USING FORMATIVE ASSESSMENTS IN LARGE LECTURES TO IDENTIFY AND ADDRESS STUDENT MISCONCEPTIONS

Second Annual Assessment Day
April 20, 2016
LECTURING...

Use Power Point or Prezi

Use more visuals than words

“Tell me and I'll forget; show me and I may remember; involve me and I'll understand.”

-Chinese proverb

https://www.insidehighered.com
Crafting an Engaging Lecture, Ashley Wiersma
Teaching and Engaging 400-600 students

Test Based Educational Assessment OR Accountability (ACS Exams)

How do you engage 400 students?
Test is an “evaluative device or procedure in which a sample of an examinee’s behaviors in a specified domain is obtained and subsequently evaluated and scored using standardized process”
(Rights and Responsibilities of Test Takers: Guidelines and Expectations)

Assessment is a “process that integrates test information with information from other sources”

Assessment is a “wide range of methods for evaluating pupil performance and attainment...”

(Filsecker & Kerres; Practical Assessment, Research & Evaluation 2012)
FORMATIVE ASSESSMENT: TAKES PLACE DURING THE COURSE OF TEACHING AND IS USED ESSENTIALLY TO FEED BACK INTO THE TEACHING/LEARNING PROCESS.

SUMMATIVE ASSESSMENT: TAKES PLACE AT THE END OF A TERM OR A COURSE AND IS USED TO PROVIDE INFORMATION ABOUT HOW MUCH STUDENTS HAVE LEARNED AND HOW WELL A COURSE HAS WORKED.

IPSATIVE ASSESSMENT: IN WHICH THE PUPIL EVALUATES HIS/HER PERFORMANCE AGAINST HIS/HER PREVIOUS PERFORMANCE.
Role of Formative Assessment

A. Rethink the role of assessment so it can help support and document classroom learning

B. Create an integrated and ongoing system for assessment that both prepares for an accreditation visit and truly enhances student learning

C. Reflection of teaching practices to determine if “Learning Outcomes” are being adequately met during the “Process” of learning using Learner-centered curriculum

D. Engaged active learning environment
How to Engage Students?

A. Instructor *stops lecturing* and students work on a question or task designed to help them understand a concept

B. Creating “**Think Moments**” and “**Encourage Peer Instruction**”

C. Students are generally passive observers instead of being active participants required for learning
THE STUDENT SHOULD DEVELOP SKILLS OF ANALYSIS, SYNTHESIS, CRITICAL THINKING, PROBLEM SOLVING - LARGELY VIA SCIENTIFIC METHOD.

How to Assess?
1) Course Grades
(2) ACS exams

http://assessment.uconn.edu/primer/goals1.html
Measurable Student Learning Outcomes:
Students should be able to **demonstrate** how to **use the IUPAC rules** by **close examination** of a given structure.
Allows instructor to collect valuable formative assessment information from student response
3-methylpentane
## Formative Assessment Example - 1

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Chem222Fall2014-Chem222-04</th>
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<tbody>
<tr>
<td>Number of Students:</td>
<td>617</td>
</tr>
<tr>
<td>Session Date:</td>
<td>10/10/2014</td>
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<tr>
<td>Class Average:</td>
<td>7.19</td>
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<tr>
<td>Session Name:</td>
<td></td>
</tr>
<tr>
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<td>8</td>
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<tr>
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<td>1:15 PM</td>
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<td>Total Points Available:</td>
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Question Title: Question 7

Correct Answer(s): D

Significant Figures: 16

### Student Responses

<table>
<thead>
<tr>
<th>Student Responses</th>
<th>Points</th>
<th>Vote Count:</th>
<th>% of Votes</th>
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<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>140</td>
<td>24</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>415</td>
<td>71</td>
</tr>
<tr>
<td>E</td>
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<td>0</td>
<td>0</td>
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Type: Multiple Choice

Peer Instruction

2nd attempt

71% Correct
Give the IUPAC name for \((\text{CH}_3\text{CH}_2)_2\text{CHCH}_3\).

a. 2-methylbutane

b. 2-ethylbutane

c. 2-methylpentane

d. 3-methylpentane

e. Hexane

### Exam Question

<table>
<thead>
<tr>
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<tr>
<td>E</td>
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<td>0.29</td>
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<tr>
<td>*D</td>
<td>228</td>
<td>67.26</td>
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<tr>
<td>C</td>
<td>24</td>
<td>7.08</td>
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<tr>
<td>B</td>
<td>72</td>
<td>21.24</td>
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<tr>
<td>A</td>
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FORMATIVE ASSESSMENT

Example - II

What is the expected *major* product of the following reaction sequence?

1. NaOEt, EtOH, 70 °C
2a. O₃, CH₂Cl₂, -78 °C
2b. DMS

Measurable Student Learning Outcomes:
Students should be able to **identify** products from **multi-step synthesis** through the **critical analysis** of reagents, reaction conditions and reaction mechanisms.

WILEY
What is the expected major product of the following reaction sequence?

1. NaOEt, EtOH, 70 °C
2a. O₃, CH₂Cl₂, -78 °C
2b. DMS

A  B  C  D  E

Why???

