Using Qualitative Data to Inform Teaching and for Educational Research

Diane Lam

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Rating of Instructor on Various Criteria (1=low/disagree, 7=high/agree)   Mean

	Mean
Instructor set high quality standards	5.3
Instructor effectively managed class discussion	4.4
Instructor appropriately related course material to managerial issues	5.2
Instructor was responsive to students' concerns	5.1
How would you rate the overall effectiveness of the instructor?	**5.0**

Distribution of Overall Effectiveness Rating (% of students by rating: 1-7)

1	2	3	4	5	6	7
4%	2%	11%	11%	25%	35%	12%

Overall Effectiveness Rating by Demographic Group

U.S. Male	5.4
U.S. Female	5.0
Non-U.S. Male	4.8
Non-U.S. Female	3.8

Comments about strengths

- Prof. Anderson is **very engaging**, with **high energy** which keeps the class engaged. His **passion** for the subject is infectious! *(Male, US)*

- Anderson is an **entertaining, articulate, and charismatic** presence… *(Male, US)*

- …Anderson's sense of **humor** added a lot to the engagement in the class. *(Male, nonUS)*

Comments about opportunities for improvement

- It seemed often that the professor was **looking for only one "right" answer** to his questions... *(Female, US)*

- I often felt that **he cut off students** in the middle of their remarks, and his responses to student remarks demonstrated that **he had not fully understood what they were saying**... *(Male, US)*

- The professor **relies too heavily on humor** to sustain class. Moreover, his humor is of the sort that you'd hear in a fraternity house, which I believe runs the risk of alienating most (if not all) foreign students and women. *(Male, US)*

Strengths codes

MANAGING THE DISCUSSION	33
Structure, Pacing, and Flow	**15**
Facilitation/guidance/leading (8)	
Questioning, Listening, Responding	**9**
Challenging, probing for depth, following up (4)	
Encourages preparation, accountability, high standards (3)	
Participation, Call Patterns	**13**
Diverse/broad/unbiased participation (7)	
Equitable call patterns (6)	

Opportunities for Improvement codes

MANAGING THE DISCUSSION	**78**
Structure, Pacing, and Flow	**52**
More flexibility, less directive (33)	
Better flow, less disjointed (12)	
Less lecturing (7)	
Less time in choosing next participant (7)	
More agenda-setting, contextualizing agenda and learning objectives (3)	
Clearer transitions (3)	
Questioning, Listening, Responding	**49**
More attentive listening (17)	
Better address content of student comments, less dismissive (17)	
Less "fishing" (7)	
Less cutting off students (6)	
More challenging, probing and following-up (5)	
Better handling of tangents (5)	

- Better understand of the value of qualitative data as a part of both research and teaching.

- Gain experience analyzing verbal data by developing and using a coding scheme.

- Be able to apply a process of quantifying qualitative data to future data.

- Be able to argue for the reliability of verbal protocol analysis.

- Quantitative vs. Qualitative methods
- Integrating qualitative and quantitative data
- Coding schemes
- Steps for verbal data analysis
- Other considerations

Quantitative vs. Qualitative Methods in Educational Research

Method	Pros	Cons
Qualitative	• Natural settings • Richer and deeper	• Subjective • Nonreplicable
Quantitative	• Objective • Replicable	• Sterile lab environment

Four Methods for Integrating Quantitative and Qualitative Data

1. Use qualitative to help interpret quantitative

   For example:
   - Experts and novices group physics problems into "types"
   - *Quantitative*: factor analyses of problem groupings
   - *Qualitative*: explanations of categories
   - No claims about the explanations, but helps to interpret categories

Quant > Qual

(Chi et al., 1981)

2. Use qualitative to complement quantitative

For example:

- Test scores (quant) compared to inferences made (qual) during problem-solving

- Test scores ←→ Inferences

Quant = Qual

(Chi et al., 1989)

3. Use qualitative as backdrop to quantitative

For example:

- Expansive framing in a classroom seemed to lead to higher student performance.

