Crossing Over Disciplines: Using a Web-based Soils Module in a Geology Course for Education Majors

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Abstract

A geology course, which targets education majors, used a Web-based PowerPoint soils presentation as an interdisciplinary instruction module. The module was well received by the students and data from comparisons between the pretest, posttest and delayed-posttest show significant knowledge gained. The performance of the students on the posttest and delayed-posttest corresponded to their GPA and their acceptance level to Web-based module instruction. The results demonstrate that modules from one discipline can effectively be used to supplement the material presented in another discipline though asynchronous methods.

Introduction

Since the Internet and PC expansion of the 90's, the use of these tools has become more pervasive throughout society. Studies within universities indicate that students are becoming increasingly proficient with computers as educational tools (Donaldson and Thompson, 1999; Johnson, 2000). In addition, asynchronous technology can be effectively used to supplement natural-science classroom instruction (Partridge and Osborne, 1999; Javenkoski and Schmidt, 2000).

With current reduction in university budgets, the prevailing emphasis is to optimize resources. In the fall and spring of the 2000-2001 academic year, an on-line soils module was used in a geology class attended exclusively by education majors. The inclusion of the soils module into the geology class has three primary advantages. First, expertise from another discipline is tapped in an area where the primary instructor may not be particularly strong. Second, the on-line "lecture" is created once and the guest lecturer does not have to give the same presentation to multiple classes each semester. Third, the Web-based instruction is asynchronous so students can adapt learning the material to their own pace. This scenario is similar to a situation faced by the faculty of the Nematology Department at North Dakota State University. Their department is small, yet they offer classes which are needed for several graduate programs. The department is able to make instructional material accessible to other departments by putting it on the Web and conducting instruction asynchronously (Francl, 1998).

Similar soils modules have been used by the first author for regional county extension agent inservice training (Lippert et al., 1998, 1999, 2000, 2001; Lippert and Plank, 1999). Based on the success of this mode of information delivery, materials focusing on basic soils were adapted for Web-based instruction for university students.

Goals of this project included: 1) to determine if an on-line soils module can be used for asynchronous instruction of students in a different discipline area, i.e., a soils module for education majors, 2) to determine which demographic factors are related to the student performance, and, 3) to receive student feedback regarding acceptance for this method of instruction.

Materials and Methods

A PowerPoint presentation, previously used for various non-technical audiences for more than 10 years, was converted into a Web-based presentation. The Web pages include pop-up text and audio files. The audio files repeat what is in the pop-up text. Because some learners are audio oriented while others are visual or text oriented, both ways of conveying information are available to accommodate both learning styles.

Before studying the module, the students were required to take an in-classroom pretest with 26 multiple choice questions (Table 1). In addition, the pretest included seven demographic questions (Table 2). The geology instructor allowed one week for the students to study the on-line material, then they

completed an in-classroom posttest which included two reaction questions (Table 2). Finally, one month after the first posttest, the students were given the same in-classroom posttest unannounced in order to evaluate knowledge retention. From the group of students, we had 150 complete data sets for analysis. The demographic responses were compared to the test answers using ANOVA (P=0.05). The means within demographic groups were differentiated by LSD.

Table 1. Multiple Choice Questions Used in the Pretest, Posttest and Delayed-Posttest

1. Soil is roughly what percent pore space?
2. The three particle sizes for soil minerals do not include:
3. The smallest soil particle is:
4. A texture triangle tells us:
5. Which statement is true?
6. Clays generally have:
7. Horizons:
8. The soil horizon which loses minerals and clay to the layer underneath it is labeled with the letter:
9. Bedrock breaks up because of:
10. Undeveloped soils have:
11. The five soil forming factors are climate, topography, biology, time and:
12. A soil will develop the fastest when the weather is:
13. Topography refers to:
14. Most organic matter is decomposed by:
15. In general, it takes about how long to form a layer of soil the thickness of a sheet of paper?
16. For plants to grow, they need how many nutrients?
17. Secondary plant nutrients are:
18. Which is correct?:
19. If phosphorus is deficient in the soil, the plant leaves appear:
20. When a plant is deficient in potassium, the leaves:
21. Phosphorus doesn't move through the soil with rainfall because:
22. When a positively charged atom takes the place of another positively charged atom on clay, it is called:
23. An acid soil:
24. Soil acidity is not formed from:
25. For maximum plant nutrient availability, the ideal soil pH should be close to:
26. Erosion always occurs when there is:

Results and Discussion

Responses to demographic questions are shown in Table 2. All but 5% of the students are female. Most of the students are freshmen (55%) with fewer students attending the class as sophomores (26%) and juniors (17%). Their GPA is reported to be mostly B's (56%) with "A" students making up 34% of the group. A strong majority of the students like using computers (92%) and the vast majority (95%) believe that they have average or above average computer skills. About three-fourths of the students never had a class lecture via the Internet.

