Creating Critical Thinkers in the Classroom

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Learning Objectives

a. Identify misconceptions or common problems encountered in the classroom concerning critical thinking skills
b. Discuss techniques to promote critical thinking
c. Develop course activities to promote critical thinking
Why reading assignments?

a. Think about how you use reading assignments in your course. Why are they assigned? Jot down ideas.

b. What are some problems you’ve encountered concerning reading assignments? Jot down some ideas.
Relating the text to your class

**Reading compliance is around 30%** (Burchfield & Sappington, 2000; Hobson, 2003; Marshall, 1974; Self, 1987)
Communicate expectations

IT'S IN THE SYLLABUS
This message brought to you by every instructor that ever lived.
WWW.PHDCOMICS.COM
Model expert behavior

“They should already be able to do this”
How do students read?

How do students read on-line text?
Parker, Heidemann, Olson presented to National Association for Research in Science Teaching, 2004

Instructor created guide to the reading (video)
https://www.youtube.com/watch?v=OhgnRwdB1w8&t=14
Olivo, R (EDUCAUSE Quarterly)
Tackling primary literature

Paper reading Goals

- Identify hypothesis
- Why are they studying this? (what will we learn?)
- Why use this model?
- What were the major results?
  - Focus on understanding figures
- Where does this new information fit in?
Notetaking

“I read it, but I don’t remember”

What are students picking up from the lecture or the reading?

Cornell system
Diagrams, charts, models
### K.W.L. Chart

<table>
<thead>
<tr>
<th>Topic: ____________________________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I Already Know</td>
<td>What I Want to Know</td>
<td>What I Have Learned</td>
</tr>
</tbody>
</table>

### KWHLAQ Chart - 21st Century Style

<table>
<thead>
<tr>
<th>K</th>
<th>W</th>
<th>H</th>
<th>L</th>
<th>A</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do I know?</td>
<td>What do I want to know?</td>
<td>How do I find out?</td>
<td>What have I learned?</td>
<td>What Action will I take?</td>
<td>What new Questions do I have?</td>
</tr>
</tbody>
</table>
Vetting Sources

Reading like an expert includes being critical of sources
The case for vaccines

Institute of Medicine of the National Academies
The Lancet
THE NEW ENGLAND JOURNAL OF MEDICINE
EUPHA
NHS
ncfR
World Health Organization

The case against

vs

Every government, every major health agency of every country around the world, the consensus of respectable, peer-reviewed medical journals, medical doctors, researchers and scientists

vs

a handful of pseudoscientific paperbacks and self-published bunk

Refutations to Anti-Vaccine Memes
The Vaccine Meme Machine

Nuh-uh! Won't open wide for...

Gerber GMOs!

I'm watching my figure.

Growing Up Obese

The CDC estimates that one in every three American kids is obese or overweight. 2012 research found that animals fed GMOs like the GMOs Gerber uses in conventional baby foods ate more, got fatter, and were less able to digest proteins due to alterations in the micro-structure of their intestines.

Not a good start for baby, Gerber!

www.gmofreeusa.org


Hey Facebook,

As some of you may know, I'm Bill Gates. If you click the "share" link, I will give you $5,000. It's about time I give back to the people!
a. Think about your expectations

b. Communicate early and often

c. Be a role model
Assignments and Assessment
Collaborative reading

Jigsaw method

Student created study guides
Reading Response Papers

Compliance goes up to 75% with reading response assignments

Still More on Developing Reading Skills”, Maryellen Weimer on FacultyFocus.com
Prompts

“Identify one important concept, research finding, theory, or idea ... that you learned while completing this activity.”

“Why do you believe that this concept, research finding, theory, or idea ... is important?”

“Apply what you have learned from this activity to some aspect of your life.”

“What question(s) has the activity raised for you? What are you still wondering about?” [You might need to prohibit the answer “nothing”.]

Implementation

1. START early!
2. List the learning objectives at the beginning of each class meeting
3. Align learning objectives with your assignment and assessment
4. Provide a rubric for assignments
5. Start simple: Connect course with life
6. Take risks! Allow students to propose “silly experiments” and to criticize the instructor!
Bloom’s Taxonomy

- **Knowledge**: The student recalls or recognizes information.
  - *define, name, memorize*  
  - *repeat, label, record*  
  - *list, recall, relate*

- **Comprehension**: The student changes information into a different symbolic form/language.
  - *restate, report, express*  
  - *describe, tell, locate*  
  - *explain, discuss, review*  
  - *identify, recognize*  
  - *translate, interpret*

- **Application**: The student solves a problem by using the knowledge and appropriate generalizations.
  - *apply, show, illustrate*  
  - *use, demonstrate, evaluate*  
  - *practice, dramatize, employ*  
  - *list, recall, relate*

- **Analysis**: The student separates information into component parts.
  - *distinguish, debate, compare*  
  - *differentiate, question, diagram*  
  - *calculate, solve, inspect*  
  - *test, analyze, inventory*  
  - *contract, appraise, relate*  
  - *criticize, experiment, examine*

- **Synthesis**: The student makes qualitative and quantitative judgments according to set standards.
  - *estimate, value, measure*  
  - *compare, appraise, assess*  
  - *evaluate, predict, select/choose*  
  - *score, rate*

- **Evaluation**: The student solves a problem by putting information together that requires original, creative thinking.
  - *compose, set up, collect*  
  - *propose, manage, create*  
  - *formulate, plan, organize*  
  - *assemble, design, prepare*  
  - *construct, arrange*
Sample Active Learning activity implemented in Diane Ebert-May’s BS161 course Spring 2014:

Beyond Genes: How Grandma’s Environment Affects Future Generations’ Genomes
Casey Henley, Nicholas Hobbs, Nicholas Panchy, and Christina Ragan
Learning Objectives

1. Build a box and arrow model that explains how epigenetic modification can lead to differences in gene expression.

2. Compare and contrast the views represented by Darwin and Freud in the reading article and explain how epigenetic modification fits in this paradigm.

