

Final report for SoTL project: Using lab visualization supplements and lecture quizzes to enhance learning in a Physical Geography lab course

By

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I. Introduction and Literature Review

A. Lab enhancements

While scarce in physical geography, studies have shown increased student interest and test scores when real-time data, conceptual simulations, or Internet resources are incorporated into a course. Weller (1996) concludes that most studies fall short of providing students with interesting opportunities to investigate their own questions about scientific phenomena. Those simulations that enable students to experience the “exciting, tortuous, recursive spiral of science” tend to show promising results. Unfortunately, most studies seem to be hobbled by short evaluation times and many compared simulations to traditional learning, without forming groups that were exposed to both methods. Moreover, many studies came from middle/high school, with a small subset focusing on post-secondary education.

The fact that nearly four-fifths of today’s college students agree that use of the Internet in the classroom enhances their learning experience (U.S. Dept. of State, 2002), yet only 48% of college faculty use the Internet on a regular basis (Pew, 2002), provides a basis for exploring its potential benefits in most courses. In the few cases where computer-based exercises were implemented into a physical geography course (Francek, 1999; Brey, 2000), success in raising the interest-level of students was reported. However, no significant improvement in learning, as measured by performance on exams, was reported.

Wentz and Vender (1999) found that computer-based instruction works best in conjunction with traditional formats. Problems generally arose if students had problems with the computer software/hardware. The availability of a computer in both the class and lab rooms where physical geography is typically taught at UW-Whitewater provides the opportunity to demonstrate and discuss the computer applications, thus reducing the potential of such problems.

B. Pop quizzes

According to Leamson (1999), both breaking lectures into shorter segments and fostering out of class student-to-student interaction should enhance learning. This would also be expected to improve attendance, as students are less willing to rely upon each other for notes and also risk missing the unannounced quiz.

II. Project objectives

Our project had two specific objectives. First, we sought to increase student retention of subject matter through supplemental materials based on Internet and other digital resources. The rationale for this was based on stagnating student scores, bimodal grade distributions (presumably science vs. non-science students), and negative comments about the “workbook” nature of some of the laboratory exercises. Second, we wished to determine if pop quizzes can be used as a tool to increase student attendance, create a classroom community, and improve comprehension of lecture material. The rationale for this objective was based on challenging students to check their notes for completeness, provide preparation for exams, maintain attendance, especially late in the semester, and promote study groups.

III. Methods and materials

A. Lab supplements

The laboratory component of Physical Geography (Geography 210) meets in weekly two-hour sessions. The content revolves around a laboratory manual containing 12 labs written by Goldblum, Jacobs, and Travis. Prior to this project the laboratory exercises were fairly traditional in approach relying on map reading, map comparison, and interpreting archived graphs and images. To improve the lab exercises, each instructor contributed a new supplemental exercise that complemented an existing exercise utilizing some digital information to make the class more “modern” and improve visualization. New labs were added for the Fall 2003 semester and continued through Spring 2004.

Examples of supplements

1. Internet exercise using real-time satellite imagery
 - Understanding atmospheric circulations through cloud and water vapor movements as seen on satellite imagery (visible, infrared, and water vapor) 12-hour animations (i.e. “loops”).
 - Interpret ocean circulation patterns (i.e. warm vs. cold) using sea surface temperatures observed from satellite.
2. Map visualization using digital elevation model (DEM)
 - Since students have difficulty interpreting and visualizing topographic maps, for the Whitewater topographic map we provided a pseudo three-dimensional map that uses shading to simulate elevation.
 - Students compared the DEM with the traditional topographic map.
3. Computer forest model for UWW nature preserve
 - For a simulated oak savanna, students manipulate fire regime and examine changes in species diversity, biomass, and basal area of dominant tree species.

- This model complements the UWW nature preserve fieldtrip where they visit a human-altered oak savanna.

B. Pop quizzes

During lecture periods we administered an unannounced three-question multiple-choice pop quiz each week (for twelve of the fifteen weeks – weeks with lecture exams were excluded). The quiz was projected on an overhead screen for all the class to see and students were instructed to consult lecture notes, textbooks, and converse with colleagues to answer questions. Quizzes were collected after ≈ 5 minutes and questions/answers were discussed as a group to provide immediate feedback to students. Each pop quiz was worth three points. Collectively, all pop quizzes were worth 6% (36 out of 586 points) of the final course grade. Pop quiz questions are similar or identical to questions that were given on later lecture exams. Pop quizzes were administered for the first time in the Spring 2004 semester.

IV. Assessment methods

Lab exams included identical or very similar questions as exams prior to supplements. Student responses were compared with results from prior semesters as a quantitative measure of enhanced learning. Secondly, questionnaires were administered inquiring about the utility and friendliness of the supplements. Questionnaires (Appendix 1) asked for feedback on pop quizzes. Secondly, student's final grades were correlated with pop quiz scores.

