Author(s): MELO 3D Project Team, 2011

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Presentation to LSA-ITC:
Enhancing Undergraduate Education Through the Deployment of Quality Learning Objects

Brenda Gunderson and Nancy Kerner
University of Michigan at Ann Arbor

2/3/12
The Goal

To improve education by integrating quality cross-discipline and course-specific Learning Objects (LOs) into undergraduate courses.
- **Learning Resources**
  Any web-based teaching tool (e.g., tutorial, collection, ....)

- **Learning Objects (LOs)**
  Interactive web resources that lead students to learning goals via informed pedagogy
The Proposed Solution

The Project
Enhancing Undergraduate Education Through the Deployment of Quality Learning Objects

MELOs

Funding

NINI Grant (New Initiatives/New Infrastructure)
from UM LSA-ITC (Instructional Tech Committee)
The MELO SOLUTION

- Educate graduate students across disciplines to access, evaluate, design LOs; and to create quality course-specific and cross-discipline LO collections.
- Graduate students disseminate these LO collections and designed LOs to relevant faculty for integration into undergraduate courses.

→ The trainee becomes the trainer

See “Bottom Up Faculty Development” at
The Outcomes

- **LO course collection**
  - Selection based on course needs and goals
  - Provided within syllabus or on website

- **LOs tagged for course integration**
  - Choice based on **needs vs type** of LO
  - Choice focused on LOs that address difficult concepts or skills
The Outcomes
Select and Integrate LOs (Physics)

Chosen Java Applets ≅ Games = LOs
Undergraduate students have different levels of academic training

Success in undergraduate education demands a solid foundation in a variety of basic academic skills

Examples:
- Writing skills
- Working in Groups
- Presentation skills
- Study skills

How can we work towards leveling the playing field?
Psych MELO Summary
The Outcomes

Innovative LO Collection Building

• Students submit ~ 100 LOs with reviews and recommendations for course implementation

• Students voluntarily author LOs!
The Outcomes

Integration of LOs into Pre-labs (Chem)

E1 Pre-Laboratory Report (page 1/1)

Name: ___________________  Team #: ___________  Date: ___________  Section: ___________

View the website http://preparatorychemistry.com/Bishop_Elem_Prop_frames.htm (Chapter 4 animations) and complete Table 1 below before answering pre-lab questions 1 - 3. Use the CRC Handbook in the SLC or online at http://www.lib.umich.edu/ to record the solubility data in Table 1. Click “Find Databases” and enter CRC Handbook of Chemistry and Physics. Click on Section 4 of the Handbook: Properties of the Elements and Inorganic Compounds and expand this to Physical constants of Inorganic Compounds.

<table>
<thead>
<tr>
<th>Cation</th>
<th>Anion</th>
<th>Compound</th>
<th>Solubility (g/100g H₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca²⁺</td>
<td>NO₃⁻</td>
<td>Ca(NO₃)₂</td>
<td></td>
</tr>
<tr>
<td>Ca²⁺</td>
<td>CO₃²⁻</td>
<td>CaCO₃</td>
<td></td>
</tr>
<tr>
<td>Na⁺</td>
<td>NO₃⁻</td>
<td>NaN₃</td>
<td></td>
</tr>
<tr>
<td>Na⁺</td>
<td>CO₃²⁻</td>
<td>Na₂CO₃</td>
<td></td>
</tr>
</tbody>
</table>

1. How do cations and anions such as Na⁺ and NO₃⁻ remain separated (dissociated) from each other in the presence of water?

2. What solubility generalizations can be made about ionic compounds, if both the cation and anion are singly or multiply charged based on the Table 1 solubility data?

3 - 4. Aqueous solutions of Table 1 compounds are mixed and a precipitate forms:

   Ca(NO₃)₂ + Na₂CO₃ → precipitate

3. Identify and record the new combination of ions possible after mixing of Ca(NO₃)₂ and Na₂CO₃.

   Based on the solubility data in Table 1, what is the likely identity of the precipitate?

   Why?

