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Best Practices in Large Classrooms

Emphasis: Using questioning and testing to support student engagement and learning

Jamie L. Schneider

Workshop Goals:
1. Model best practices for teaching large classrooms
2. Introduce concept of learning through testing with feedback

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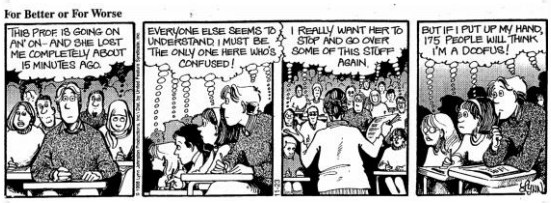
How do you know if this is happening?



Goal: Model Best Practices to increase student-faculty and student-student connections

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Introduce yourself to two people sitting near you

- Discover one fun fact that you may be asked to report out
- 1-2 minutes

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How long have you been teaching at the college level? (not including TA positions)

A. 0-1 years
B. 1-2 years
C. 2-3 years
D. 3-4 years
E. More than 4 years

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Which discipline(s) best represents your major teaching load?

A. Biology or Agricultural Sciences
B. Math, Computer Sciences, or Engineering
C. Chemistry or physics
D. Geology or other earth sciences
E. Other areas or none, I'm not currently teaching

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How many students are in the largest class that you are currently teaching?

A. 1-25 students
B. 26-50 students
C. 51-75 students
D. 76-100 students
E. More than 100 students

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Which of the following best describes a typical class that you teach?

A. Most of the time is spent lecturing

B. Most of the time is spent lecturing but I do pause for questions several times during each class

C. Classroom assessment techniques are regularly mixed in during lectures

D. Group work and lecturing are regularly used

E. Most of the time is spent in group work

UWRF Science and Math Faculty Survey (N=42)

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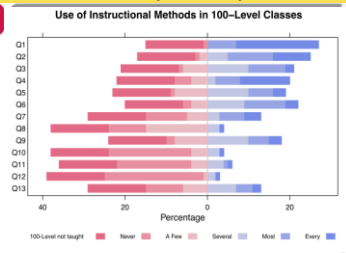

Survey Questions

1. Listen or take notes during lecture
2. Watch you solve problems or perform demonstrations
3. View a web-based image
4. View a Power Point slide
5. Work on a problem individually
6. Work on a problem in pairs or small groups
7. Answer questions and record responses with clickers
8. Make presentations
9. Solve constructed problems with intermediate steps to encourage inquiry
10. Watch a video of your lecture before class to free up class time for other activities
11. Complete a quiz before class
12. Provide a scheduled time for a group activity led by an upper-level student
13. Integrate lecture and lab lessons

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Possible Benefits to you

- How will attending this UW Women & Science 2-Day workshop benefit you?
  - Quietly reflect for 1 minute
  - Find a partner and list top three benefits (2 minutes)
  - Share the benefits with the group

Think – Pair - Share

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Classroom Response Techniques

- Before – During – After Teaching

- Before
  - Engage student thinking and assess pre-knowledge
- During
  - Engage student thinking and assess current knowledge
  - Respond in real time to issues
- After
  - Engage student thinking and assess longer term thinking
  - Respond in real time to issues

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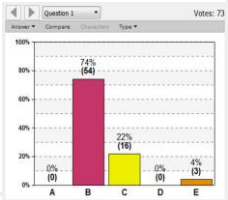
Before Teaching Example

In the ancient tribe of Jumanji, distance was measured in hedgehogs and monkeys. Four hedgehogs equal three monkeys. Suppose the medicine man told a young scout to travel 42 monkeys to reach the water hole. How many hedgehogs should he travel?

