The pHunger Games

Betsy Jamieson, Carrie Read, Dave Gorin
Liberal Arts Luncheon
October 5, 2012
First a word from our sponsor. . .

Sherrerd Prizes for Distinguished Teaching

THE 2012 RECIPIENTS

Michael Barresi, assistant professor of biological sciences; Floyd Cheung, associate professor of English language and literature; and Jennifer Guglielmo, associate professor of history, have been named recipients of the 2012 Kathleen Compton Sherrerd ’54 and John J.F. Sherrerd Prize for Distinguished Teaching. The three prize recipients will be honored during a reception and presentation of the awards Thursday, October 11 at 4:30 p.m. in the Campus Center Carroll Room.
The National Conversation: Are College Students Learning?

- **The Feds:** Spellings’ report, 2006. “Student achievement, which is inextricably connected to institutional success, must be measured by institutions on a “value-added” basis “

- **The Academy:** Arum and Roksa. Academically Adrift. 2011. “45 percent of these students demonstrate no significant improvement in a range of skills - including critical thinking, complex reasoning, and writing…”

- **The Pundits:** David Brooks. NY Times editorial 04/20/12. “If you’ve got a student at or applying to college, ask the administrators these questions: ‘How much do students here learn? How do you know?”

Local Context:

- NEASC Accredits Smith College.
- And NEASC Requires Assessment.
Goals for Chemistry Majors

Desired Learning Outcomes:

1. Communicate chemistry ("tell a good story") in writing
2. Read a scientific paper
3. Interpret experimental data
4. Transfer knowledge between discrete course units
5. Information literacy (chemistry-specific)
6. "Think like a chemist"
7. Explore new/forgotten topics and self-teach
8. Appreciate historical development of major ideas

Also, ~30 specific content areas ("what good chemists should know")
A Starting Point: Carrots vs. Sticks

Traditional Assessment:
ACS DUCK

“American Chemical Society-
Diagnostic of Undergraduate
Chemistry Knowledge”

Multiple-choice, cumulative exam

Work alone.

Prep: study guides/practice tests

Motivation to study:
• require passing score?
• rank student scores?

No Fun. Not “Real.”
A Starting Point: Carrots vs. Sticks

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Our Thought: More Fun

ID a “Real” task.

No preparation required. Use skills and info literacy.

Competition format.
• Cash prize
• Line on CV
• Reception/Token gift for all participants

Collaboration with friends.

Minimize panic/stress
Designing an Assessment Tool

Learning Outcomes

Write science
Read science
Interpret data
“Think chemistry”
Learn independently
Information literacy
Transfer knowledge
History

Test Attribute

Open-ended
Primary literature
Chemistry content
Idea maturation
No studying/prep
Many subdisciplines

Implementation

Write a referee report to a journal editor.
Designing an Assessment Tool

Test Attribute | Implementation | Meets attributes?
---|---|---
Open-ended | Given a (doctored) journal article, evaluate the experimental design, data analysis, and conclusions of the “authors”. | No forewarning of content.
Primary literature | Write a referee report to a journal editor. | Begin: individuals alone
Chemistry content | | Then: grouped into teams
Idea maturation | | Non-human resources allowed
No studying/prep | | State-of-the-art research is often “multidisciplinary.”
Many subdisciplines | |
### How About a DUCK?

<table>
<thead>
<tr>
<th>Implementation?</th>
<th>Test Attribute</th>
<th>Meets attributes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple choice test (ACS-DUCK)</td>
<td>Open-ended</td>
<td>Nope. Scantron.</td>
</tr>
<tr>
<td></td>
<td>Primary literature</td>
<td>Limited. Maybe excerpts?</td>
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<tr>
<td></td>
<td>Chemistry content</td>
<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>Idea maturation</td>
<td>Nope.</td>
</tr>
<tr>
<td></td>
<td>No studying/prep</td>
<td>Nope. Study guides.</td>
</tr>
<tr>
<td></td>
<td>Many subdisciplines</td>
<td>Yes, but in isolation.</td>
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Senior Day Schedule

- 10 AM - Assessment handed out. Students work individually.
- 11 AM - **Submit individual work.** Teams are assigned. Groups begin to work.
- Noon - **Submit initial group work.** Lunch with faculty advisor.
- 1 PM - Faculty advisors leave. Teams work on reviews.
- 3 PM - **Teams turn in final reviews.** Students are given a short survey to complete.
- 4:30 PM – Winners of cash prize announced. Senior gifts distributed. Faculty and participants adjourn to Packards for celebration.
Participants

- All 17 senior chemistry majors were asked to participate on a volunteer basis
- Pilot program ran on the Monday of Senior Week
- 12 students said they would participate
- 11 students actually participated
- Divided them into 4 teams with 2-3 students each
Nuts and Bolts

- Engaged dept. liaisons to garner student support early in project
- **Wrote/planned assessment during 5 weekly meetings**
  - Started with a real journal article
  - Used GoogleDocs for collaborative writing
- Created a short survey and instructions for faculty advisors
- Other logistics: reserving rooms, arranging for food and prizes, setting up teams
Department Involvement

