

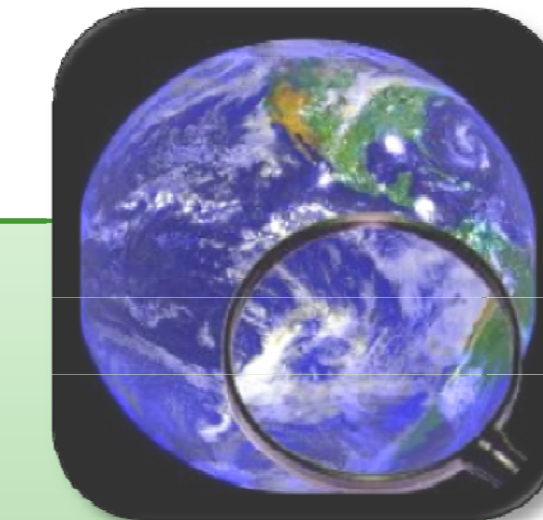
# Improving Metacognitive Skills of 2<sup>nd</sup> year Environmental Science Students: What to Measure?

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**Premise:** Optimal courses include Goals → Assessment → Active learning. **Consequence:** If some goals are "metacognitive", how to assess them?

## Current practice



### UBC's Environmental Sciences Program

An integrative, cross-disciplinary approach to the study of sciences underlying environmental issues facing societies.

<http://www.ensc.ubc.ca/>

### Implementation:

- Selected students (grades & essay);
- One "integrative" **core course** each year;
- Students attain expertise via 1 of 7 areas of concentration.



### Core courses – envr200, envr300, envr400

Investigations into scientific, technical, social, economic, legal & ethical environmental issues of global, regional and local importance.

### envr200 Learning Goals: Students should be able to ...

1. Find scientific information & evaluate relevance & biases of sources.
2. Formulate, ask and discuss relevant questions.
3. Synthesize information from a variety of sources & viewpoints.
4. Differentiate among all types of publication & news media.
5. Communicate coherent oral and written syntheses.
6. Defend positions that may not be their own.
7. Effectively contribute in group projects as a member or leader.
8. Evaluate contributions & results of self / peers / whole group.
9. Evaluate the work of other groups and individuals.



### General strategies: focus on metacognition rather than content

1. Feedback loops (expert and peers);
2. Individual / peer / group work;
3. Guided and self-directed work;
4. balancing variety with consistency of learning settings and outcomes;
5. Conscious evaluation of progress;
6. Learn some content in depth;
7. Incorporate prior knowledge;
8. Use many sources & experts;
9. Reflective scholarship.

