Scholarly and evidence-based teaching: The risks and rewards

Neil Haave, Ph.D.
Associate Director
Abstract

In this session, Associate Director Neil Haave will discuss the benefits of considering the pedagogical literature when designing our learning environments. We will also consider how to respond when our best efforts are resisted by students.
Where are you from?

A. Alberta
B. Canada
C. North America
D. Rest of the world
What are you teaching?

A. Sciences  
B. Arts  
C. Professional  
D. Other  

https://epoll.srv.ualberta.ca/  
Use code: OJU
Evidence-based teaching

Which class would you rather be in: red or blue?

A – red classes
B – blue classes
C – panel A red class, panel B blue class
D – panel A blue class, panel B red class

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Evidence-based teaching: impact of active learning

If the experiments analyzed here had been conducted as randomized controlled trials of medical interventions, they may have been stopped for benefit—meaning that enrolling patients in the control condition might be discontinued because the treatment being tested was clearly more beneficial.

~ Freeman et al. 2014.

So, why don’t more instructors implement active learning strategies?
Is active learning like broccoli? Student perceptions of active learning in large lecture classes

C. Veronica Smith¹ and LeeAnn Cardaciotto²

Abstract: Although research suggests that active learning is associated with positive outcomes (e.g., memory, test performance), use of such techniques can be difficult to implement in large lecture-based classes. In the current study, 1,091 students completed out-of-class group exercises to complement course material in an Introductory Psychology class. Students were assigned either active learning or content review activities. Students in the active learning condition reported greater retention of and engagement with the course material but not greater enjoyment when compared to students in the content review condition. The importance of choosing pedagogical methods that promote the construction of knowledge rather than just behavioral activity is discussed.


Discrepancies between student perception and achievement of learning outcomes in a flipped classroom

Jenna Van Sickle¹

Abstract: In a college algebra course that used flipped/inverted pedagogy, students achieved learning outcomes at a significantly higher rate, as evidenced by results on the final exam. At the same time, student perception on a number of measures decreased significantly, including how interested students were in the course and whether the instructor effectively facilitated learning. This article will draw on a variety of research to suggest reasons for these discrepancies and possible solutions to help improve student perception in learner-centered instruction.
Why the student misperception?

• **Engaging in the hard, messy work of learning**
• First experience with learner-centered instruction
  – incongruent with student learning culture
• Lack of preparation outside class
  – in-class faced with what students do not know which may make them feel like they are learning less in class
• Student-student & student-teacher relationships
  – traditional is more equitable
  – learner-centered relies more on peer learning
• Class culture: is it okay to be wrong?

What things can be done to alleviate student resistance?

• Explain reasons at the beginning & during the course
  – Share the data/studies/literature

• Facilitate the activity
  – Walk around among the students, ask questions, use student names

• Link the teaching strategies with post-college life
  – Ask students which skills they think they may need

• Give students a voice in expressing concern over you and their peers
  – Mid-course feedback for both the instructor and their team-mates

• Scaffold independent learning
  – This is tricky: it is critically situational & context dependent

How are these implemented in a particular class context?


Bloom's Taxonomy Language for communicating about learning

Learning Levels

Levels describe the extent of learning, ranging from:
- simple to complex
- superficial to deep
- isolated to integrated

Perceptual
Acuity of perception within a field of study enabling diagnosis and prediction; expertise

Cognitive
Intellectual skills and abilities: Factual, Conceptual, Procedural, Metacognitive

Psychomotor
Conscious coordinated movement of the body and its parts

Affective
Increasing internalization of positive attitudes toward the object of study

Interpersonal
Skills of behavior and attitudinal dispositions toward and with other people

Learning Domains

Creating
Evaluating
Analyzing
Applying
Understanding
Remembering

ogitation
Maintenance
Performance
Coordination
Movement
Psychomotor

Interpersonal
Steakkeeping
Proposing
Supporting
Assisting
Advocating
Characterizing

Reflecting Learning

Extending Learning

Higher levels reflect learner generated meaning and solutions where they are not fixed, but explored, negotiated, and constructed.