V. Results and discussion

A. Lab exam scores

There was no statistically significant change in overall lab exam scores from before supplements (Spring 2003) to the two semesters (Fall 2003 and Spring 2004) following implementation of lab supplements (Figure 1). Individual questions, which specifically addressed individual lab supplements, showed equivocal results. A question that examined understanding of forest conditions (forest modeling supplement) showed no significant change from Spring 2003 to Fall 2003. A question that addressed the ability to understand topographic relief (DEM supplement) showed a statistically significant ($p=0.03$) decrease in score from Spring 2003 to Fall 2004. A question testing change in understanding of atmospheric circulation was not identified.

B. Lab supplement questionnaire

Students did show a preference for the two computer based supplements (Internet and forest modeling), with few students finding the DEM supplement helpful. This may be due to the fact that students could complete these exercises at home, in other words at their leisure. Students, by a 10 to 1 margin, thought that the supplements should be used

in the future (Figure 2a), although a majority of them felt like they didn't help towards earning a better grade (Figure 2b). This follows with previous studies that found a similar student response (Francek, 1999; Brey, 2000), and implies that the students' appreciation of this alternative lab style is more due to their desire to move away from a traditional lab format with no consideration as to whether it truly helps them better understand the various topics.

C. Pop quizzes

The results from the pop quiz questionnaire showed that a statistically significant majority of students found: the pop quizzes led them to attend class more (66% vs. 33%) and pop quizzes helped in exam preparation (61% vs. 29%). Also, a significant majority (85% vs. 15%) found the pop quizzes challenging and thought provoking. About half the students said they were more likely to meet outside of class than they would have otherwise and 45% stated that the pop quizzes helped improve exam scores.

A correlation of overall lecture score with pop quiz score was highly significant ($r=0.72$) and positive (Figure 2).

VI. Conclusions

Incorporating Internet lab supplements was received favorably by students, but did not increase test scores significantly. We plan to continue using the supplements as a way to enhance student interest in the laboratory. Incorporating pop quizzes into the lecture is positively correlated with student scores and thus shows promise as a tool to maintain student interest, attendance, and build camaraderie in the classroom. We plan to continue administering the pop quizzes in future semesters.

References cited:

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Figure 1

Overall lab exam scores for the three lab quizzes each semester. Spring 2003 was before lab supplements were added. There is no significant change in lab exam averages between before and after for any lab quiz.

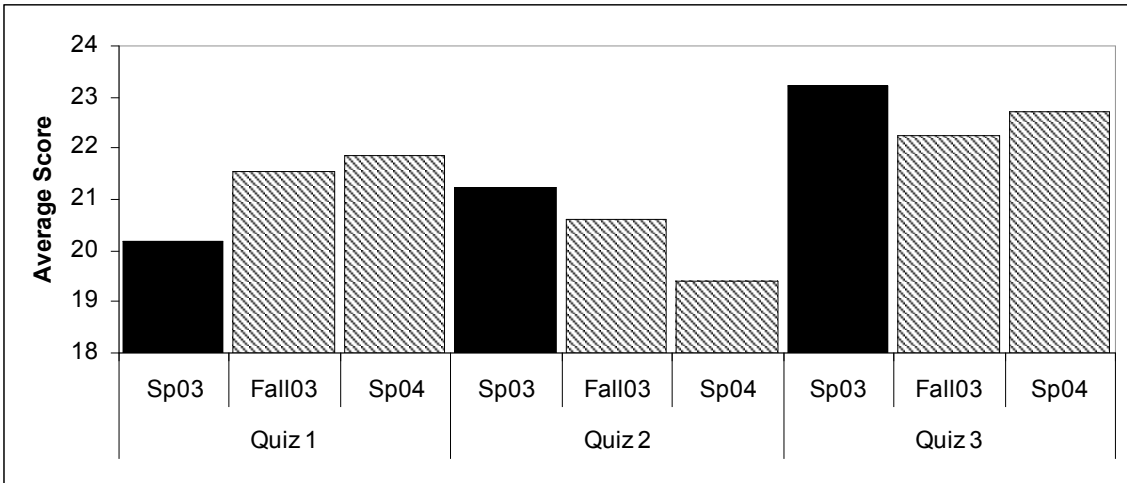


Figure 2

Correlation of pop quiz scores (out of 36) with overall grade in class. Correlation coefficient is 0.71 and is statistically significant ($p < 0.001$).