A. 42 Hedgehogs
B. 42*4/3 Hedgehogs
C. 42*3/4 Hedgehogs
D. 3/4 * 1/42 Hedgehogs
E. 4/3 * 1/42 Hedgehogs



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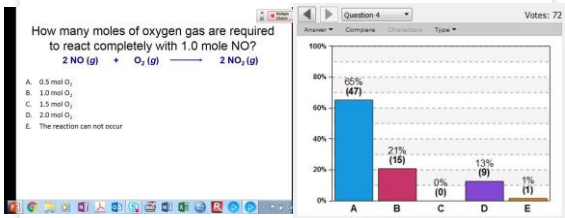
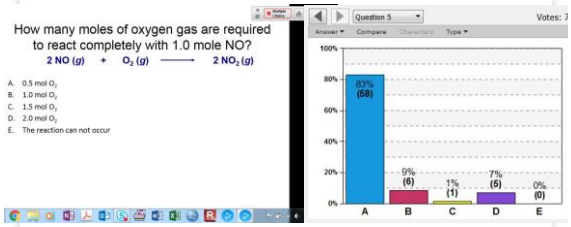
During Teaching Example



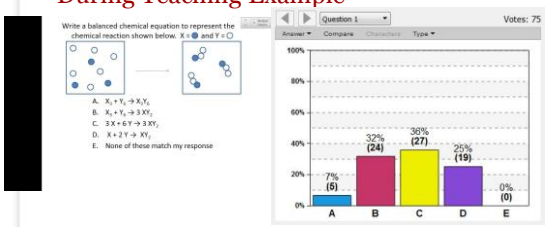
What do you do next?

During Teaching Example



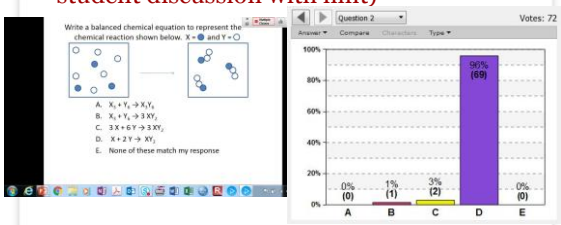
Individual Vote – Student-Student Discussion – Individual Vote
Follow with solution and/or error thinking

During Teaching Example



What do you do next?

During Teaching Example (After student-student discussion with hint)



Individual Vote – Hint – Student-Student Discussion – Individual Vote
Follow with solution and/or error thinking

Other Methods of Polling

- "Pledge of Allegiance" (0–5 fingers held on chest)
  - Important to vote all at once
- Mini-white boards & dry erase markers
- Color-coded cards
  - All cards same color backing for response anonymity
- Pitfalls to be aware of:
  - Raising hands does not generally work (they see each other)
  - Especially in large classes, electronic devices are more effective

Why use classroom response options?

- Take 1 minute to quietly write down some reasons and/or uses
- Share out.

Want to learn more about polling to support learning?

- Peer Instruction Literature
- Eric Mazur, Harvard Physics Professor

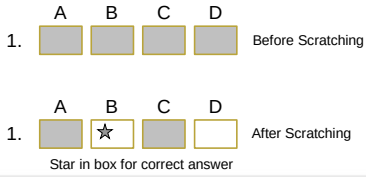
Feedback on Quizzes or Tests

What did you give for multiple-choice test feedback?

A. Nothing or just scores
B. Scores
C. Posted Answer Key
D. Written responses next to each item
E. Scantron with answers marked wrong

Other During and/or After Teaching Classroom Assessment Techniques

- Immediate Feedback Assessment Technique Quizzing
  - Group or Individual



Star in box for correct answer

Working with 2 other people

- Take the group quiz. Have one person read the directions before starting.

Issues with Multiple-Choice Testing

- Taking a test can improve retention (testing effect)

BUT

- Students reading or endorsing the lure items (or distractors) may acquire **incorrect** knowledge

Butler and Roediger (2008) found that corrective feedback minimized these negative effects

Psychological Science inn the Public Interest **2013**, *14, 4-58.*
Mem. Cognit. **2008**, *36*, 604-616.

What is optimal corrective Testing feedback?

- Student should have access to all of the following:
  1. The original multiple-choice item with options
  2. The student original answer
  3. The correct answer
  4. Elaborative corrective feedback: debated whether explanation for correct answer is necessary

Bull. Psychon. Soc. **1992**, *30*, 173-176.
Bangert-Drowns, R. L.; Kulik, C. C.; Kulik, J. A.; Morgan, M. *Rev. Educ. Res.* **1991**, *61*, 213-238.
Butler, A. C.; Godbole, N.; March, E. J. *J. Educ. Psychol.* **2013**, *105*, 290-298.