Lower levels within each domain reflect learned knowledge and skills from existing bodies of knowledge. Responses are correct or incorrect.

Hierarchy conveys the need for learners to master lower levels before progressing to higher levels.

Top 10 employee skills employers desire

- Leadership 80.1%
- Ability to work in a team 78.9%
- Communication skills (written) 70.2%
- Problem-solving skills 70.2%
- Communication skills (verbal) 68.9%
- Strong work ethic 68.9%
- Initiative 65.8%
- Analytical/quantitative skills 62.7%
- Flexibility/adaptability 60.9%

Which of the following would be better achieved through individual study?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing life-long learning skills


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All three goals are clearly important; for instance you can’t use knowledge without first obtaining it. But, let’s think for a moment of how best to accomplish these goals. Learning is not a spectator sport – it takes work; that includes work in the classroom and work that you do outside of the classroom. Which of the items below would be better achieved in class?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing life-long learning skills

Thinking of what you want to get out of your university education and this course, which of the following is most important to you?

A. Acquiring information (facts, principles, concepts)
B. Learning how to use information and knowledge in new situations
C. Developing lifelong learning skills

1st-yr reading guide for photosynthesis

Reading Guide IV
How do photoautotrophs make their own food?


Objectives & keywords
1. Describe the location and structure of the chloroplast and how this structure relates to its function. (198-201, fig 10.4)

   stroma    granum    thylakoid space    chlorophyll    thylakoid membrane    thylakoid

2. Write a summary equation for photosynthesis. (201, fig 10.5)

3. Explain the role of redox reactions in photosynthesis. (201-202)

4. Describe the steps in the light reactions, where they occur and summarize them with an equation. (Don’t worry about the details of the complexes in the electron transport chain or P680 and P700) (202-203, 208-209, figs 10.6, 10.13, 10.14 & 10.15)

   photosystem II (PS II)  photosystem I (PS I)  cytochrome b,f  linear electron flow

5. Distinguish cyclic electron flow from non-cyclic electron flow. (209-210, fig 10.16)

6. Describe important differences in chemiosmosis between oxidative phosphorylation in mitochondria, photophosphorylation in chloroplasts, and substrate-level phosphorylation in glycolysis and the citric acid cycle. (210-212, figs 9.7, 10.17 & 10.18)

7. Summarize the carbon-fixing reactions of the Calvin cycle. (Don’t worry about any intermediates not listed in the keywords or the specific numbers of ATP and NADPH. Memorizing biochemical structures is not necessary) (212-213, fig 10.19)

   glyceraldehyde-3-phosphate (G3P)  3-phosphoglycerate reduction  Rubisco ribulose-bisphosphate (RuBP)  carbon fixation regeneration

8. Describe the role of ATP and NADPH in the Calvin cycle. (212-213)

9. Explain the significance of photosynthesis. (217-218, fig 10.22)

Retrieval practice

Figure Questions: 10: 12, 16, 19, 22
Concept Checks: 10: 1-3
Test Your Understanding: 10: 1-2, 4-7, 10

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**Tricarboxylic Acid (TCA) Cycle – topic outline**

I. Mitochondrion structure

II. Stages of cellular respiration
   A. Glycolysis
   B. Pyruvate oxidation
   C. TCA cycle
   D. Oxidative phosphorylation

III. Acetyl CoA as substrate for the TCA cycle
   A. Sources of acetyl CoA
   B. Pyruvate oxidation
      1. Transport across the MIM
      2. Pyruvate DH
         a. Three enzymes – a multienzyme complex
         b. Five coenzymes
         c. Five reactions
         d. Mammalian enzyme includes regulatory kinases and phosphatases

