PREPARING SUCCESSFUL STUDENTS

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What does a successful student look like?

- ***Integrity, dedication to task,*** and solid preparation in basic scientific principles and modern biochemistry
- **Able to analyze, problem-solve, and innovate**
- Prepared for graduate study or work
- Prepared to create jobs for self and others, render service to society

What is the situation on the ground?

- Incredible "intellectual horsepower"
  - Students have enormous raw talent and potential
  - Many are idealistic Ghanaian patriots looking to serve
- Weak analytic, synthetic, and basic lab skills for their level of intelligence (higher level skills are lacking)
- Weak general and "in discipline" knowledge
  - Students don't read much
    - Confabulation
- Motivation, initiative, and work ethic are highly variable
  - Students lack clarity about unacceptable practices
    - Plagiarism, dubbing, and cheating (this is a world-wide problem)

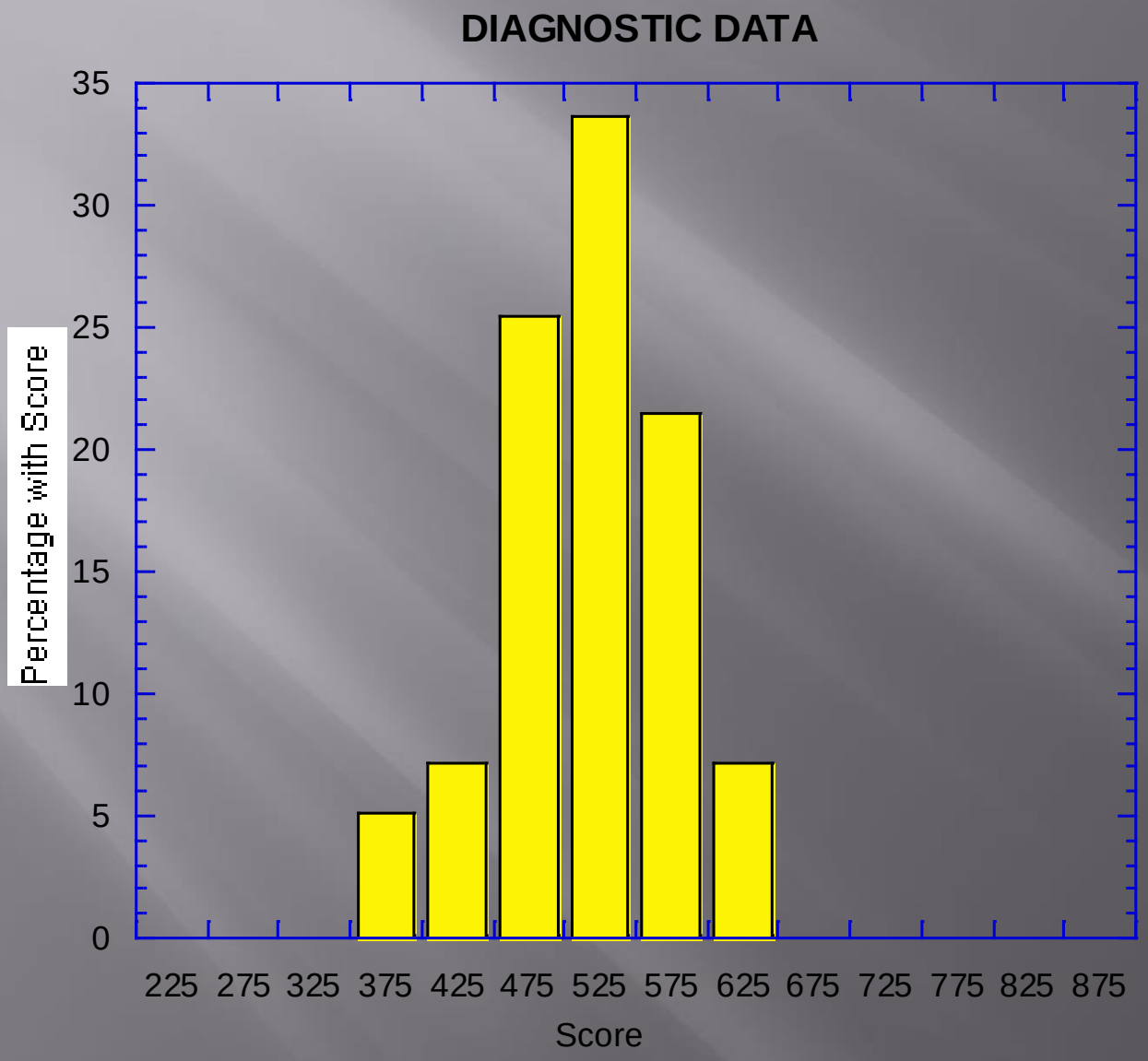
HYPOTHESIS: ***All weaknesses can be completely remedied with changes in educational style, starting at the basic school.***

