Introducing Challenging Coursework - Asking, and Reflecting On, What’s Working

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Challenging Coursework

Neurophysiology

- Challenging conceptual material
- Lecture
- Problem solving - homework assignments, clicker questions, HELP room

Course

- Challenge

Typical format: teacher-centered

Interventions: student-centered

Critical Thinking: Neurobiology of Disease

- Reading & interpreting primary scientific literature
- Teacher feedback
- Partner work
- Pre/post attitudes & learning (performance)

Outcome Measures

- Attitudes on interventions, & Measure of performance
Challenging Coursework

Neurophysiology

- Challenging conceptual material
- Lecture
- Problem solving - homework assignments (F05), clicker questions (F06), HELP room (F08)

Course

- Challenge
- Typical format: teacher-centered

Interventions:

- Student-centered

Outcome Measures

- Teacher feedback
- Partner work
- Pre/post attitudes & learning (performance)
What Do the Students Think of Interventions?

**Attitude survey** (F07) - 90% response rate (94/105)
- *students enjoyed*
- clickers (91%)
- homework assignments (50% enjoyed, 22% neutral)
  - & *felt helped their understanding*
- clickers (90% found helpful)
- homework assignments:
  - helped understanding of course material (100%)
  - helped with exam preparation (98%)
  - didn’t have to study/cram as much for exams (80%)
Has level of understanding of material improved?

• How to answer? Outcome measures
  – Pre/post tests (gains before/after intervention)
    • No pre/post assessment data
  – Exam performance (F04 versus F08)
    • 83% of questions changed
      • Why?
      • 14 questions (17%) on both F04 & F08 exams
        • % answering correctly increased by 15%, on average
        • increased from 62% to 77%, on average
  – Other outcome measures?
    • Rate questions based on *Bloom’s taxonomy of cognitive domain*
Bloom's Taxonomy of the Cognitive Domain
(Levels of Learning)

1. **Factual Knowledge**: remember and recall factual information
   Define, List, State, Label, Name, Describe

2. **Comprehension**: demonstrate understanding of ideas, concepts
   Describe, Explain, Summarize, Interpret, Illustrate

3. **Application**: apply comprehension to unfamiliar situations
   Apply, Demonstrate, Use, Compute, Solve, Predict, Construct, Modify

4. **Analysis**: break down concepts into parts
   Compare, Contrast, Categorize, Distinguish, Identify, Infer

5. **Evaluation**: think critically about and defend a position
   Judge, Appraise, Recommend, Justify, Defend, Criticize, Evaluate

6. **Synthesis**: transform, combine ideas to create something new
   Develop, Create, Propose, Formulate, Design, Invent

Higher levels: Require deeper conceptual understanding
Has level of understanding of material improved?

- Other outcome measures?
  - Rate questions based on *Bloom’s taxonomy of cognitive domain*
    - refining & testing rubric
    - preliminary results
Bloom’s Analysis of Exam Questions

Fall 2004
78% remember & comprehend
22% apply & analyze

Fall 2008
27% remember & comprehend
64% apply & analyze
9% evaluate & synthesize

P = 0.000000000000004
Bloom’s Analysis of Exam Questions

Fall 2004
- Remember (72.6%)
- Comprehend
- Apply
- Analyze

Fall 2008
- Apply
- Comprehend
- Analyze
- Evaluate
- Synthesize
- Remember

So following incorporation of problem-solving practice, students are performing at much higher cognitive level on exams.
What’s Next?

• Neurophysiology
  – Finish testing rubric
  – Independent reviewers rate exam questions
  – Independent reviewers rate clicker & homework questions
Challenging Coursework

Neurophysiology

Course

Typical format: teacher-centered

Interventions: student-centered

Critical Thinking: Neurobiology of Disease

Challenging conceptual material

Lecture

Reading & interpreting primary scientific literature

Problem solving - homework assignments (F05), clicker questions (F06), HELP room (F08)

Attitudes on interventions & Measure of performance

Pre/post attitudes & learning (performance)

Teacher feedback

Partner work
Evolution of Critical Thinking Course

Read & interpret primary literature

need practice

2 practice assignments (write portions)
(teacher feedback)

need more practice

Small group discussion of articles
practice assignments
In-class critique of student writing
(in addition to instructor feedback)

need more practice,
but grading overload

Student Problem: understanding how to read primary literature & what it means to look at data

Instructor Problem: limit to feedback can provide
Calibrated Peer Review (CPR)

• What is CPR?
  – web-based tool (www.cpr.molsci.ucla.edu)
    • facilitates use of writing as a learning & assessment tool
    • enables frequent writing assignments without increasing instructor grading load
    • discipline & level independent

• How does it work?
  – students submit a writing assignment
    • typically about a paragraph
    • we did 1-2 pages
  – rate 3 calibration essays (calibrate as reviewers)
    • detailed grading rubric (both content & style questions)
  – review 3 peer papers (anonymous)
  – self-assessment
  – students get feedback
CPR Intervention

F07

- Assignments
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

Sp08

- Assignments
  -> Practice Intro
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

Spr08 Fall08 Spr09

“CPR was just really hard and frustrating!”

