

A Novel Approach to Teaching Environmental Biology Literacy

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SUMMARY

A novel approach is being used to increase environmental biology literacy to a large number of students (2,000 per year) through laboratory exercises. The goal of the course is to provide students with the tools to make educated decisions regarding their political and personal connections with the environment. A series of project based and individual activities are designed to link local issues to regional and global environmental problems. By using a problem solving and critical thinking based approach, students are able to relate the environment to their everyday lives. The lab sequence begins by examining one aspect of the environment and continues by building on information gained from previous labs until students are able to analyze the relative health of an environment as a whole. After getting accustomed to analyzing data, students participate in project based labs in which they must experimentally determine the effects of various changes in environmental parameters. The laboratory experience culminates in student designed poster presentations, integrating a wide range of environmental concerns. Assessment of this course has indicated that the knowledge gained in this course has helped students understand how the environment relates to their own life.

KEYWORDS: environmental biology literacy; project based; problem solving; critical thinking; poster presentation; assessment

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Introduction

It is generally accepted that students attending labs in conjunction with associated lecture courses gain a greater understanding of the material. The kinesthetic nature of labs, combined with the auditory and visual components of lecture, teach to all three major learning styles. However, in traditionally run labs, especially those accommodating large numbers of students, exercises are usually stand alone with little or no true discovery being done on the part of the student. Outcomes are predictable, and the labs themselves are "cookbook." This leads to reliance on memorization rather than true understanding of real-life environmental issues.

Background

Both Environmental Biology Lecture and Environmental Biology Labs were added to the core curriculum at Georgia Southern University in Fall Semester, 1998, with the advent of the semester system. Three other science disciplines also offer environmental courses: Chemistry, Geology, and Physics. In order to complete graduation requirements, each student at Georgia Southern must successfully complete a general science course with lab and an environmental science course with lab. While the other sciences lack large facilities, the Biology Building has a large lecture hall (seating 250 students) and four lab rooms dedicated to both General Biology Labs and Environmental Biology Labs. As a result, over 70% of all Georgia Southern undergraduates enroll in both Environmental and General Biology lectures and labs.

Funding for laboratory equipment used in the Environmental Biology Lab course was obtained through a National Science Foundation ILI grant awarded in July, 1998. These funds allowed for the purchase of equipment designed to withstand use by over 2,000 students per year. Technology funds awarded in May, 2000, have allowed a computer component to be added to the course. In addition to new equipment and computers, the course uses an in-house laboratory manual written by this author which allows for complete customization and lower costs for students.

Course Goals

There are three main goals for the course:

1. to introduce concepts new to many students,
2. to explain the science behind "common" knowledge about environmental issues, and
3. to provide the tools that allow students to make educated decisions about environmental policies and information.

Many of our students rely on the media to obtain "facts" about what's going on around them. This course attempts to dispel some of the commonly held myths while encouraging students to look at all sides of an issue.

Course Overview

The environmental lab course is designed to incorporate both stand-alone and project based labs. Project labs are set up early in the semester, usually by the second lab. An entire lab session is devoted to set-up, explanations and demonstrations of specific laboratory equipment, and discussions about project topics. Students are then expected to come in each week and make project measurements and observations before beginning the scheduled stand-alone lab.

While projects look at a number of environmental issues simultaneously, stand-alone labs deal in depth with a single issue. More than half of the stand-alone labs are conducted either partially or completely outdoors on the university campus. TAs (Teaching Assistants) continuously incorporate each of the concepts learned into new labs, creating a "little picture" to "big picture" scenario. This provides the students with a feeling of continuity rather than the discontinuous sequence in more traditionally taught labs.

Many of the results from both project based and stand-alone labs vary from class to class and semester to semester. This leads to more discussion on the part of the students and encourages critical thinking skills rather than rote memorization. It also requires the TAs to have a more thorough understanding of the concepts themselves.

Assessment

Student: Students are given weekly quizzes to encourage reading prior to coming to lab. They are also given a written mid-term exam with a heavy reliance on "scenario" type questions. An example question might read: "You have purchased a piece of property with a stream running through it. It is located 1.5 miles downstream from the local golf course. As the summer progresses, you notice a sharp increase in algae populations and a decrease in other aquatic organisms such as fish and frogs. What do you think is causing these problems? How will you test your hypothesis? What kinds of steps can you take to alleviate this problem? Support your answers."

In addition to weekly quizzes and the mid-term exam, students are also required to write lab reports detailing their results and conclusions for most of the stand-alone labs. They are given one week to complete each lab report.

After completing all of the stand-alone labs, students are required to take a lab practical exam. They are given access to all of the equipment they have used throughout the semester and are asked to determine the relative health of an environment assigned by their TA. They are encouraged to do as many different tests as are appropriate and compare their results to environments they have already tested during the semester.

Finally, students are given a full lab period to take down their projects, calculate class averages, and groups are assigned one project and asked to complete a poster. Criteria for posters are provided to each student prior to and during the poster session. The last lab of the semester is devoted to the poster session where students are required to answer questions posed by their peers, their TA, and any faculty member who happens by. Posters are evaluated, based on the aforementioned criteria, by both their TA and peers, and each student has the opportunity to assign within-group points for participation to other group members.

Course: Each semester students are given a course evaluation. The first part of the evaluation is designed to get feedback about individual labs and projects and the overall course. The second part of the evaluation is designed to get feedback regarding their experience with their TA.

Over 80% of the students enrolled between Fall Semester 1998 and Spring Semester 2000 gave a favorable response to the query "Overall, did you enjoy Environmental Biology Labs? Why or why not?"

Additionally, students were asked to rate their agreement to the following statement: "Knowledge I have gained in this course has helped me understand how the environment relates to my own life." The rating scale was from 1 to 5 with 5 indicated strong agreement. The mean response of students queried between Fall Semester 1998 and Spring Semester 2000 was 4.5.

Upon comparing final grades of students completing the more traditionally taught General Biology Labs and those completing Environmental Biology Labs, there was a significant increase in the total number of points

earned (ANOVA, $p < 0.001$). This comparison was made since over 90% of the students taking one of the biology labs take the other during their academic career at Georgia Southern.

Conclusions

Student assessment of the Environmental Biology Lab course indicates that over 80% of the students enjoy the course compared to the 76% favorable response for General Biology Labs. Furthermore, students indicate an increased knowledge in how the environment relates to their own lives after completion of the Environmental Biology Lab course.

By combining stand-alone labs with project oriented labs, students are gaining a greater understanding of environmental concepts, issues and problems. They are able to apply this understanding toward problem solving when presented with different scenarios. They have shown a greater retention of the information presented throughout the course than their General Biology Lab counterparts.

Changes are current being made in the General Biology Lab course to include projects and more continuity in the curriculum. Additionally, student assessment is being geared less toward encouraging rote memorization and more toward applying of knowledge. New labs continue to be developed by the author for both courses.

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