Table 2. Pretest and Posttest Demographic and Personal Questions, Including Responses (N=150)

Pretest

1. Sex: male (5%), female (95%)
2. What is your GPA? A (34%), B (56%), C (9%), D (0%), prefer not to answer (1%)
3. Class standing: freshman (55%), sophomore (26%), junior (17%), senior (2%)
4. Do you like using computers? Yes (92%), no (5%), not sure (3%)
5. How often do you use a computer? Daily (93%), a few times a week (7%), about once a week (0%), a few times a month (0%), rarely (0%), never (0%)
6. What is your self-assessment of your computer skills? Above average (20%), average (75%), below average (5%)
7. Have you ever had a previous class lecture that was delivered on the Internet? Yes (23%), no (77%)

Posttest

1. Do you like receiving class lectures via the Internet? Definitely yes (21%), moderately yes (63%), not sure (7%), moderately no (4%), definitely no (5%)
2. Was there any part of the information presented that you found difficult to understand or feel should be presented in a different way? (open response)

Table 3 shows the difference in percent knowledge gain between the pretest and posttest, posttest and delayed-posttest, and pretest and delayed-posttest. For ease of reporting, the knowledge gain percentages between the tests are categorized into: 1) Substantial gain (30% and above); 2) Moderate gain (20-29%); 3) Little gain (10-19%); and 4) Negligible or no gain (0-9%). Knowledge scores for all the 26 questions increased from pretest to posttest. Of the 26 questions, 22 showed substantial gains (over 30%) in knowledge scores from pretest to posttest, two questions showed moderate gain (20-29%) and two showed little gain (10-19%). Overall, the knowledge gain score from pretest to posttest ranged from a low of +12% (question 2) to a high of +93% (question 5). As expected, all questions showed a decrease (negative percentage) in knowledge retention from the first posttest to the delayed-posttest. Knowledge scores for all 26 questions increased from pretest to the delayed-posttest. Of the 26 questions, 15 showed substantial gains (over 30%) in knowledge scores from pretest to delayed-posttest, five questions showed moderate gain (20-29%), five showed little gain (10-19%) and one question showed negligible or no gain (0-9%). Overall, the knowledge score gain from pretest to delayed-posttest ranged from a low of +6% (question 2) to a high of +69% (question 5).

As a result of ANOVA comparisons between the demographic data (Table 2) and the posttest and delayed-posttest scores, significant difference between means can be found in few instances. The posttest and delayed-posttest scores correspond positively with GPA. Differentiating the means using LSD showed that for the posttest, the students with a GPA of "A" and "B" formed one group which outperformed the two groups "C" and "prefer not to answer," The LSD analysis of the delayed-posttest data showed that the scores were different between two groups with "A" in one group and "B," "C," and "prefer not to answer" in the second group.

One other demographic parameter from the posttest "Do you like receiving class lectures via the Internet?" shows noteworthy differences with regard to the posttest and delayed-posttest scores. The separation of the means with LSD for the posttest shows two

Table 3. Posttest, Pretest and One-Month Delayed-Posttest Results

Question No.	Difference, %*		
	1	2	3
Q1	71	-40	31
Q2	12	-6	6
Q3	85	-23	61
Q4	47	-9	37
Q5	93	-24	69
Q6	85	-39	46
Q7	22	-6	16
Q8	43	-19	23
Q9	41	-29	11
Q10	38	-11	27
Q11	79	-11	68
Q12	45	-8	37
Q13	18	-7	11
Q14	33	-9	24
Q15	54	-15	39
Q16	55	-23	32
Q17	29	-15	14
Q18	61	-12	49
Q19	85	-34	51
Q20	43	-22	21
Q21	66	-19	47
Q22	53	-10	43
Q23	51	-33	18
Q24	48	-27	21
Q25	54	-25	29
Q26	37	-5	31

* Column 1 is the percentage of students who answered correctly on the posttest minus the percentage of students who answered correctly on the pretest. Column 2 is the percentage of students who answered correctly on the delayed-posttest minus the percentage of students who answered correctly on the posttest. Column 3 is the percentage of students who answered correctly on the delayed-posttest minus the percentage of students who answered correctly on the pretest.
Scale: Substantial gain (30% and above); Moderate gain (20-29%); Little gain (10-19%); Negligible or no gain (0-9%).

different groups with one group responding either "definitely yes," "moderately yes" or "not sure" and the other group responding either "moderately no" or "definitely no." The LSD analysis for the delayed-posttest shows similar results with "definitely yes" and "moderately yes" in one group and "not sure," "moderately no" and "definitely no" in the second group. For this group of students, those who responded more positively to receiving instruction via the Internet received the higher test scores.

Mostly favorable or neutral responses were given to the open-ended question on the first posttest "Was there any part of the information presented that you found difficult to understand or feel should be presented in a different way?" Forty-one percent responded "no", 26% responded that the presentation was well done and easily understood and 10% left the question blank. The following comments fell in a range of 2% to 4% per response: "the audio in addition to the text was helpful", "some charts were hard to follow," "it was advantageous to study the material at a personal pace," "the imbedded quizzes were helpful," "it took a long time to cover all the material," "it would be better if the text were not in a separate pop-up box," "more description was needed for some of the graphs" and "the computer format was undesirable in place of personal instruction."

Summary

Overall, the data and survey responses collected from this study give strong indication that an on-line module from one discipline can be incorporated to supplement another. Since this Web module was created from a PowerPoint presentation, it would not be difficult for instructors to create such a module if they have a PowerPoint or similar presentation readily available. A strong majority of the students were in favor of such a form of instruction and the test scores indicate significant knowledge gained from the technical topic of soil science. The ANOVA shows that, in this case, GPA and acceptance of Web-based instruction corresponds positively to the performance of the students.

Students, who normally perform well with the traditional lecture format, as indicated by GPA, would probably do well with a Web-based module. Based on these results, an instructor would not need to be concerned with the medium (in this case the computer and the Web) influencing the performance of the students. The students who normally do well in traditional lecture classes will also do well with this format; those who don't do as well in traditional classes, will repeat the same performance with Web-based instruction. The other factor, the relation of student acceptance of Web-based instruction to posttest and delayed-posttest results, requires further investigation.

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NACTA Web Page Moves

The NACTA web page has a new home at this new URL (address): www.NACTAteachers.org. If you click on "more" you will see the new web pages that are in progress. If you click on "enter" you will see the original web pages. We felt like the time was right to bring the web page and the Journal together, so we made a move that allows the Journal editor to manage the web pages.

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