

Interactive Learning and Assessment Strategies in General Chemistry 2011 Curriculum Reform Project

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Goals of the curriculum reform project:

To re-design a course that

- makes learning more interactive for students
- makes learning more visible to the instructor.

To engage and retain more students, specifically women and students of diverse cultural and socioeconomic backgrounds, in the physical sciences and chemistry

Getting Started: Two Sources

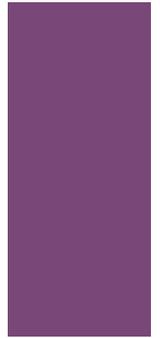
- Haak, D.C.; HilleRisLambers, J.; Pitre, E.; Freeman, S. “Increased Structure and Active Learning Reduce the Achievement Gap in Introductory Biology” *Science* **2011**, 333, 1213-1216.
- Angelo, T. A. and Cross, K. P. Classroom Assessment Techniques: A Handbook for College Teachers; Second Edition ed.; Jossey-Bass: San Francisco, **1993**.

Increased Structure and Active Learning Article

Science **2011**, 333, 1213-1216.

A highly structured course design

- improved the performance of all students in a college level introductory biology course
- and reduced the achievement gap between disadvantaged and non-disadvantaged students without increased expenditures.
- based on daily and weekly practice with problem solving, data analysis and other higher-order cognitive skills



Increased Structure and Active Learning Article

Science 2011, 333, 1213-1216.

Podcast Interview



From the *Science* Podcast: an interview with Scott Freeman on how increased structure and active learning reduces the achievement gap in introductory biology.

Listen:

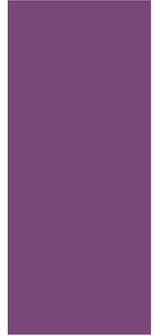


[Download the interview \[MP3\]](#)

Classroom Assessment Techniques

by T. A. Angelo and K. P. Cross

- Classroom assessment is an approach designed to help teachers find out **what** students are learning in the classroom and **how well** they are learning it.
- This book gives excellent examples of activities to include and how to implement them into your courses.
- Classroom Assessment aims at providing **early feedback**.
- This approach is learner-centered teacher-directed and firmly rooted in good practice.



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Course Details

- What course:
 - General Chemistry I (CHEM 103) Fall 2012
- Enrollment:
 - 75-150 students, 75% pre-nursing students, >5% chemistry majors, large lecture course with 3-5 lab sections
- Why I selected this course:
 - Introductory chemistry students lack of retention of fundamental concepts and lack of engagement for the subject material.
 - Large intro-level lecture courses present a unique opportunity for chemistry instructors to add inclusive and interactive teaching and learning techniques

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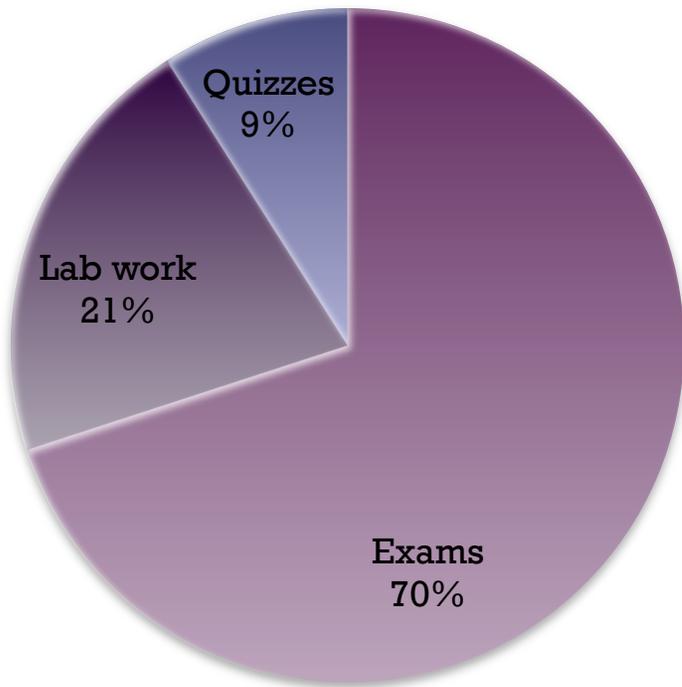
- Proposed changes to course
 - Create a highly structured course which included
 - Traditional assessments: monthly exams, cumulative final, weekly quizzes, biweekly homework assignments and lab experiments
 - incorporated a **weekly classroom activity** into the lecture part of the course.