Diagnostic Exam for Biochemistry Second Year Students

- A high-school level general chemistry quiz was given – only basic principles tested in a general way, no calculations required

Academic Year	Average	Number Passing, >40%	High Grade
2008-2009	35%	6	B (60-70%)
2009-2010	NA	NA	NA
2010-2011	26%	4	D (40-50%)
2011-2012	20%	2	D (40-50%)

Mock SAT Chemistry Test, 2011



Average Score

510

48th percentile

What accounts for the current state?

- **<u>Structural problem</u>: student numbers relative to current resources**

- Teaching-learning style in Basic School - Senior High

- Too few PhD holders among senior staff (45%)

- Curriculum and pedagogical style
  - Course very packed with lectures only
  - Lack of flexibility and little student choice
  - Aspects of curriculum need to be updated

- Natural human resistance to acknowledge problems, seek solutions, and change

GOOD NEWS: We have it within our power to change all of the above and it is happening gradually.

Two Contrasting Styles of Learning (Instrumental)

CHEW – POUR – PASS – FORGET (CPPF)

Memorize facts or formulas for short-term retention on objective (MCQ) tests. Afterwards, without real understanding, retention can be difficult.

" You don't need to understand it, just memorize it."

"How many past questions have you solved? Two? You are a fool."

MAIN GOAL: Highest possible GPA, learning is irrelevant

Two Contrasting Styles of Learning (Transformative)

UNDERSTAND – APPLY – INNOVATE (UAI)

Deeply understand principles for long-term retention, apply the concepts to real problems, and then use them in new ways or in different situations.

" Understand the concepts and what the variables in the equation represent, I'll give you the formula on the test."

MAIN GOAL: Clear understanding and long-term retention of knowledge that is built upon over time. Good grades automatically follow.

CPPF

- Recall is all
  - $A = \varepsilon c l$
- Near exclusive use of secondary sources
  - Notes and summaries
  - Infrequent reading of texts or literature
  - Previous exams
- Strong dependence on previous students
- Note-taking in lectures
- Exams – only lecturer gives assessment