(Engle et al., 2010)

- Expansive framing in a one-on-one tutoring session where individual aspects of framing were manipulated.

(Engle, Nguyen, & Mendelson, 2011)

Quant ≤ Qual

4. Quantify the qualitative data

- Interviews

- Focus groups

- Class discussions

- Student reflections

- Responses to assessment questions

- Comments on course evaluations

Goal of verbal protocol analysis: capture what the student knows and how it changes with learning, (and do it in a way that is as objective as possible)

Blood Flow in the Heart

One-way valves separate these chambers and prevent blood from moving in the wrong direction. The atrioventricular valves (a-v) separate the atria from the ventricles. The a-v valve on the right side is the tricuspid valve, and the a-v valve on the left side is the bicuspid valve. Blood flows out of the ventricles. Two semilunar (s-l) valves separate the ventricles from the large vessels through which blood flows out of the heart. Each of the valves consists of flaps of tissue that open as blood is pumped out of the ventricles.

Blood returning to the heart, which has high concentration, or density, of carbon dioxide and a low concentration of oxygen, enters the right atrium. The atrium pumps it through the tricuspid valve into the right ventricle. Blood from the right ventricle flows through the semilunar valve into the pulmonary artery and then to the lungs. In the lungs, carbon dioxide leaves the circulating blood and oxygen enters it. The oxygenated blood returns to the left atrium of the heart. The oxygenated blood is then pumped through the bicuspid valve into the left ventricle. Blood from the left ventricle flows through the left semilunar valve, into the aorta, and then throughout the body.

This passage talks about blood flow, and kind of answers questions I had earlier about yeah, direction from atrium to ventricle, to -- through the semilunar valves to the right pulmonary-- er to the lungs. From the lungs back to the left atrium to the ventricle to another semilunar valve. Why "lunar" and what are these-- oh okay, these are tricuspid and bicuspid. Why would that be? three and two what? What are cusps? hmm.. Why would the right side have three? hmm.. semilunar valves, maybe that has to do with the shape of them, maybe they're crescent-like. interesting shape. And AV valves. So this just stops the heart from-- I mean if it's just contracting or whatever, it has to go in one direction otherwise it's contracting by itself with-- could lead to go in either direction so having these one-way valves, these flaps forces it to go one way, from right to left..

#3592 Passage 3 19:44

Coding Scheme:

A way to categorize behavior so that you can code what you observe in terms of how often a type of behavior appears.