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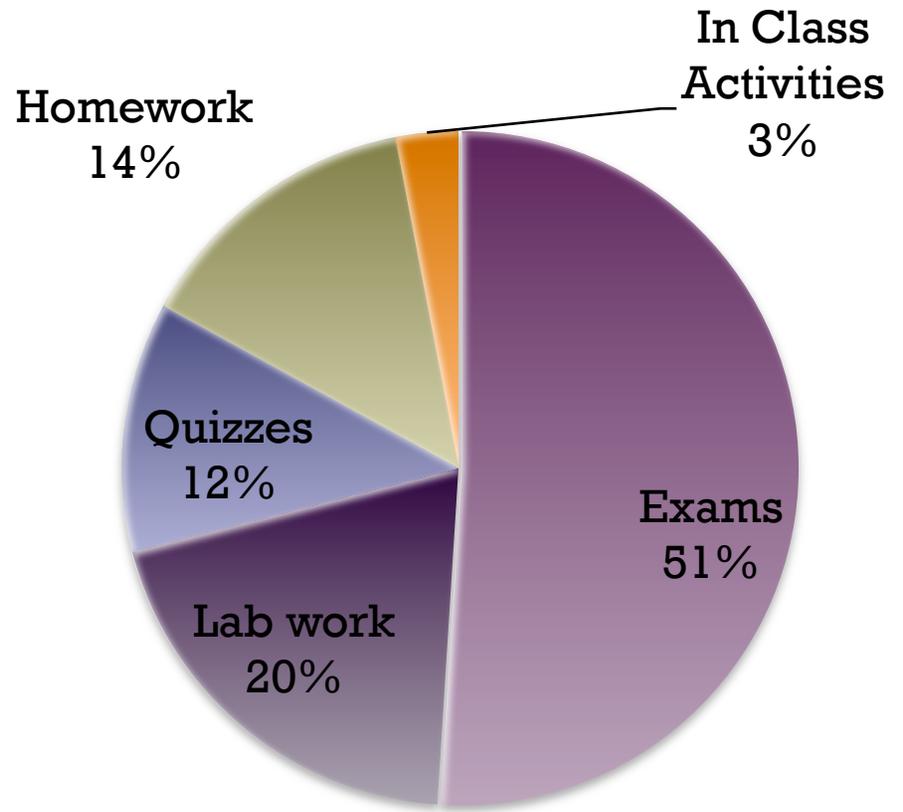
Proposed Changes to the Course



Traditional Course



Highly Structured Course



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Proposed Changes to the Course

■ Weekly Classroom Activity

- Each week – a different activity depending on the material covered
- 2 points a week, 30 total points (3% overall grade)
- With high-frequency, low-risk activities, students should either gain familiarity with material or learn early that they don't understand a topic to seek further assistance
- To ease the burden of grading ~100 weekly assignments – activities were graded 0, 1 or 2 point scale

Examples of Classroom Activities

CHEM 103 - Fall 2012

- Week 1: Response Notecard on Attitude of Previous Chemistry Experience
- Week 2: ChemActivity on the Nuclear Atom by Moog and Farrell
- Week 3: End of Class Notecard, Minute Paper
- Week 4: Self Assessment of Exam 1
- Week 5: Group Quiz on topics from lecture
- Week 6: Net Ionic Equation practice
- Week 7: Identify Types of Reactions practice
- Week 8: End of class notecard, Minute Paper
- Week 9: Lewis Structure practice
- Week 10: Formal Charge practice
- Week 11: Intermolecular forces practice
- Week 12: Intermolecular forces quiz preparation
- Week 12: Molar masses of gases practice
- Week 13: End of class notecard, Minute paper

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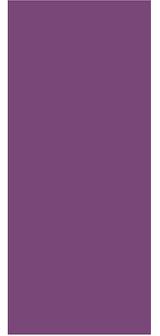
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Classroom Assessment Techniques by Angelo and Cross

Minute Paper

- A minute paper is a 3-5 minute writing assignment at the beginning of lecture period or a 3-5 minute writing assignment at the end of the lecture.