4. What do the test results below tell you about the precipitate formed in the reaction of Ca(NO₃)₂ and Na₂CO₃?

   Test: Ca(NO₃)₂ + NaNO₃ → no reaction
The Outcomes

Online LO Pre-Labs with VoiceThread (Org chem)

Chose one of the compounds below and explain what you would expect its H-NMR and C-NMR would look like. How many unique signals? What is the splitting in the H-NMR? Where would you expect the peaks to be in the spectrum? If someone has already commented on one structure, chose another. If they are all taken, look at the other analyses your peers have provided and determine whether you agree or disagree.

The H-NMR for molecule D would have two unique signals, one at 0.9 ppm and one at 5.3 ppm and the C-NMR would have three unique signals. The signal at 0.9 ppm would be highly integrated, whereas the other signal would not be quite as integrated. The signal at 0.9 ppm is also more shielded, thus representing the CH3 group, while the other signal is less deshielded due to the π bonds in the ring. The signal at 5.3 ppm would represent an internal hydrogen atom. The splitting for the signal at 0.9 ppm would be a doublet because there is only the one neighboring hydrogen, thus according to the n+1 rule this would be a doublet. The splitting for the signal at 5.3 ppm would be a quartet because using the n+1 rule and the three neighboring hydrogens, it would be split into a quartet. Magnetic anisotropy due to the ring could also potentially be moving the signals more downfield.
Online LO Pre-labs with Voice Thread (Org chem)

Ctools Analytics:

Average of 230 LO views a week
Only 48 students have access

VoiceThread:

For the last week in lab:

Discussion 1: 119 views, 16 comments
Discussion 2: 72 views, 17 comments
Discussion 3: 91 views, 15 comments

Students are visiting the site multiple times!
The Outcomes

Video/Audio Screen Capture (Chemistry)

- Screen captured resource tutorials
The Outcomes

Video/Audio Screen Capture (Writing)

- Video captured feedback for written documents
  - personalized feedback on student papers.

- Screen captured tutorials
  - how to construct a concept map for writing

http://www.screencast.com/users/cmodey/folders/Jing/media/8bd96754-d693-4b5e-ba59-952afb2f2e4d
The Outcomes

Video/Audio Wrapping of Imperfect LOs

- Simulating Confidence Intervals
- Authors: Beth Chance, Allan Rossman (CP)

http://www.rossmanchance.com/applets/Confsim/Confsim.html
Advantages of LO?

- Addresses fundamental concept.
- Provides excellent visual demonstration.
- User can adjust controls.

Disadvantages of LO?

- Learning Objectives?
- Directions?
- Terminology/Notation unknown to our students
Instead of: LO
My students will see:

- Objectives
- Directions
- Assessment

LO
Lesson03:

In this lesson, you will generate confidence intervals for estimating a population proportion. You will be able to set the value of the (usually unknown) population proportion, the sample size, and the confidence level. You also are able to decide how many samples will be generated and a confidence interval based on each sample will be computed and displayed. The applet graphs the intervals and those which did contain the true proportion are shown in green, while the intervals that did not contain the true proportion are in red. The true proportion is shown by a blue line on the graph. Trying different settings will allow you to make comparisons and draw some important conclusions about how confidence intervals work.

Assignment:

Check Ctools for due date and submission details.

For each of the questions below, use the applet to help you address the question. Submit your 1-2 sentence summary for each question directly inline to your GSI Ctools site Assignment for prelab3 (or as instructed on your class Ctools site).

1. Set the confidence level to 99% and the sample size to 100.
   (a) What is the long run proportion of confidence intervals that contain the population proportion?
   (b) Does this long run proportion depend on the sample size \( n \)? (Try some other sample sizes keeping the confidence level at 99%)

2. What happens to the length of the confidence intervals as the confidence level increases? Compare some intervals at the 90%, the 95%, the 99% confidence levels (keeping the population proportion and the sample size \( n \) the same).

3. What happens to the length of the confidence intervals as the sample size increases? Compare some intervals made using samples sizes of \( n = 30, n = 50, \) and \( n = 100 \) (keeping the population proportion and the confidence level the same).
The Outcomes

Innovative LO Designs

A New Interactive and Entertaining Redox Applet

Chemistry Cage Match: The Battle For The Electron

Learning Objective: To understand the principles of Redox in terms of a variety of chemical properties
The Outcomes: **LOs Created**

**Name That Scenario**

This site gives you a chance to practice recognizing the appropriate situations in which to apply various statistical procedures. You will be presented with a series of ten real world statistics scenarios. Your task is to select the most appropriate statistical procedure for each scenario.