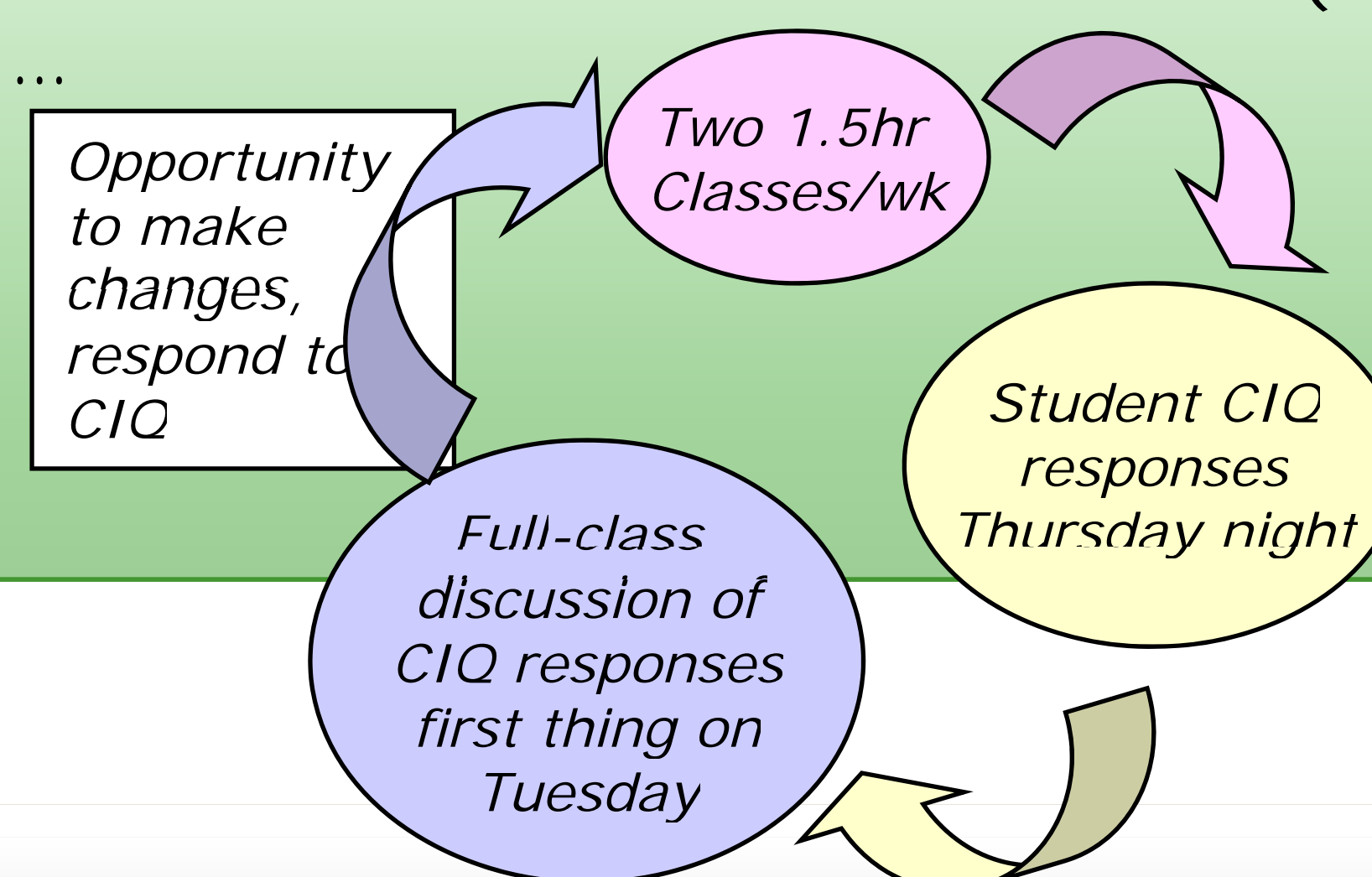
### Activities to support these strategies [# per term]

1. *Group poster sessions with peer review;* [3]
  2. *Simulated Town Hall meetings;* [3]
  3. *Writing newspaper articles about Town Hall meetings;* [2]
  4. *Individual research papers: peer reviewed drafts;* [1]
  5. *Individual research presentations with peer review;* [1]
  6. *Assigned pre-class preparations, including posing questions for guest speakers, research assigns. etc.* [19]
  7. *Weekly CIQ: Critical Incidence Questionnaires (7).* [13]
- No "exams". → Rubrics for most activities.

### One Example: CIQ questions: Reflection with Feedback (9)

What made you feel most ...

1. Engaged
2. Distanced
3. Affirming or helpful
4. Puzzling or confusing
5. Surprised



### CIQ examples; feedback about learning & the course: (9)

- **CIQ's:** "...good to know what peers have written ... so many thoughts in common ..."
- **Individual's learning:** "... most engaged while explaining my group's poster to others..."
- **Logistics:** "... surprised by the lack of time provided to discuss group projects ..."
- **Interactions with others:** "...distanced when some peers dominated discussions ..."
- **Other:** "... I became a little frightened ... don't think I've been committed enough ..."