- Embarked on project with full support of the department
- Shared draft of the assessment and student survey with the department for comment
- Recruited colleagues to serve as faculty advisors to student teams
- Most everyone was present for award announcement and celebration that followed
<table>
<thead>
<tr>
<th>Concept/Issue</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Learning outcome/s Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dissociation Constant:</strong> the $K_d$ value reported in the paper for this complex is compared to those reported for other complexes; the conclusion is the opposite of what it should be.</td>
<td>In addition to Good, explain what a $K_d$ is - and why a smaller $K_d$ value means stronger binding.</td>
<td>Explained that the statement is incorrect and that a larger $K_d$ value is actually indicative of weaker binding, not stronger.</td>
<td>Mentioned that the statement made in the paper is incorrect, but no additional explanation.</td>
<td>Did not question assertion.</td>
<td>1, 2, 3, 4, 5, 8</td>
</tr>
</tbody>
</table>
Poor/Fair: There was also no explanation provided for the large $K_d$ value (3 orders of magnitude greater than cited values), This requires some explanation.

Good: Your conclusion about the dissociation constant ($K_d$) also needs to be revised. From our understanding a small $K_d$ represents a strong binding affinity and a high $K_d$ represents a low binding affinity. In your Conclusions, you reported the CS1 to Cu$^+$ $K_d$ to be $3.6 \times 10^{-12}$ and claimed that it had stronger binding than previously reported complexes with values on the order of $10^{-15}$. You have come to the opposite conclusion of what your data show.

Excellent: The author claimed that due to the fact that ($K_d$) for the binding of Cu$^+$ to CS1 is higher than the $K_d$ of previously reported complexes, Cu$^+$ binds stronger to CS1 than the other sensors. The dissociation constant is the inverse of the association constant, meaning that: $K_d = \text{Reactants/Products} = ([\text{CS1}] + [\text{Cu}^+])/[\text{CS1-Cu}^+]$. Therefore, a larger $K_d$ corresponds to a reaction that dissociates more readily than one with a smaller $K_d$. This means that a higher $K_d$ actually indicates that Cu$^+$ binds less strongly to CS1 than the other sensors.
Content Rubric Relates to Learning Outcomes

Content Rubric | Learning Outcomes
---|---
1) | Write science
2) | Read science
3) | **Interpret data**
4) | “Think chemistry”
5) | Learn independently
6) | Information literacy
7) | Transfer knowledge
8) | History
Learning Outcome, 1 of 8

- **Learning Outcome (LO):** Interpret experimental data
  - 4 of the 13 content rubric items tested this LO (including the $K_d$ example previously shown)

- Teams were given 1 point for every excellent/good rating in each of these 4 items

- Teams with scores of 3-4 points were rated excellent for this learning outcome (2 points = good; 1 point = fair, and 0 points = poor)

  1 group: received a *good* score for this LO
  3 groups: received *excellent* scores for this LO
Faculty Responses from Lunch

• Students identified a host of problems, including virtually all that I noticed.

• Students seemed to be well on their way. Understood the goal of the paper, and I asked them to specify in light of that larger goal what specific goals the paper needed to accomplish.

• Students said “we need help because we want the money!”

• They are definitely on the right track and thinking well about problems. They are looking for additional information but needed help to think about accessing journals instead websites.
Student Survey: Content and Capacities

What course material/courses did you need to apply to identify and solve problems in this paper review?

- Physical chemistry II (9)
- Light and chemistry (7)
- Organic synthesis (6)
- Organic II (5)
- Organic I (4)
- Environmental Analytical (3)
- Chemistry IV (2)
- Bioinorganic (1)

What skills developed at Smith did you identify?

- Analysis of data
- Critical thinking
- Outlining and organization
- Teamwork/leadership
- Scientific writing
Student Survey: Mikey Likes It!

Did this assess your ability to "think like a chemist"?

• 9/9 responded positively
• "It tested our ability to critically evaluate conclusions drawn from a body of data. It also did a good job of pulling from lots of different fields of chemistry."

Would you recommend participation to future rising seniors?

• 9/9 responded with "yes"
Student Survey: Knowledge Building

Individual
- Did not get much done
- Not confident
- Confusion
- Answered surface problems

Group
- Ideas developed quickly
- Confident
- Clarity
- Deepened the discussion and answers
Lessons Learned

Issue

• Couldn't get at how students used references

• Not everyone participated

• Perhaps too easy?

• Better coverage of LOs

Plan for Improvement

• Will ask next group to submit a list of references used

• Change time (Jan.), make it 'mandatory'

• Add a few more challenges

• Will look at this as write assessment - not afterwards
Acknowledgements

Institutional Research
• Minh Ly
• Kate Rowen
• Dana Sherwood

CHM
• Kevin Shea
• Bob Linck
• Kate Queeney
• David Bickar
• All who adjourned to Packards

$$$
• Aunt Sophia (Provost’s new initiative fund)