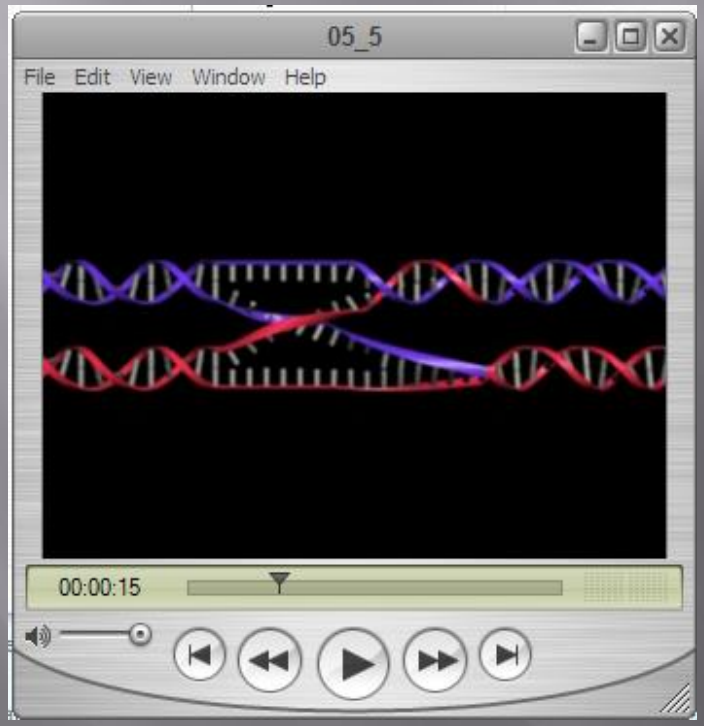
UAI

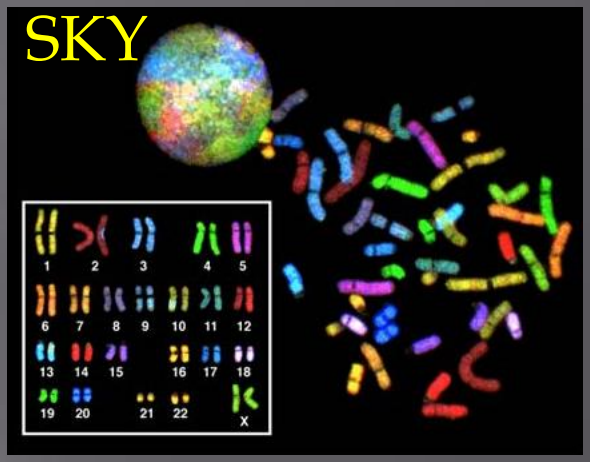
- Understand to help recall
  - A depends on concentration…
- Extensive use of primary sources
  - Textbooks must be read
  - Back-up material from the web or literature
  - Secondary source supplements
- Get some tips from previous students, but go-it-alone and work with current classmates
- Multi-media in lectures
- Continuous, varied assessment by both students and lecturer

Some Specific Innovations

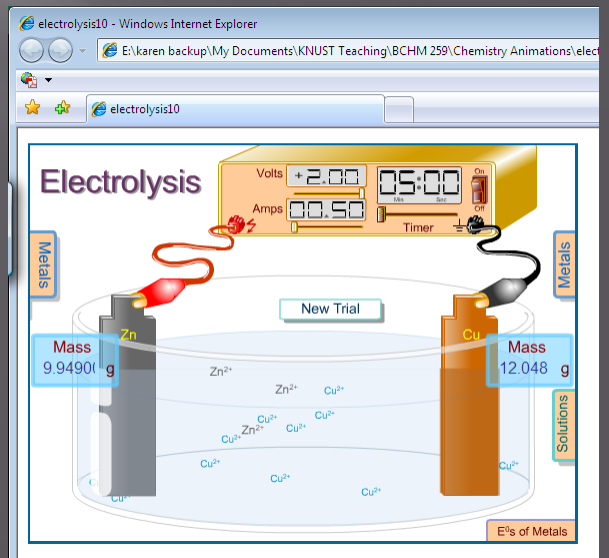
Use of animations, graphics, and web-based applets to illustrate concepts and techniques

DNA Recombination





Electrolysis Simulation



Inexpensive Kits Sold for Online Learning

$6 per student per semester for 3 labs

Others labs were done for free at virtlab.com

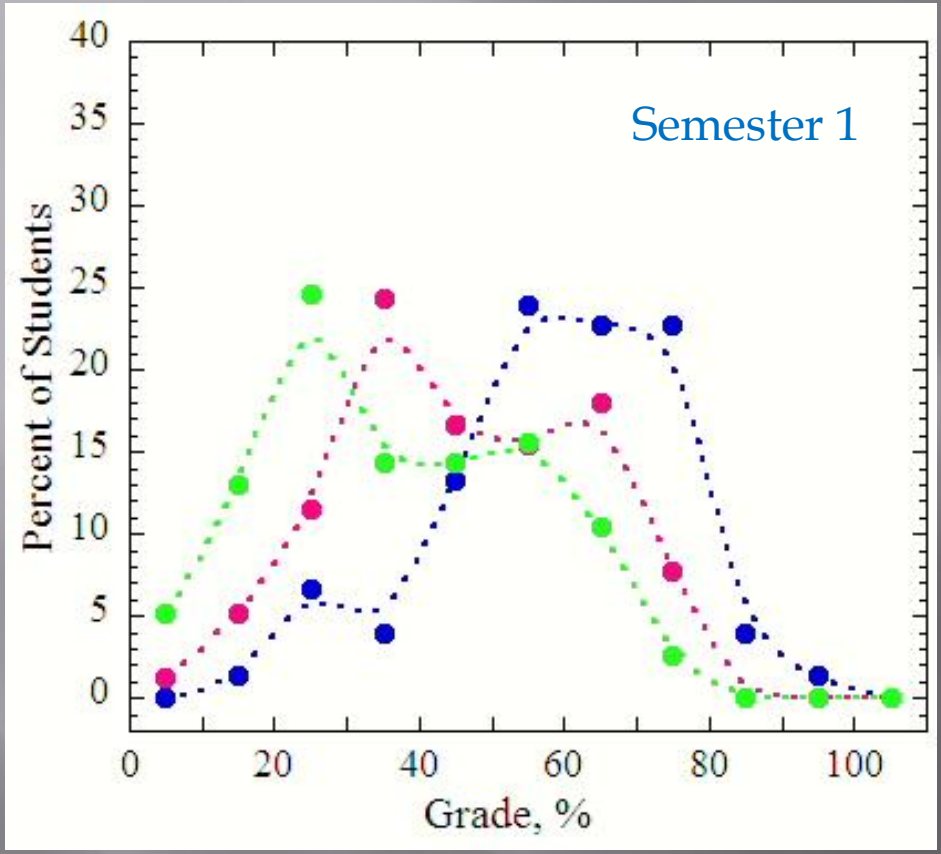
Other Specific Innovations

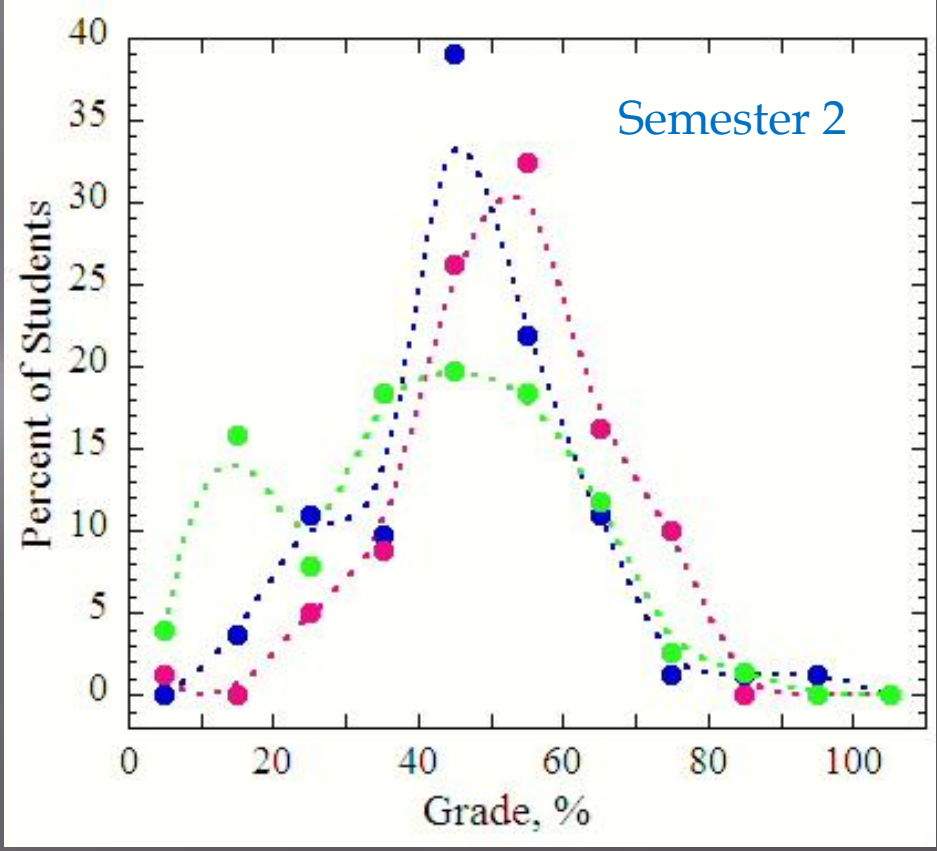
- Frequent in-class assessment and homework
- Build a vegetable/fruit battery competition
- Team charters – cooperative learning
- Biotech business case studies
- Outreach to rural JSS and SS students
- Documentary films, students write a POV essay
- Actual experience in research for publication
  - Survey research in Kumasi
  - Summer enrichment programs with foreign students
- Undergrad journal club for extra credit

Extra Support Services

- Regular office hours, optional weekly tutorial
- Saturday extra-help sessions with TAs and post-grads
- Research symposium for undergrads
- Student retreats on topics of interest
  - Study skills
  - Time management
  - Opportunities for attachment
  - Health maintenance
  - Values clarification and career planning
  - Leadership

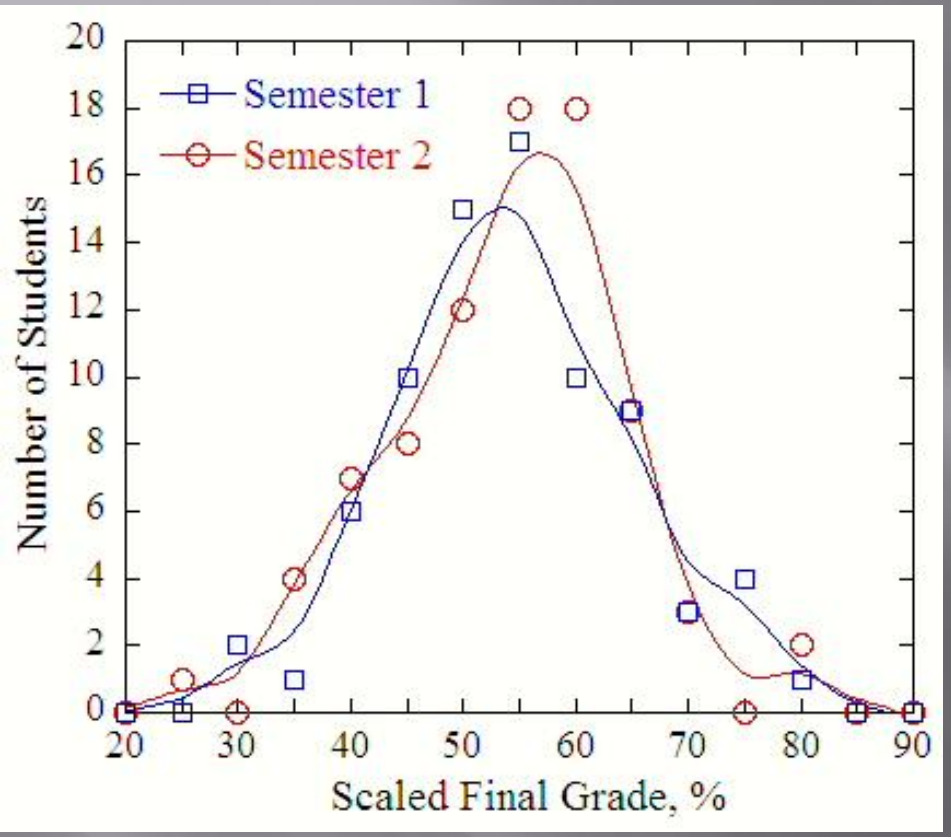
Objective Outcomes: Physical Chemistry II Topics: Electrochemistry and Spectroscopy

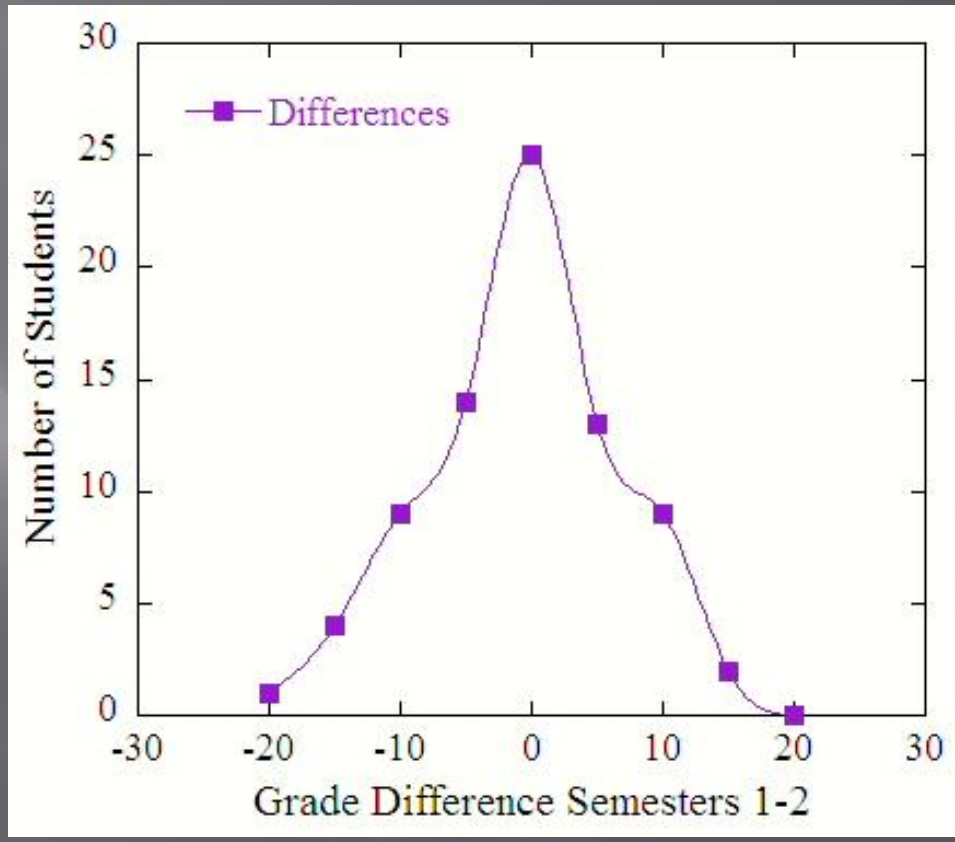




Changes in continuous assessment grade distributions reflect adaptation to new study methods.

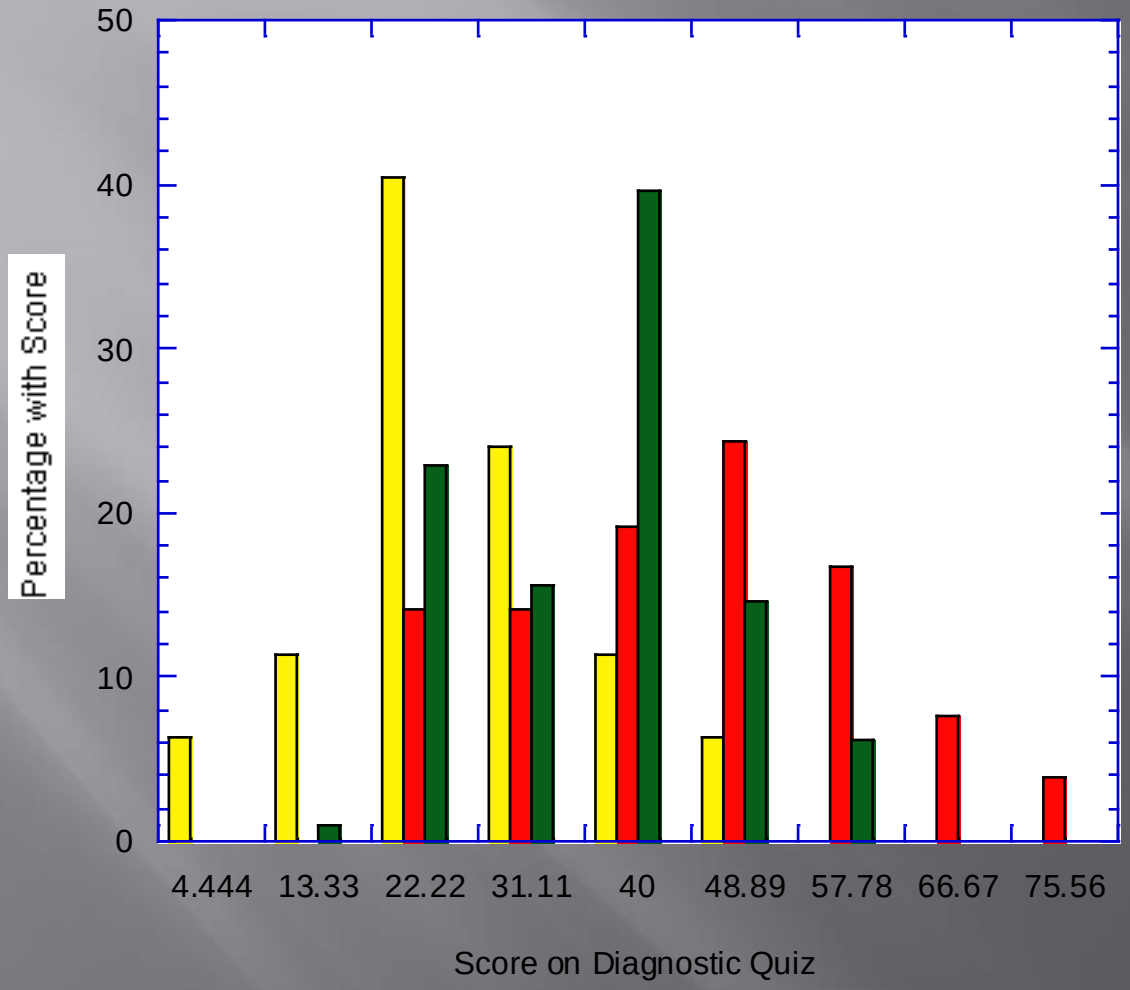
Objective Outcomes: Final Grades
Both semesters: Ave = 56% or C+, SD=15%





Distributions were identical both semesters. 64% of students received identical or higher grades second semester. Another 20% only dropped by 5 points or less.

Results: Retained Knowledge?



Retention quiz given at the start of the semester after the chemistry course

Yellow – no active learning

Green – active learning approach

Orange – active learning approach with more time allowed for quiz

Challenges

- **<u>Novelty</u> – students were unfamiliar with the approach and struggled to adapt**
  - You MUST explain why this approach is beneficial
  - Frequent tips about how to study are needed
  - Reassurance that grades would not be affected helped
    - Grades were HIGHER than usual

- Unacceptable practices

  63% of students admitted to cheating on in-class assessments

  11 out of 12 group term papers plagiarized

- Failure to grasp the ramifications of the traditional system fully
  - Assumed some interest in the topics that were covered
  - Students tried to memorize material not suited to that approach
  - **Colleagues resisted the new methods**

Subjective Outcomes: Student Satisfaction Surveys and Focus Groups

Student focus groups , one minute feedback, and individual comments

Survey instrument with 30 questions [35 students]

- 16 related to the method and its value for learning and professional preparation
- 7 related to new study behaviors
- 7 related to general features of the course, e.g, lecturer and TA quality

Summary of Satisfaction Survey Results

QUESTION TYPE	5	4	3	2	1
	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Method, %	30	38	19	10	3
New Behaviors, %	43	26	17	8	6
Course Overall, %	50	30	12	7	1

The Way Forward

- Stay positive and keep exploring new approaches
- Be prepared for resistance and don't give up
- Clearly communicate the benefits of the new approach
- Reassure students that final grades will not suffer
- Elicit student input and feedback at all stages (content reduction)

THANK YOU FOR YOUR ATTENTION