IV. TCA cycle (aka Krebs cycle or citric acid cycle)
   A. Two phases - Eight enzymes: be able to explain the biochemical logic
      1. Oxidation phase
         a. Citrate synthase – condensation
         b. Aconitase – rearrangement
         c. Isocitrate DH – oxidative decarboxylation
         d. α-ketoglutarate DH – oxidative decarboxylation
      2. regeneration phase
         a. Succinyl CoA synthetase – substrate-level phosphorylation
         b. Succinate DH – dehydrogenation (an oxidation, a transmembrane protein)
         c. Fumarase – hydration
         d. Malate DH – dehydrogenation (an oxidation)

B. Fates of the carbon and oxygen atoms (radiolabel experiments)
   1. When are the carbons of acetyl CoA lost as CO₂?
   2. Why cannot acetyl CoA be used to make carbohydrate?

C. Regulation
   1. Pyruvate DH
   2. Isocitrate DH
   3. α-Ketoglutarate DH
   4. Energy status: availability of...
      a. NAD⁺ (which enzymes affected?)
      b. CoQ (which enzymes affected?)
      c. GDP (i.e. ADP, which enzymes affected?)

D. Amphibolic nature

E. Anaplerotic reactions (e.g. pyruvate carboxylase)

V. The glyoxylate cycle
   A. Function (found in which organisms?)
   B. Two enzymes bypass oxidative decarboxylations of TCA cycle
   C. Three compartments
   D. Four pathways convert fat to CH₂O
How support students’ transition to independent learning?

4th yr example
Instead of a reading quiz, students are held responsible for their pre-class reading via a typed 2-page response to the reading which acts as their ticket to class.

AUBIO 411 HISTORY AND THEORY OF BIOLOGY (LEC 1B01 Wi18)

Reading Guide: All in the genes


(This book was originally written for the Massey Lectures broadcast on the radio program Ideas by the CBC. Lewontin's five lectures are available here. The chapter All in the Genes is part 2)

1. What is Lewontin’s critique of a genocentric view of biology?
2. Why should this critique matter to you/us?
3. Consider if Lewontin’s critique were wrong: What would effect would this have on our society?
4. Relate this chapter to our classes which discussed to some extent the developing hegemony of the gene and/or reductionism:
   - Maienschein's analysis of the preformation/epigenesis split
   - Blanc’s article on the split between heredity, evolution, and development
   - Allen’s articles on holistic vs mechanistic materialism
   - Smocovits’ article on the evolutionary synthesis
   - Gilbert’s article on the re-synthesis of evolution, development and genetics.
   - Basen’s video on reproductive technologies.
5. Who is Richard Lewontin? (try Googling his name) How does this give some weight to his critique? Should this matter?

Richard Lewontin was interviewed for the CBC Ideas series: How to Think About Science. Listen to episode 18 here.
Quick Key & IF AT cards for reading quizzes: An example of two-stage testing

Print blank answer forms at www.quickkeyapp.com

Fill bubble completely. Do not cross-out bubble rows or put marks on bounding boxes
Make sure all bounding boxes, QR codes print black and not faded or broken
The Perry Scheme of Intellectual Development


The art of teaching

- instructor experience
- learner maturity

- Zone of proximal development
  (Lev Vygotsky, 1896-1934)

Staged self-directed learning

- Scaffold opportunities to practice independent learning
  - Across the curriculum
  - Across the term
  - Within a learning module
  - Within a class

What can teachers do?

Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.

~ Herbert A. Simon
(1916 – 2001)
Nobel Laureate
Co-founder of Cognitive Science
Professor, Carnegie Mellon University

SoTL Scholars Program

• A new program through CTL
• Designed to develop SoTL capacity at the UofA
• Improve our teaching to enable student learning by
  o critically reflecting on our own teaching
  o Assessing our own teaching
• Moving faculty from consumers of SoTL to SoTL scholars
UNIVERSITY OF ALBERTA
CENTRE FOR TEACHING AND LEARNING
Books that have impacted my understanding of learning…1


Books that have impacted my understanding of learning...2