What is a coding scheme? Examples

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Bloom's Taxonomy
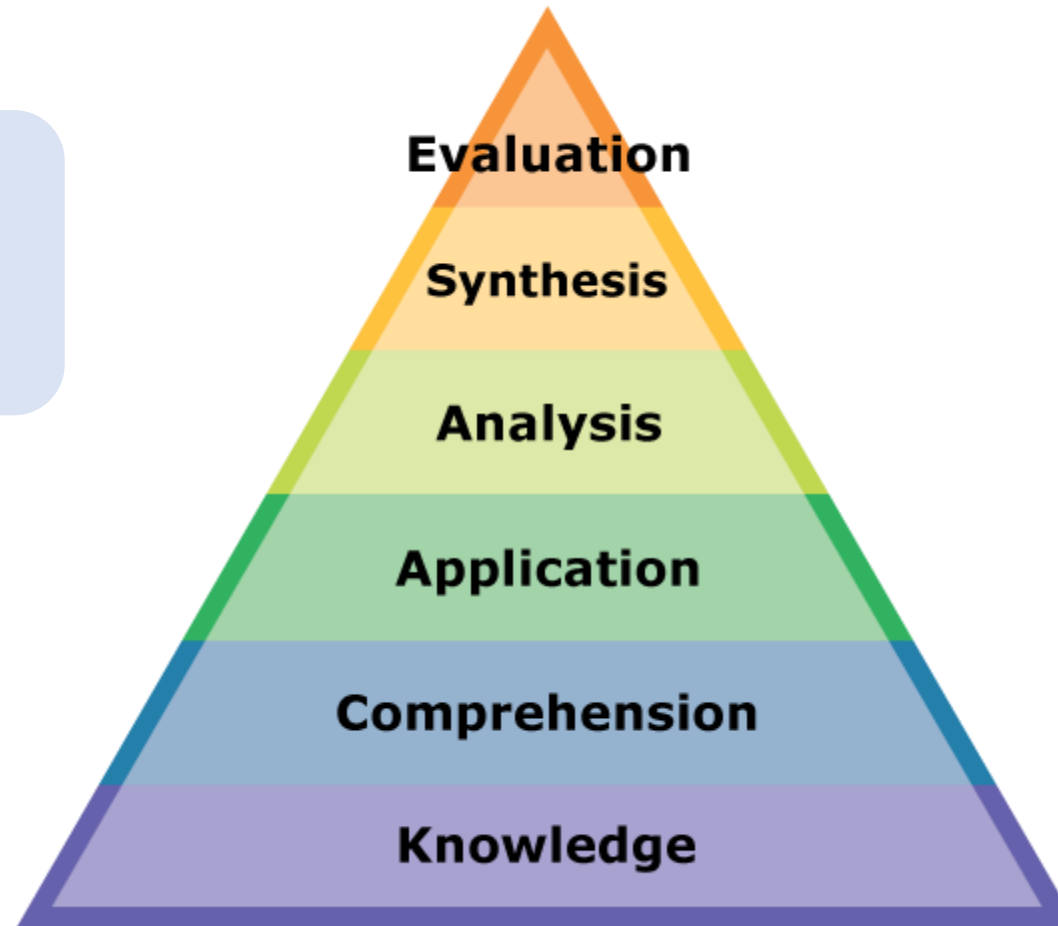
Cognitive Domain:
Learning Objectives

Classroom Observation Protocol for Undergraduate STEM
COPUS

Self-explanations

Comprehension Monitoring	Being aware of understanding
Elaboration	using prior knowledge or experiences to understand the sentence; adds details to expand on an idea, includes use of metaphors and analogies
Goal-driven	A goal is inferred of a particular structure or action
Predictions	Predicting what the text will say next
Bridging	Making reference to an idea presented in a previous sentence in the text to better understand relations between sentences
Summarizing	Identifying main points across multiple sentences
Paraphrasing	Restating the text in different words

1. Reduce or sample the protocols

- Take a random sample
- Choose a subset based on "non-content" criterion
  - e.g. a pause, change in activity
- Do preliminary coding on the entire set and then more detailed coding on a subset.

Grain size: a sentence, an idea, a reasoning chain, an episode, a topic, an impasse

During strenuous exercise, tissues need more oxygen.

"During exercise, the tissues, um, are used more, and since they are used more, they need more oxygen and nutrients, and um the blood, blood's transporting it to them."

Inference: Blood transports more oxygen and nutrients to tissues during exercise.

During strenuous exercise, tissues need more oxygen.

"During exercise, the tissues, um, are used more, //

and since they are used more, they need more oxygen and nutrients. //

And um the blood, blood's transporting it to them."//

- Inference 1: Tissues are used more during exercise.

- Inference 2: When tissues are used more, they need more oxygen and nutrients.

- Inference 3: Blood transports oxygen to the tissues.