3. Relate epigenetic modification to concordance/discordance between twins.

4. Interpret the data provided by the case study and be able to both provide a legend for the figure and draw a conclusion from the data.
Homework for 4/21/14

Read “Grandma’s Experiences Leave a Mark on Your Genes”
http://discovermagazine.com/2013/may/13-grandmas-experiences-leave-epigenetic-mark-on-your-genes

Answer the following questions in your carbonless notebook:

1. Find 3 claims made in the article and provide 2 pieces of evidence for each claim. Be brief (3-5 sentences) but clear in each argument.

2. Where does a methyl group attach to DNA? What is the outcome of methylation on gene expression? Draw the physical state of the genome (tightly wrapped or relaxed) when genes are being transcribed and the physical state of the genome when genes are inactive.

3. Create a parallel model of epigenetics (one branch for increased methylation, one for decreased) using the following terms.

   Structures:
   - Protein levels
   - DNA around histones
   - mRNA levels
   - DNA methylation
   - Behavior
Rubric for Homework:

Question 1 (1 pt)
1pt- Students provided 3 legitimate claims and evidence to support them.
0pt- Students did not provide 3 claims.

Question 2 (1 pt)
1pt- Students provide a drawing of what is happening in both tightly wrapped and loose DNA.
0pt- Students did not provide a drawing or drawing is not correct.

Question 3 (8 pts)
1 pt: Model includes two parallel paths (bifurcation)
2 pt: Increased methylation tightens DNA around histones; decreased loosens
2 pt: Increased methylation decreases mRNA and protein; decreased increases
2 pt: Correct order of boxes - methylation, DNA, mRNA, protein
1 pt: Have behavior box either at beginning or end

8 pts
- Model includes two parallel paths (bifurcation)
- Protein level box comes after mRNA box
- Students indicate that high DNA methylation results in a decrease in mRNA and protein
- Behavior can be placed at the beginning, end, or both
- Students correctly identify that high methylation tightens DNA around histones, and low methylation leads to DNA loosening around histones
Homework Review: Parallel Models of Epigenetic Mechanisms

- Decreased DNA methylation
- Increased DNA methylation

Structures

- Experience
- mRNA levels
- DNA around histones
- Protein levels
- Behavior
- DNA methylation
Licking and Grooming

Increased DNA methylation of GR

Tightens

DNA around histones

Decreases

GR mRNA levels

Decreases

GR Protein levels

Increases

Fearful behavior

Decreases

Fearful behavior

Decreased DNA methylation of GR

Loosens

DNA around histones

Increases

GR mRNA levels

Increases

GR protein levels

Decreases
Student participation

1. Have students turn in copy of hw
2. Allow for discussion in small groups
3. Walk around to monitor
4. Have student with correct answer draw model on board/document camera
Two scientists walk into a bar...

“Bad mothering.”

“Hey, geniuses, tell me how my son got into this sorry state.”

“Bad inheritance.”

Q1: Describe how epigenetics can contribute to alcoholism in the son.
Q3: Imagine there is an allele for alcoholism susceptibility (ALK161). If people who have this allele are *more* likely to have alcoholism, modify your parallel models to illustrate how one monozygotic twin could have alcoholism, while the other monozygotic twin does not.
Environment?

- Increased DNA methylation of ALK161
  - Tightens
  - Decreases
  - Decreases
  - Alters
  - DNA around histones
  - ALK 161 mRNA levels
  - ALK 161 Protein levels
  - No Alcoholism

- Decreased DNA methylation of ALK161
  - Loosens
  - Increases
  - Increases
  - Alters
  - DNA around histones
  - ALK161 mRNA levels
  - ALK161 Protein levels
  - Alcoholism
Clicker question

Q4: Whose answer to the mother mouse’s statement is correct?

– A. Freud
– B. Darwin
– C. Both
– D. Neither
Peer-reviewed articles


Glucocorticoid Receptor (GR) mRNA Expression in Rats

Q5: Write a figure legend in your carbonless notebook.
**Q7**: Use your model to predict what the methylation levels on the GR gene would be (just needs to be relative - high or low) in the offspring of both high and low LG mothers. Draw what your evidence would look like (ie draw a graph) in your carbonless notebook.
Q8: Let’s say the researchers then cross-fostered newborn pups to a new mom immediately after birth. Pups that were born to high LG moms were switched with pups born to low LG moms. So a pup would have the genetic background of a high LG mom but be raised by a low LG mom or vice versa. Predict the methylation levels in these two groups and draw what your evidence would look like.
1. Relate info. to students’ lives
2. Use various media
3. Allow for discussion
4. Challenge with higher-order thinking
5. Provide feedback
Please take a few minutes to consider how you could use or relate to something we talked about today in one of your courses. Take a moment to jot down some ideas.

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Thank you for attending our Inside Teaching Lounge!
References