## Potential for further measurement of metacognition

### Background (preliminary)

#### Characteristics of metacognition (Sources in brackets)

- Three "properties" (3): Aptitudes, Events, Context
- Four strategies: planning, monitoring, evaluating, modifying (2,4)
- Reflective capacity (1, 8)

Characteristics mapped to ENVR200

### A few options for measuring metacognition

#### Aptitudes (3) – "are you able to ..." or "what are your tendencies?"

- Self report questionnaires (2, 3, 4, 6)
  - (eg LASSI, MSLO, CLASS, EOT, custom, etc.)
  - Interviews (structured, unstructured, etc.) (2, 3)
  - Teacher judgments (ad-hoc or probing)
  - Longitudinal measurement may be possible
- envr200 ->300 ->4xy

#### Events (3) – "what do you do when ...?"

- Think aloud measures
- Error detection tasks
- Trace methodologies, e.g. coding questions posed.
- Observations of performance (2, 3)
- "What do you notice" (novice – expert distinction)
- Invention activities with pre-post assessments (11)
- Wrappers (5)
- Domain specific thinking strategies
- eg: A. Schoenfeld & math problem solving; (12)
- Diagnostics (pre-course & possibly post-course) (6)

### Measurement: egs. of caveats & challenges: (3)

- Are students addressing *learning* or *well-being* goals?
- Is reflective or reactive behavior being targeted?
- What interactions are there between the setting and interventions?
- Choice of model affects measurement options.
- Dynamic processes: targets may be affected by measurements.
- What units? What time scales? Sampling "what"?
- Technical & statistical issues with complex data.
- Efficiency & costs: needs for longitudinal studies.

## Mapping envr200 learning activities onto metacognition model components

Learning environment, products, and potential for measuring

ENVR 200 COURSE ACTIVITIES	CURRENT ENVIRONMENT & PRODUCTS				EIGHT CHARACTERISTICS OF METACOGNITION THAT MIGHT BE MEASURABLE, FOR EACH OF 15 COURSE ACTIVITIES.							
	class/home	#times used	group/individ	product	aptitude	event	context	plan	monitor	eval't	modif'n	reflect'n
Class Preparation Notes	h	19	i	s	y	m		m	m			
Critical Incidence Questionnaires (CIQ)	h	13	i	s	y	y	y		m	m	m	y
Poster presentations	c	3	g	r	y			m				
Peer ass'nt of poster effort	c	3	i	p		y				m		
Poster reviews	c	1	i	p		y				m		m
Town Hall Meeting position paper	h	1	g	o	y		m	y	y	y	m	
Peer ass'nt of pos'n paper effort	c	1	i	p		y						
Newspaper articles about THMs	c	2	i	s		y			m	m		
Research Paper	h	1	i	l	y			y	y	y		m
Research presentation	c	1	i	o		y			m			
Peer review of research paper	c	1	i	p		y						
Peer review of presentations	c	1	i	p		y						
Field trip	c	1	g	a		m	y				m	m
guest speaker events	c	10	i	a	m		m	y	y	y		
reflections	h	1	i	s	m						m	y

y = yes, directly; m = maybe, with additional intervention

### Examples of possible additional interventions

Intervention	aptitude	event	context	plan	monitor	eval't	modif'n	reflect'n
Skills diagnostics (Pre-course and possibly post-course) (6)		m	m					
Wrappers (5) for specific exercises		m		m	m	m	m	
Tracing of skills throughout CPNs & CIQ	m		m	m				m
Self-reporting questionnaires (4, 6)		m	m	m	m	m	m	m

### EXPLANATION OF THIS TABLE:

This is a summary of (a) setting (environment), (b) learning outcomes (product), & (c) possibilities for measuring metacognitive skills for each of the current course activities. Entries in the eight right-hand columns are initial ideas only.

envr200	code	Products: What students produce	Feedback
35	s	short writings (1-2 paragraphs, *200 wrds)	online, instructor (rubric)
1	l	longer writings (2-3 pages)	peers + instructor
6	p	peer reviews	via rubric
2	o	oral presentation or positions (THM)	peers + instructor (rubric)
3	r	poster	peers + instructor (rubric)
3	a	attendance only	

**Comment:** The "yes" / "maybe" correspondence between course activities and characteristics of metacognition is preliminary. Implementation of measurements needs careful consideration of needs, challenges, 'costs', precedent, etc. Interventions should be 'low impact' and incorporated with existing learning outcomes, as exemplified by Lovett, (5).

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