- Avoid categories schemes that call for too much interpretation on the part of the coder
  - E.g. Instead of "often," use "4 or more times"
- Categories should be
  - exhaustive (can use "other" and "none" categories)
  - mutually exclusive
 - derived from a single construct

- Decide what constitutes evidence that a data point belongs to a certain category

- Revise if data points will not clearly fit into one category

- Consider how many lines of verbal protocol should be considered when interpreting the meaning of a segment (e.g. max, min, both)

Practice coding

A 10% glucose solution (A) is separated from a 2% glucose solution (B) by a selectively permeable membrane. The membrane is permeable to water __BUT NOT__ to glucose.

i) Water moves across the membrane
   a. More from A to B
   b. More from B to A
   c. Equally both directions
   d. Neither direction

ii) Why?
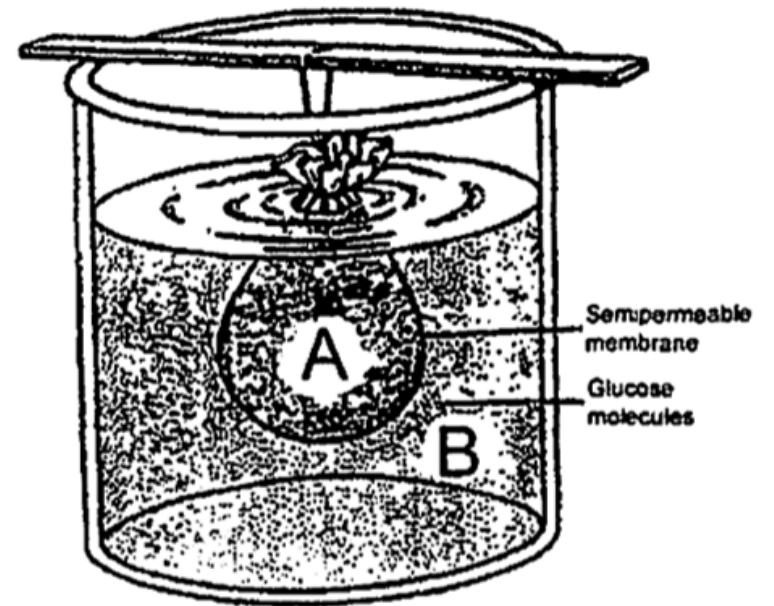
- With a partner or two, try to develop your own coding scheme to analyze the data on the worksheet.
- Then, code the responses independently
- Calculate percent agreement
- Revise your coding scheme if agreement is low
- Code again

Coding Scheme for Student Understanding of Diffusion

Coding Scheme for Student Understanding of Diffusion

		Quantitative	
		Amount	Concentration
Spatial	High to low	CE3	CE6
	Two sides	CE2	CE5
	One Side	CE1	CE4

| 1 | B | Because there is less glucose in B than A |

		Quantitative	
		Amount	Concentration
Spatial	High to low	CE3	CE6
	Two sides	CE2	CE5
	One Side	CE1	CE4

2	B	Because it moves from a low concentration to a high concentration

		Quantitative	
		Amount	Concentration
Spatial	High to low	CE3	CE6
	Two sides	CE2	CE5
	One Side	CE1	CE4

3	B	(B) has a higher concentration of water than (A) does.

Other considerations

- Interrater reliability: Do not use percent agreement
    - Use Cohen's kappa

$$k = \frac{p_o - p_e}{1 - p_e}$$

p_o = Observed probability

p_e = Expected probability

Kappa Statistic	Strength of Agreement
< 0	Poor
0 – 0.20	Slight
0.21 – 0.40	Fair
0.41 – 0.60	Moderate
0.61 – 0.80	Very good
0.81 – 1.00	Almost perfect

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- How do you control for verbose subjects?
  - Take a baseline measure
  - Focus on content (what they say) not how much they talk

- Interrater reliability: Do not use percent agreement
  - Use Cohen's kappa
- How do you control for verbose subjects?
  - Take a baseline measure
  - Focus on content (what they say) not how much they talk
- Should discrepancies between raters be resolved?
  - Raters disagree vs. both raters unsure
  - Could call this portion of the data "uncodable" and report that 80% of the data were coded
  - If resolving, resolve at the very end

- These steps for verbal protocol analysis can also apply to other types of qualitative data (e.g. gestures, videos)
- For classrooms: Large grain size to save time.
- If you don't develop or use a coding scheme, look at your students qualitative data more carefully
- Free-response > MCQs

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