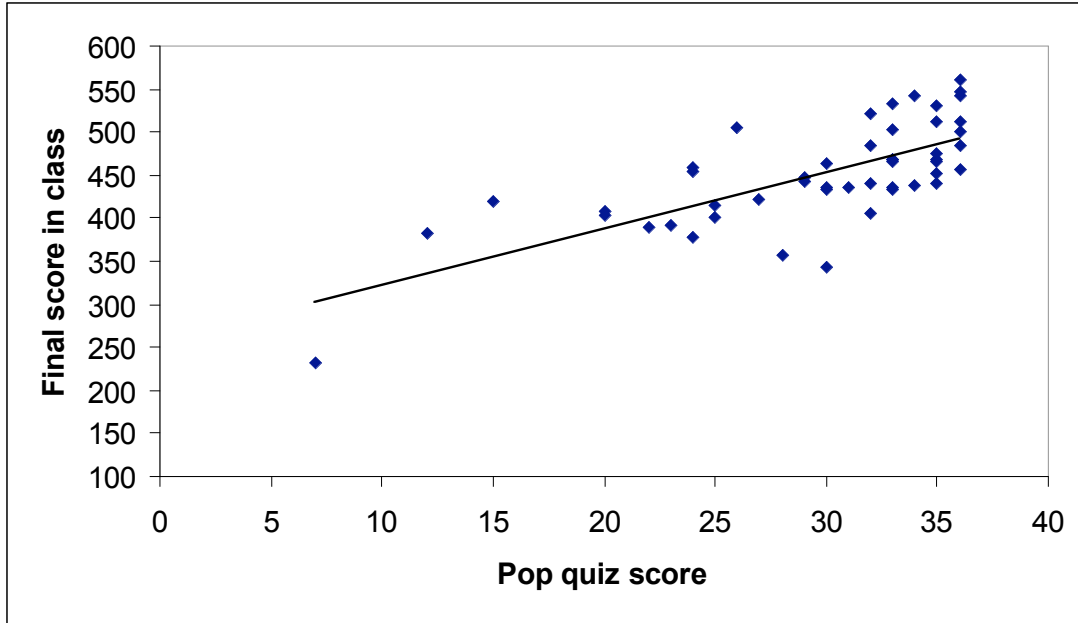
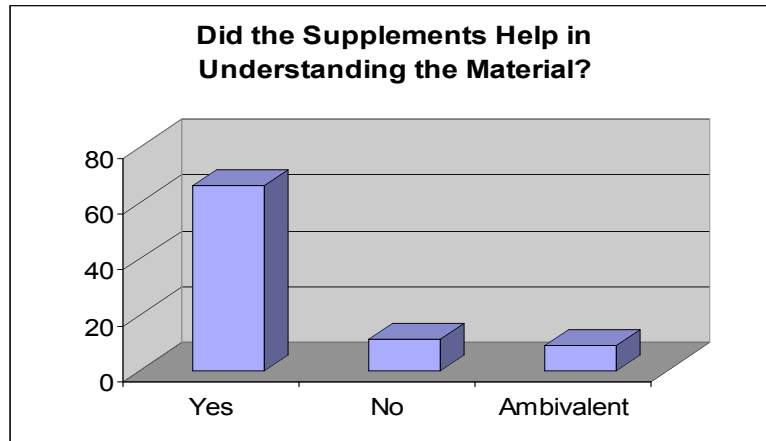
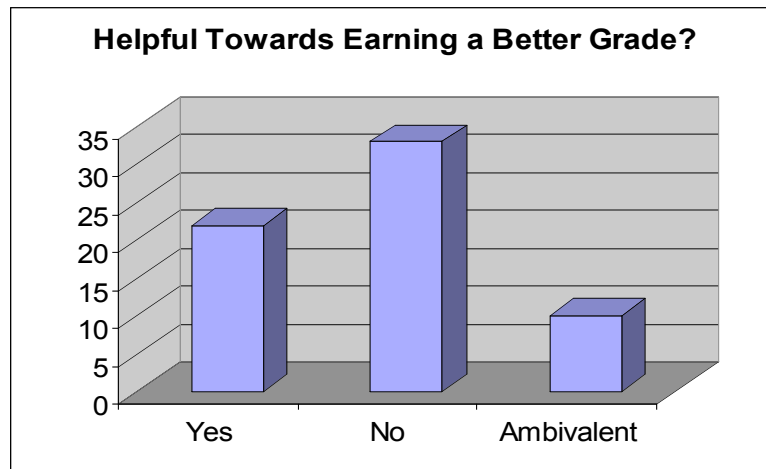


Figure 3

Summary of student responses to questionnaire inquiring about (a) the value of the lab supplements towards understanding the material and (b) how helpful they were towards earning a better grade.



(a)



(b)

Appendix 1

Pop Quiz Questionnaire

1. Have the weekly pop quizzes led you to attend class more regularly than you would have otherwise?
 Yes No I don't know

2. Do you find the pop quizzes challenging and thought provoking?
 Yes No I don't know

3. Has discussing the pop quiz questions with other students made you more likely to study outside of class with the same people?
 Yes No I don't know

4. Do you think the pop quizzes have helped you prepare for the lecture exams?
 Yes No I don't know

5. Do you think the pop quizzes have improved your scores on the lecture exams?
 Yes No I don't know

COMMENTS: