



# How Chemistry Faculty Infuse Classroom Practice with Active Thinking

## A Summary of Case Study Findings

Prepared by the National Center for Postsecondary Improvement:  
Project 5.3

# Comparing campuses in the study

- ◆ Types of Institutions:
  - 3 Universities (“Land-Grant, Urban, National”)
- ◆ Similarities
  - Research I classification
  - Presence of medical, law and graduate schools
  - Tenure (research only or multiple paths)
  - Highly decentralized academic units
  - Approximately 23-24,000 undergraduates

# Comparing campuses (continued)

## ◆ Differences

- Levels of innovation (top-down or grassroots)
- Approaches to faculty-administration divide
- Type of admissions (flexible or selective)

# What are the teaching and learning issues?

- ◆ Three emergent questions:
  - What do students do with Chemistry knowledge?
  - How can student learning be related to research inquiry and the practice of discovery?
  - What motivates faculty to shift teaching practice in an effort to improve?



# When intellectual deadness haunts the college classroom...

“If you’re just sitting there...you’re not thinking.  
You’re dead....I’m not gonna sit there and talk at  
you and permit you to be dead.”

*(Landgrant University)*

# What undergraduates do with knowledge they acquire in Chemistry classes

- ◆ Satisfy pre-requisites, general education
- ◆ Acquire preparation for careers in chemistry
- ◆ Learn how to match relevant content, concentration, skills

## Key issue:

- Applied and transferable skills calls for discovery learning

# Discovery learning

“We’ve created a whole set of open-ended experiments where [students] are not all doing the same thing. They’re doing similar things, but we give minimal directions. It is [the students’] job to explore, ***in the way that a research chemist explores in the laboratory***, what needs to be done to get this problem solved...

# Discovery learning (continued)

... They're small simple problems, but for them this is quite a challenge. In fact, we had one good student who went stomping around the lab saying, 'This is the first lab I haven't been able to dry-lab!' He was a good enough student to know what the answers ought to be and could calculate backwards, but here... none of that. ... [This] totally changed the tone of the laboratory ... **from an exercise to a true experiment** with no outcome that is predetermined."

*(National University)*



# More quotes ...

“I think we’ve been able to improve the quality of instruction by changing the focus [and] making [it] very much discovery oriented. We’ve been able to give each student a manageable number of samples so they can explore a total of 25 combinations....Out of a class of 600, we can explore a much, much larger space and get duplicates, triplicates, ten-fold replicas of each measurement. The student is going to look at those and say ‘Yes, this really is what’s happening.’”

“With that, the whole flavor of the class has gone from one of ‘Do this measurement because that’s what we always do in October,’ to ‘This is the range of possibilities, explore it and see if you can identify any trends.’”

# Key finding: What motivates faculty to engage in active teaching?

- ◆ General principles from higher ed. research
  - “It’s not the salary”:
    - The role of extrinsic rewards (Bandura, Ross & Ross, 1963)
  - The role of teaching in tenure and promotion decisions
    - Black burn & Lawrence, 1995; Merchant & Newman, 1994; Jabker & Helinski, 1978
  - The role of intrinsic rewards
    - good work, reputation, etc.
  - Erikson’s “generativity”
    - Baldwin & Blackburn, 1981; Levinson, 1978; Walker & Quinn, 1996

## Implications ...

# What does this mean for student preparation?

- ◆ The need for undergraduate education to systematically embrace discovery learning
- ◆ The need to understand how and why a student is struggling (preparation, effort, etc.) by “rediscovering discovery”
- ◆ The need to recognize qualitative differences in students who are struggling: under prepared vs. disengaged students

# What to consider when addressing resistance within departments

- ◆ The current diversity of practice
- ◆ General principles of Teaching and Learning that support the benefits of Active Thinking and Discovery Learning

# National Center for Postsecondary Improvement



- ◆ <http://ncpi.stanford.edu>