Online Soil Science Lessons: A Useful Supplement to Classroom Instruction

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BACKGROUND

Evolving technology and the rise of the interactive World Wide Web offer opportunities for new approaches in teaching methods and delivery. The rationales for developing online Soil Science lessons were: (1) To reinforce the critical need of the Soil Science discipline in today's food, energy, and environmental issues; (2) To meet the needs of the diverse clientele with interest in agricultural and/or non-agricultural disciplines; (3) To overcome, to some extent, the budget and logistical constraints of conducting field observations in college classes. Creation of this set of online soil science lessons is in response to the needs listed above and to improve general interest and motivation in undergraduate soil science education. The online Soil Science lessons are hosted by the UNL *Plant and Soil Sciences elibrary*, a site with 111 lessons and receives over 4 million hits/year.

KEY POINTS

❖ Student performance as measured by post-lesson testing improved significantly over pre-lesson testing in two out of three institutions.
❖ The greatest gains in student test performance were made when online lessons were used as required coursework assignments in the classroom.
❖ The percentage of students answering test item correctly (i.e, item difficulty index) increased post lesson.
❖ Percent of students answering both Bloom's lower level (knowledge and comprehension) and higher level (application, synthesis, analysis, evaluation) questions increased in post lesson testing compared to pre lesson testing.

DEVELOPMENT

❖ Soil science lessons using an independent study, problem-based (case-study) format and an online delivery system were developed in 2005-2006 by instructors at 3 Universities (University of Nebraska-Lincoln, UNL; Colorado State University, CSU; and Oregon State University, OSU).
❖ Format of the lessons was intended to incorporate a broad range of relevant topics in the area of 'Soil Genesis and Development'. A set of 19 Learning Objectives were identified as desired outcomes for students using the lessons.
❖ Application lessons (e-applications or case-studies) included examples from agriculture, environmental science, and ecology.
❖ Principles lessons are intended as a reference base for the 'application lessons', providing necessary content information to successfully interpret, analyze, and recommend solutions for problems presented.

Web Address For Online Lessons
WEB URL: http://plantandsoil.unl.edu/crunctechnology2005/soil_sci/
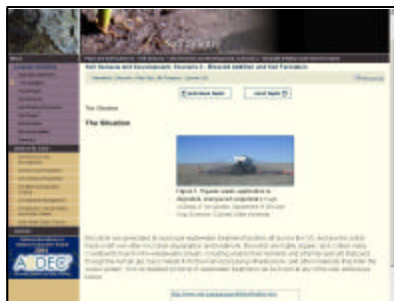
IMPLEMENTATION AND ASSESSMENT

Implementation varied by Institution
❖ UNL – classroom implementation, instructor present. Lessons independently completed by students. Required course assignment.
❖ CSU – completed independently by students, outside of classroom. Optional, extra-credit homework assignment.
❖ OSU – completed independently by students, outside of classroom. Required homework assignment.

Assessment of Learning
❖ Informal implementation of lessons began in Fall 2005 (UNL), with preliminary results and student input used to edit and upgrade lesson functionality and utility.
❖ Formal implementation of lessons made in Fall 2006 at UNL, CSU, and OSU.

Assessment Tools
❖ Student demographic information.
  Class standing, academic major, gender.
❖ Pre and Post Test Format: 50 objective online questions used for both pre- and post- lesson testing.
  75% of test items were knowledge/comprehension
  25% of test items were either application, synthesis, analysis, and evaluation (higher levels Bloom's Taxonomy)
❖ Pre-Lesson Test.
  Given before students began any work on the lessons, and before presentation of any related material in the course. Taken via computer using online testing system.
❖ Post-Lesson Test.
  Same as pre-test, taken immediately upon completion of three e-application lessons (case-studies).
❖ Learning Styles Inventory: Kolb, LSI.
  A self- taken survey of 12 questions intended to describe the way a person learns, and how he/she deals with ideas and day-to-day situations in life (D.A. Kolb, 1993).
❖ Post-lesson user survey.
  In-depth survey covering lesson-users experience with the online lessons. 54 questions.
❖ Course grades (UNL only).
  Student grades for the entire semester soils course correlated with the student performance using the online lessons.

OUTCOMES

❖ UNL pretest scores were lower than CSU and OSU possibly due to student background preparation level at UNL.
❖ The greatest gain in performance (posttest vs. pretest) was at UNL with an average gain 10.5 points (Fig. 1).
❖ Posttest scores at UNL and OSU improved significantly compared to pre-test scores at UNL and OSU (Fig. 1).
❖ Post baccalaureate students (N = 5) at UNL outperformed undergraduate students on the pretest, however, the posttest performance was similar among all class-standing with the most gain made by sophomores.
❖ At UNL, pretest performance was similar among majors, although not significantly different from the others. Professional Golf Management majors (N = 12) made the highest average score and most gain (17 points) from pretest to posttest. The Least average gain (9 pts) was made by Horticulture majors (N = 18).
❖ There were no differences in either pretest and posttest performances between gender (20% female, 80% male)
❖ On average, 49% of students answered Bloom's lower level pretest questions correctly. This increased to 74% answering correctly for the posttest.
❖ On average 40% of students answered Bloom's higher level pretest questions correctly. This increased to 58% answering correctly for the posttest.
❖ There was correlation also of pretest or posttest to final course performance at UNL (Fig. 2).
❖ There was no correlation between test (pre- or post) and student attitude, class standing, learning style or gender (Table 1).
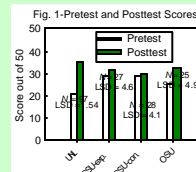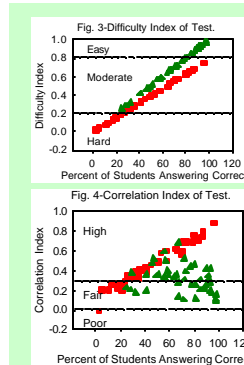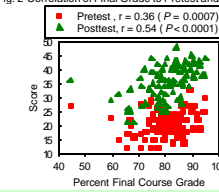

Fig. 1-Pretest and Posttest Scores.

Fig. 2-Correlation of Final Grade to Pretest and Posttest, UNL.
Pretest, r = 0.36 (P = 0.0007)
Posttest, r = 0.54 (P < 0.0001)

Example Test Question

Example Test Question

Example Test Question

Example Within Lesson Question

Example Within Lesson Question

Fig. 3-Difficulty Index of Test.

Fig. 4-Correlation Index of Test.

Test Item Analysis

❖ Test had good internal consistency
  Pretest Reliability: 0.92
  Posttest Reliability: 0.79
❖ ~25% test item hard pre-lesson (Fig. 3)
❖ Test correlation was fair to high (Fig. 4)
❖ No test item was easy pre-lesson (Fig. 3)
❖ No test item was hard post-lesson (Fig. 3)
❖ ~36% of test item was easy post-lesson

Table 1 -Spearman Correlation, r, at UNL

	Posttest	Attitude	Class Standing	LSI	Gender
Pretest	0.22*	-0.030	0.076	-0.032	0.081
Posttest		-0.124	0.009	0.133	0.034

* Significant at 0.05 or less.

CONCLUSION

❖ Student motivation is an important element of the learning process, and online lessons can help to stimulate motivation.
❖ Lessons can be a useful tool to earth science educators, although additional creative strategies may be needed to enhance student engagement in lessons such as developing case studies in multi-user virtual environment (MUVE).