**DIRECTIONS**

1. Select at least two of the following Procedures.

2. Choose "First Scenario" to begin.

<table>
<thead>
<tr>
<th>One Proportion</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Proportions</td>
<td>Regression</td>
</tr>
<tr>
<td>One Mean</td>
<td>Chi-sq Goodness of Fit</td>
</tr>
<tr>
<td>Paired</td>
<td>Chi-sq Homogeneity</td>
</tr>
<tr>
<td>Independent T-test</td>
<td>Chi-sq Independence</td>
</tr>
<tr>
<td>First Scenario</td>
<td></td>
</tr>
<tr>
<td>Clear selection</td>
<td></td>
</tr>
</tbody>
</table>
Students took a “pre-test” and “post-test” during lab before and after being given access to the LO.

<table>
<thead>
<tr>
<th></th>
<th>Mean Scores (Out of 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
</tr>
<tr>
<td>NTS</td>
<td>4.66</td>
</tr>
<tr>
<td></td>
<td>(4.4, 4.9)</td>
</tr>
<tr>
<td>Control</td>
<td>4.92</td>
</tr>
<tr>
<td></td>
<td>(3.8, 6.0)</td>
</tr>
</tbody>
</table>
The Outcomes

Creation of Inter-disciplinary LOs

Four Characteristics of Good Mathematical Writing

This website focuses on the following four characteristics of good mathematical writing. Each solution should:

1. Begin with a restatement of the question

   You **Restate The Problem** by explaining what the problem is asking for as you understand it.

2. Include computations with explanations

   **Computations With Explanations** are mathematical expressions which are continually being justified and clarified by prose.

3. Provide figures, graphs, tables, etc. whenever appropriate

4. End with a clear, concise conclusion.

   **Conclusions** are the results of your computations as well as [insightful](http://instruct.math.lsa.umich.edu/support/teamhomework/) observations about these results.

[http://instruct.math.lsa.umich.edu/support/teamhomework/](http://instruct.math.lsa.umich.edu/support/teamhomework/)
The Outcomes
Graduate Student Impact

_Porscha McRobbie_ – Interactive Wolfram LOs for physical chemistry concepts

• **Professional development and Career Decisions**

_Porscha McRobbie:_ Accepted a position with Wolfram Demos.

_Noah Gardner:_ “Opened me up to a whole new teaching style”; “my favorite part of my graduate school experience. I now intend to teach.... “

_Tanya Breault:_ Considered dropping out of graduate school. Is now “committed to a career in teaching and research”
The Outcomes

New LO Projects

Transforming A Large Lecture To An Interactive Personalized Online Format

Funding

Level 2 Grant

from UM LSA-ITC (Instructional Tech Committee)

- transition from a live lecture to a web-based multimedia online format so as to offer personalized, ultra-accessible teaching and learning opportunities
Transforming Lecture

Why?

- The large (450 seat) lecture hall setting is NOT conducive to active learning
Students in the large introductory class are heterogeneous with respect to learning styles and background knowledge and...
Transforming Lecture

Stepping Stones to Pedagogical Innovations

- Online Learning Resources
- Video Capture of demonstrations
- Podcasts
- Software
The Outcomes

Awards, Workshops, Conference Presentations

• Provost’s Teaching Innovation Prize (TIP - UM)
  (Brenda Gunderson, 2011)
• LO Flipbook Video Award
  (Adena Rottenstein, 2011)
• Innovative Use of MERLOT Award (SloanC/MERLOT Intl Conf)
  (Nancy Kerner, 2009)
• U-M Enriching Scholarship Workshops (2008 – current)
• MERLOT/Sloan-C Conference Presentations (2009- )
• Graduate students/faculty ➔ MERLOT LO peer reviewers
Overall Outcome

Moving from a model where students are not only engaged learners but also co-teachers
Thank You!

UM LSA-ITC

Any Questions?
Additional Source Information
for more information see: http://open.umich.edu/wiki/CitationPolicy


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