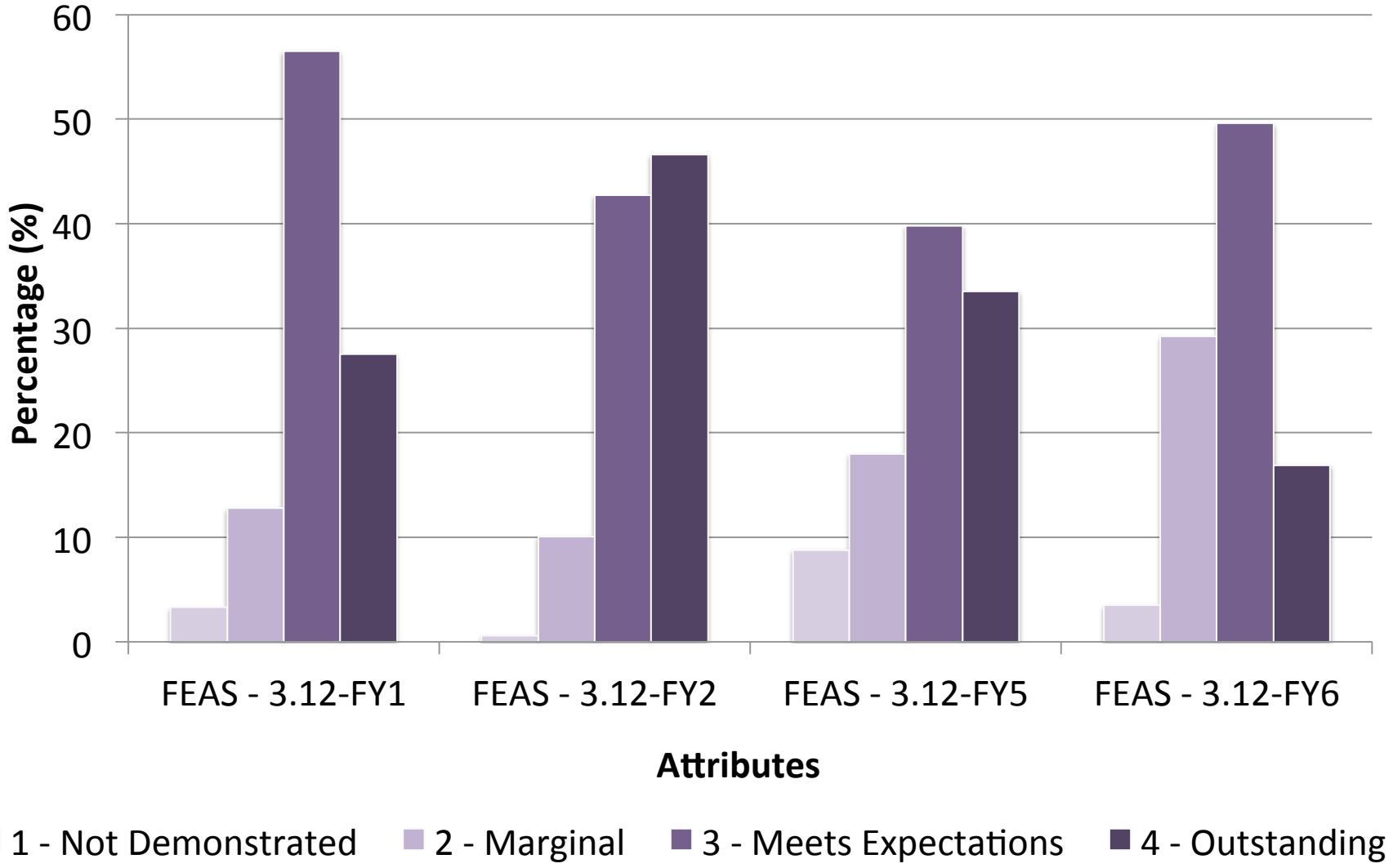
STEP 4: Analyze and interpret

Histogram for Investigation (UofT)

Percentage of students who meet or exceed performance expectations in indicators



Histograms for Lifelong learning (Queens)

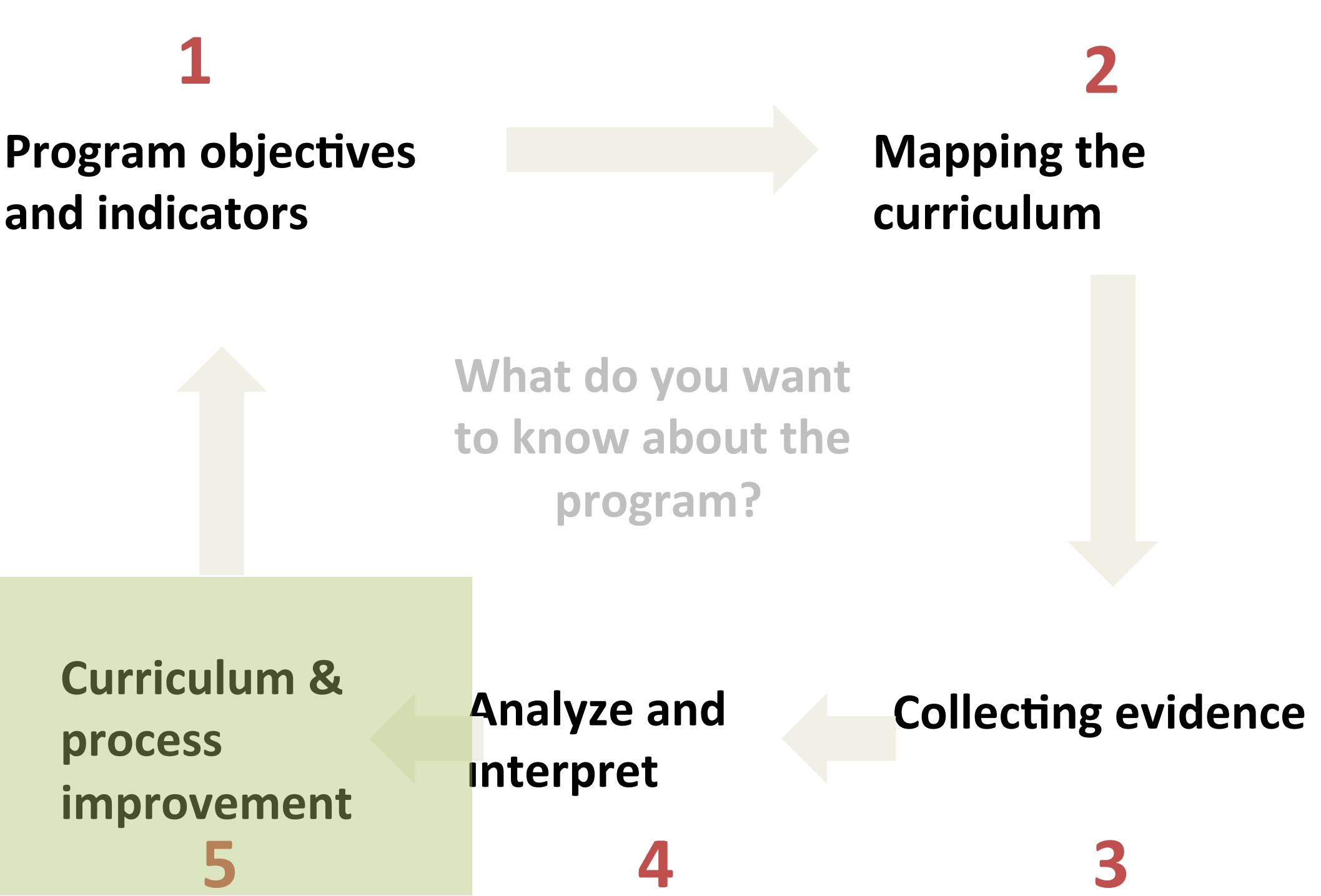


3.12-FY1 Uses information effectively, ethically, and legally to accomplish a specific purpose, including clear attribution of Information sources.

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.



STEP 5: Curriculum and process improvement

Conclusions

- Focus on intentionally closing the loop
- Alignment between outcomes, instruction, and assessment
- Tools (mapping, course planning, software) should support the end goal