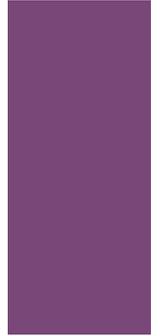


Today's Classroom Activity #8

Note card, 2 points

Write your name on your note-card

- What is the most significant thing you learned today?
- What question is uppermost in your mind at the end of this class session?



Classroom Assessment Techniques by Angelo and Cross

Minute Paper

- The benefits from using minute papers are
 - that they require more active listening from students
 - improves students writing
 - writing assignments help document **for students** that they are indeed learning something in the course.

Student's Favorite Classroom Activity

Self Assessment of Exam #1, 2 points

Chemistry 103

Self Assessment of Exam 1 (2 points)

Fall 2012

Due in class Tuesday Oct 9th at 3:30pm

Name _____

Circle the answer for the following questions on study tips:

How many days a week do you spend working on chemistry (not counting class)?	1-3 days	3-5 days
How much time in a day do you spend working chemistry problems (not counting class)? Less than 30min 30min	1 hour	More 1h
Did you use the exam topic list to study for exam #1?	Yes	No
How many SI sessions have you attended?	More than 1	1 or 0
Do you skim/ read the assigned sections of textbook to prepare for lecture?	Yes	No
Do you take notes /write down key terms when reading the assigned sections?	Yes	No
Do you work the examples in the chapter as you read the chapter?	Yes	No
Do you use the back of the book solution answers only to check your answers?	Yes	No
Do you take notes in lecture?	Yes	No
Do you participate in the calculation-based examples during lecture?	Yes	No

Student's Favorite Classroom Activity

Self Assessment of Exam #1

What is **helping** you learn in this class? (examples: *reading the sections before and after class, coming to lecture, SI sessions, quizzes, working examples in the chapter, working with peers in groups*)

What is **not helping** you learn in this class?

What is **something I can do** to help you learn more?

What **personal action plan** can you put in place to help yourself learn more this semester?

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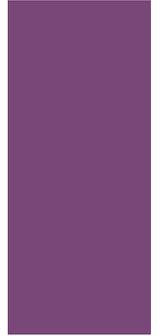
Advantages of Classroom Activity

- Provided opportunities to describe concepts or reflect on learning
- Written record of students directly participating with the lecture material
- Encouraged group work (could work alone or together)
- Encouraged attendance
 - served as a measure of student attendance (required for UW-EC)

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Disadvantages of Classroom Activity

- Took 5-15 minutes of class time every week
- Some students didn't like working together
- If you are asking students to do something a little different than they are used to, you may have to sell it a bit.



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Student Comments

■ Group Work:

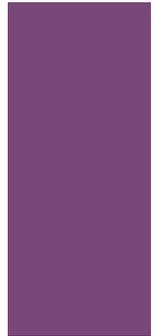
- I learned from the activities that we worked together with a partner on, it plays on each persons strengths
- Working with others [on the activities] gave me a different point of view about how I saw the problem

■ Self Assessment worksheet

- [I liked the] self assessment worksheet – it was kind of a kick in the butt for me to realize there is more I can do to get better grades

■ General

- I liked the activities, they helped me grasp the material better than if we just went over it in class



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Student Comments

■ Notecards:

- The end of class notecards was memorable because I like being able to give feedback in the middle of the semester when it will still make a difference to me.
- The notecards were helpful because I found I paid closer attention because I knew I had to write something down at the end of class
- End of class notecards it helped me think about what I understood and what I didn't from the lecture
- I really enjoyed using notecards to share our opinions with you and getting points for coming to class.

Summary

Interactive Learning and Assessment Strategies in General Chemistry

- Inclusion of Weekly Classroom Activities to Large Lecture Course in Chemistry
- The classroom activities
 - were a small change that made a big difference to my CHEM 103 course last fall
 - improved critical thinking skills and reflection, fostered group discussion and required instructor intervention
 - helped meet my course goals to makes learning more interactive for students and makes learning more visible to the instructor.
 - were well-received by students

Acknowledgements

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Wisconsin Teaching
Fellows &
Scholars