1st Attempt
13% correct

Rote memorization From Similar Online HW Qs
SUMMATIVE ASSESSMENT

Example - II

1. NaOEt, EtOH, 70 °C
2a. O₃, CH₂Cl₂, -78 °C
2b. DMS

A

B

C

D

E

Exam Question
Chem 224
### Condensed Item Analysis Report - Chem 224 - Spring 2016 - Exam 1

<table>
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<tr>
<th>Response</th>
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<td>46.19</td>
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<tr>
<td>D</td>
<td>5</td>
<td>2.54</td>
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<tr>
<td>* C</td>
<td>86</td>
<td>43.65</td>
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<tr>
<td>B</td>
<td>3</td>
<td>1.52</td>
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<tr>
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### Condensed Item Analysis Report - Chem 224 - Spring 2015 - Exam 1

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<td>* C</td>
<td>91</td>
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<tr>
<td>B</td>
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<tr>
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<td>1.98</td>
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</table>

A: ![Chemical Structure](image1)
B: ![Chemical Structure](image2)
C: ![Chemical Structure](image3)
D: ![Chemical Structure](image4)
E: ![Chemical Structure](image5)
Studies have previously shown that though many students can successfully pick the correct answer from a number of available options, their understanding of how to actually construct structures is limited.
A. Answering multiple choice question correctly does not always indicate deeper level of understanding

B. Provides feedback to instructor that students are getting it wrong, but does not provide feedback on HOW or WHERE students are going wrong

C. There is very little opportunity to point out to student the specific mistakes they made in the problem-solving process that led to their wrong answer
FINDING INNOVATIVE WAYS TO EVALUATE STUDENT WORK

Group A

Group B

Group C

Educreations App
WiFi
iPads
MacBook with AirServer
Peer Mentors
Student Directed Teaching Example – I

Group A

Group B

\( \text{HNO}_3 \)

\( \text{H}_3 \text{PO}_4 \)

\( \text{H}-\text{O}-\text{P}^+-\text{O}^-\text{H} \)

\( \text{P}-\overline{\text{O}}_1 \)
Peer Mentors

Handing out iPads

Engage
Explore
Explain
Elaborate
Evaluate
Student Volunteer’s are encouraged to construct knowledge through in-class discussion with peers and peer mentors.
Student Directed Teaching Example – II

Group A

Group B

Group C

amide
Student Directed Teaching Example – III

Group A - Missing formal charge

Group B
Predict the trend in acidity for the following compounds.
Rank by increasing acidity and explain (Hint-draw conjugate bases).
The $pK_a$ value for cyclopentadiene is much lower than typical C-H bonds.
Cation !!!!

Anion

Group A

Group B

Group C

Acid-Base Reactions
Aromaticity
Organic-II

Providing formative Assessment
Helps Reinforce Conceptual Understanding
ADVANTAGES OF iPad USE

A. Ability to identify specific problem areas for students and correct their errors with immediate feedback

B. Students can learn from the misconceptions and mistakes of their peers

C. Students are more engaged, since they are likely to be randomly called on to solve a problem for the entire class

D. Students learn that there are multiple approaches to solving the same problem
CHALLENGES

A. Explaining the importance of formative assessment to students

B. Changing classroom culture

C. Set up – charge iPads and get ready before class

D. Need self-motivated volunteers (peer mentors)
Student Survey: Learning with i-clickers

I have increased my understanding of organic chemistry by participating in the clicker questions during lecture.

A. Strongly agree (enjoy active learning)
B. Some what agree
C. Undecided
D. Somewhat disagree
E. Strongly disagree (waste of time)
49% strongly agree that i-clicker helps learning.
Student Survey: Learning with iPads (Spring 2015)

Peer Instruction requires students to be significantly more actively involved and in-dependent in learning than does a conventional lecture class. It is common for some or many students to be initially skeptical about this form of instruction.

Your instructor used iPad for peer instruction along with i-clicker. Rate your experience of use of iPad as method of peer instruction over the semester.

A) 5 – Excellent (experience for active learning)
B) 4 - Very good
C) 3- Good
D) 2- Satisfactory
E) 1- Poor (I did not enjoy participating in active learning. I want my teacher to do all the writing and explaining)
ACS and Exam Performance

ACS scores

10% above national average
ACKNOWLEDGEMENTS

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Co-Director of ACERT

Nikki Nagler

Matt McCaleb

&

Hunter College
Office of the Provost
FITT 2014: Empowering student learning in Organic Chemistry by designing a flipped classroom

PSC-CUNY 2015: Using Electronic Voting Systems (i-clicker) and Multiple Choice tests (Scranton) data to understand how students learn and identify common misconceptions in learning undergraduate Organic Chemistry

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Nancy Guerrero
Educational Technologist
Technology, Teaching and Learning, ACERT, Hunter College

Shiao-Chuan Kung, Ed.D.
Educational Technologist
Technology, Teaching and Learning, ACERT, Hunter College
I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel.”

- Maya Angelou

TEACHING ASSISTANTS

Solomon Feuerwerker

Roman Povolotskiy

Jaclyn Yamada

Samantha Schoer

Dr. James McNamara
PEER MENTORS

Ali Khaleel  Sharon Pang  Henry Yelkin

AND TO ALL MY ORGANIC CHEMISTRY STUDENTS
THANK YOU!

The Three Great Ancient Teachers

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Everett, NY

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