“No, a thousand times no.”

“GRR”

Students: too challenging
Instructor: ready to give up
CPR Intervention

F07
- Assignments
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

Sp08
- CPR
  - Assignments
    - Practice Intro
    - 2 papers
  - Small group discussion
  - Final Papers
  - Presentation

F08
- CU Learn - mimic CPR
  - Assignments
    - Practice Intro
    - Divide to 4 papers
    - Work w/ partner for review
  - Small group discussion
  - Final Papers
  - Presentation

Changes for F08
- divide 2->4 assignments
- partner for CPR
- CU Learn
CPR Intervention

F07
- Assignments
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

Sp08
CPR
- Assignments
  - Practice Intro
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

F08
CU Learn - mimic CPR
- Assignments
  - Practice Intro
- Divide to 4 papers
- Work w/ partner for review
- Small group discussion
- Final Papers
- Presentation

Tear Factor

Spr08

Fall08

None!

Students: all about writing
Instructor: CU Learn too cumbersome
CPR Intervention

**F07**
- Assignments
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

**Sp08**
- Assignments
  - Practice Intro
  - 2 papers
- Small group discussion
- Final Papers
- Presentation

**F08**
- Assignments
  - Practice Intro
  - Divide to 4 papers
  - Work w/partner for review
- Small group discussion
- Final Papers
- Presentation

**Sp09**
- Assignments
  - Practice Intro
  - 4 papers
  - Work w/partner for review
  - Work w/partner for writing
- Small group discussion
- Final Papers
- Presentation

**Changes for Sp09**
- Focus on content
  - De-emphasize style questions
  - Small group activities
  - Co-write (b/c of CPR)
"Not a big fan"

"[CPR] was the most helpful in developing my skills."

And, some students would even want to use CPR in another course!
Partner work increases extent to which students find CPR helpful

partner work!

mean ± SE

* $p<0.05$

# $p<0.1$

very much

quite a bit

some

a little
Partner work is viewed as beneficial

- **94%** felt partner work was ‘somewhat’ helpful or greater
- When asked to explain their answer:
  - **75%** felt led to improved quality
    - **42%**: different opinions led to better / less biased / more standardized [evaluation]
    - **26%**: one person could catch things the other missed
  - **26%** felt led to better understanding of assignment

F08, n=19
mid-semester survey
Student quotes about partner work for CPR

- “Working with someone is great b/c it makes you feel like you’re understanding the material better if you agree with your partner. It also allows for some help when you miss key points in papers, or read something wrong.”

- “Talking with a peer made it much easier to see what we were thinking and then trying to talk it through to explain why we thought it was A, B, or C. [You] notice much more.”

- “The other person might have a completely different view than yours on certain topics. Its good to listen to their reasoning and explain yours and come up with an agreement on which reasoning is more valid and makes sense”

  - “Not everyone grades in the same way. While it can be beneficial to view other people's opinions, it can also be a tedious process”
Partner discussion rated highest in helpfulness

- Correspondence analysis

- Thinking on own
- Electronic
- Instructor
- Classroom discussion
- Partner discussion

F08
n= 15
Which type of feedback is *most* helpful in passing calibrations?

- 72% chose some form of peer discussion:
  - *partner discussion* (33%)
  - or *classroom discussion* (small group discussion with some instructor feedback) (39%)
Focusing on content led students to feel they acquired more general reviewing/critiquing skills.

Average Likert Score

- Spr08, n=18
- Fall08, n=15
- Spr09, n=18

Mean ± SE

* p<0.05
# p<0.1
Focusing on content helped students feel they learned more about how to read & interpret primary literature

mean ± SE

* p<0.05
Focusing on content helped students feel they learned more about how to read & interpret primary literature

mean ± SE
* p<0.05    # p<0.1
Other observations...

• When students worked with partners:
  – there was a significant improvement in whether they felt CPR was worth their time
  – they performed better on the last 2 CPR calibrations (for results, & significance and implications)
What’s Next?

• Critical Thinking
  – Independent reviewers rating answers to rubric summary questions & overall score for final papers in different semesters to assess performance

• Potential COLTT workshop on CPR in August
Conclusions

• Interventions leading to more student-centered learning improve student attitudes & abilities
  – problem-solving practice in Neurophysiology allows students to work at a higher cognitive level on exams (& they enjoy the practice!)
  – partner work on CPR in Critical Thinking leads to:
    • more positive attitudes
    • better performance on calibrations
    • quality of final papers?
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  • Dr. Kate Semsar, STF
Bloom’s Analysis of Clicker Questions

Fall 2006
58% remember & comprehend
42% apply & analyze

Fall 2008
29% remember & comprehend
71% apply & analyze

p=0.008
Bloom’s Analysis of Homework Questions

- **Fall 2005**
  - 77% remember & comprehend
  - 23% apply & analyze

- **Fall 2008**
  - X% remember & comprehend
  - X% apply & analyze
  - X% evaluate & synthesize