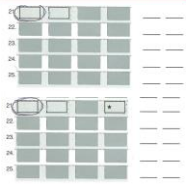
Timing of Testing Feedback

- **Delayed feedback** (after testing event)
  - Spaced presentation of information
- **Immediate feedback** (during testing event, preferably when each item is answered)
  - Massed presentation of information

Both effective but spaced presentation is better testing feedback when students engage actively with feedback

HOWEVER, students' lack motivation to engage actively with feedback once scores are posted.

J. Exp. Psychol. **2007**, *13*, 273-281.
Rev. Educ. Res., **1988**, *58*, 438-481.



Immediate Answer-Until-Correct Feedback

IFAT Website: www.epsteineducation.com

Continue trying to uncover the star for the correct answer

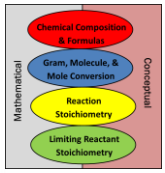
- Partial credit can be awarded for 2 or 3 scratches
- Classroom studies in psychology testing were positive
- Student performance and correction of initial errors were highly correlated in a general chemistry II study

Brosvic, G. M.; Epstein, M. L. *Psychol. Rec.* **2007**, *57*, 391-408.
Slepkov, A.D., et al. *J. Chem. Educ.*, 93(11), pp. 1839-1846.

Guiding Research Question

- Can multiple-choice testing in first term general chemistry with Answer-Until-Correct (AUC) feedback enhance student learning?
- Specifically, will scores on repeat testing improve with AUC feedback.

Repeat Testing Study Exam Descriptions and Statistics



Exams 1 and 2 are algorithmic clones

- Same stem wording but different chemicals or values
  - Same order of items
- Same distractor errors
  - Different order of distractors
- Strong statistical evidence from Wilcoxon rank sum test in favor of null hypothesis that exam score distributions are identical (p=0.261)

Reliable and Valid Instruments

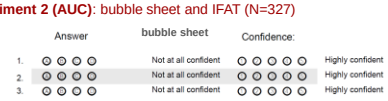
- Student and instructor reviewed
- Item difficulty Index (fraction correct) between 0.3 and 0.9
- Item discrimination Index between 0.2 and 0.7
- KR-20 and Split Half Reliability 0.8
- Moderate Pearson Correlation (*r*=0.579) between course grade and study scores

Our Testing Feedback Methodology

20 item multiple-choice practice exam time 1 → Score Feedback 24-48 hours after → **20 item multiple-choice practice exam time 2**

Experiment 1 (Control): bubble sheet only (N=280)
Experiment 2 (AUC): bubble sheet and IFAT (N=327)

bubble sheet only



- Volunteer First Term General Chemistry students at three institutions
- Multiple terms of students at each school for each feedback experiment
- Outside of course requirements (some offered extra credit)
- Practice exam 1 about 2-3 weeks prior to final exam
- Practice exam 2 about 1 week after exam 1

Overall Score Statistics (Repeated measures ANOVA)

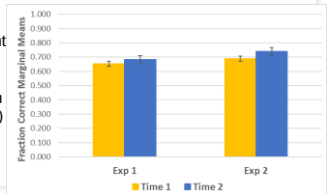
Comparing Changes in exam scores between Experiments 1 (Control) & 2 (AUC)

- Main effects of time, Time 2 > Time 1
  - F (1, 605) = 57.64, p<.001, *effect size* = .087
- Main effects of experiment, Exp. 2 > Exp 1
  - F (1, 605) = 9.52, p=.002, *effect size* = .015

Main effect qualified by interaction between Experiment and Time

Time 1: No Difference between Exp 1 & 2 (t(605)=1.69, p> .05)

Time 2: Exp. 2 > Exp 1 (t(605)=3.19, p< .05)



Summary and Future Work

- Answer-until-correct feedback enhanced student performance upon repeat testing (albeit small changes)
- Student were more likely to repeat errors with non-corrective feedback compared to AUC feedback
- Students were more likely to correct errors with AUC feedback compared to non-corrective feedback

Future Work

- Capture student response process with AUC feedback
- Repeat studies with other feedback types and timing
- Move study into the classroom

Acknowledgements

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