Integrating the Learning Cycle into Environmental Studies

Keck Science Reform for Non-Science Majors

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The Learning Cycle:

The learning cycle is a teaching method that is based on cognitive research suggesting that students learn more effectively when they are able to reconstruct their understanding through interactive exercises (Bransford et al., 1999). The method involves several phases, including (1)engaging students with a question or activity that probes their prior knowledge and focuses their thinking, (2) having students explore their ideas and concepts with the instructor and other students, and (3) explaining the concepts and clarifying common misconceptions, which are especially prevalent in non-majors courses. The method also includes assessment of the level of student understanding and common misconceptions held before, during, and after instruction, to evaluate the effectiveness of both teaching and learning (Ebert-May et al., 2004).

Science topics discussed in ES 150:

- Geology
- Nutrient Cycling
- Ecosystem Biology
- Community Ecology
- Wetlands Ecology
- Population Change
- Pollution

Goals of the proposal:

- To elucidate varying perspectives and misconceptions in a course with both science majors and non-majors
- To enhance learning through interactive exercises
- To inform students about current events related to science and the environment
- To enhance connectivity between class material and current issues

Implementation of goals:

- Attended workshop on Innovative Methods for Teaching Ecology (Ecological Society of America, August 2006)
- Developed new lessons with a greater focus on student involvement and accountability
- Incorporated interactive lessons that built on the readings (minimized lectures)
- Incorporated more class discussion during class meetings
- Invited guest speakers in areas related to the topics
- Redesigned laboratory experiences to better illustrate the concepts discussed in class (Figures 1, 3)
- Administered the Science and Math Values Inventory (SaM-VI) at beginning of the semester (for sample SaM-VI questions, see Box 1).

Figure 1. Environmental studies students evaluating water quality of the Cahaba River by sampling macroinvertebrates.

Current assessment: Mid-term evaluation scores

STRONGLY AGREE				STRONGLY DISAGREE
1	2	3	4	5

Category 1: Effectiveness of Course Design

(possible range 4-20; N=11, mean=8.36± 3.44 SD)

- Working during class time in groups on topics related to readings helps me understand the material better.
- The posting of questions and responses on Blackboard has facilitated the discussion for the days that we address *Taking Sides* issues (DDT and ANWAR).
- The class discussions on the *Taking Sides* issues have facilitated my understanding of these topics.
- The reading guides and questions are useful for preparing for class and tests.

Category 2: Connectivity

(possible range 2-10; N=12, mean=4.42 ± 2.78 SD)

- Although the topics in this class are very diverse and interdisciplinary in nature, the readings, class work, discussions, and lab have connected the topics reasonably well.
- The labs have helped me gain an appreciation for what we've discussed in class.

Category 3: Overall Satisfaction

(possible range 3-15; N=12, mean= 5.92 ± 3.68 SD)

- My group works well together.
- I enjoy this class.
- I am learning a lot in this class.

Additional Analyses of Results

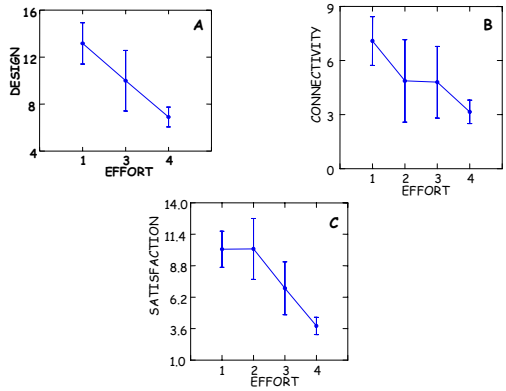

Figure 2. Relationship of perceived student effort to perception of (A) effectiveness of course design, (B) connectivity of course material, and (C) overall satisfaction. Students who believed that they put forth more effort tended to find the course design to be more effective (p=0.06), the course to be more connected (p=0.12), and more satisfying (p=0.27). These three categories were also related to student year and whether or not the student was a science major (data not shown).

Future assessment and dissemination of results:

- The SaM-VI will be given again at the end of the semester, and overall impression of science and math values will be compared from the beginning to the end of the semester (See sample questions in Box 1, below).
- Results will be disseminated to the ACS and at the 92nd Annual Meeting of the Ecological Society of America in August, 2007

1. Solving science problems improves my critical thinking skills
2. It's hard to focus on my science classes when I have so much else to do
3. My self-esteem suffers when I take science exams
4. Studying science is necessary to prepare me for my career.
5. I enjoy reading magazine articles about science
6. Understanding science allows me to better understand my other classes
7. My future income will be higher if I have a good understanding of science
8. My lifestyle choices will be healthier if I have a good knowledge of science
9. My life will be better if I understand science e
10. Science gives me insight into real-world problems

Box 1. Sample questions from the Science and Math Values Inventory (SaM-VI). A Linkert scale (similar to that from the mid-term evaluation) is used to evaluate responses.

References

Bransford, J, A. L. Brown, and R. R. Cocking (eds). 1999. How people learn: brain, mind, experience, and school. National Academy Press, Washington, D. C.

Ebert-May, D., K. Williams, D. Luckie, and J. Hodder. 2004. Climate change: confronting student ideas. Frontiers in Ecology and the Environment 2: 324-325.

Sample exercise: Using Invasive Species to Understand Communities

Preparation for Class:

1. Textbook chapter on community ecology (ch 4, Raven, P. H, and L. R. Berg, Environment, 5th Edition, John Wiley and Sons, Inc, 2006.
2. Additional Reading on invasive species (Soule, M. Natural Areas. In Invasive Plants Fact Book, The Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW) https://www.denix.osd.mil/denix/Public/ES-Programs/Conservation/Invasive/natural.html
3. Complete Reading guide (see below) and submit the answer to one question (identified by instructor) before class

Reading Guide

Sample terms:

Evolution	Adaptation
Invasive species	Camouflage
Natural selection	Competition
Succession	Ecological niche
Species richness	Predation
Keystone species	Symbiosis
Mutualism	

Sample Question:

- Describe, in your own words, how natural selection might happen in a population of salamanders that inhabit an area that is experiencing a severe drought. Be sure to include each of the components involved, as explained in your book.

In Class Activity:

1. Students work in groups of 3-4, each answer one of the following sample questions, using any resources to which they have access (including internet)

- Describe how invasive species might alter the process of succession. Find an example describing an invasive species that is/may be affecting succession in an area. Describe the invasive species and how the process of succession in the area is being/has been affected.
- Find an example in which invasive species have altered the course of natural selection and evolution in a native species. Describe in detail how the native species has adapted to the selective pressures from the invasive species. How might this adaptation influence other species within the community of the affected species?

2. Groups discuss their findings with the class. Students are responsible for all of the material from class discussion.

Figure 3.Environmental studies students learning about the ecosystem services of natural wetlands at Ebenezer Swamp.