



BACKGROUND

Evolving technology and the rise of the interactive World Wide Web offer opportunities for new approaches in teaching methods and delivery.

Creation of this set of online Soil Science lessons is a response to a need to improve general interest and motivation in undergraduate soil science education, and to update course content to meet the needs of a changing clientele.

Lesson Development

Soil science lessons using an independent study, problem-based (case-study) format and an online delivery system were developed in 2005-06 by instructors at 3 Universities (UNL, CSU, and OSU).

Format of the lessons were intended to incorporate a broad range of relevant topics in the area of 'Soil Genesis and Development'. A set of 21 '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.

*Lessons were created with the intention of stimulating student interest and promoting deeper understanding and enhanced retention of soil science knowledge.



Learning Objectives For Soil Genesis and Development Online Lessons

1. Classify rocks according to the major rock types.
2. Describe the influence of parent material on soil properties.
3. Define and distinguish physical, chemical, and biological weathering processes.
4. Describe how rock and mineral properties and environmental factors influence the weathering of rocks and minerals into soil.
5. Identify the 5 factors of soil formation and distinguish between the active and passive factors.
6. Explain the effect of climate on soil profile characteristics.
7. Identify the effects of biota/organisms on soil formation.
8. Interpret the influence of topography on soil development.
9. Given different parent materials, state the mode of transportation or environment of deposition. Discuss how the type of parent material affects material sorting within a soil.
10. The student will be able to describe the four major processes of soil formation.
11. The student will be able to describe how these four processes redistribute soil materials in vertical and horizontal dimensions.
12. The student will be able to explain which soil processes are dominant in each soil horizon.
13. The student will be able to develop a profile horizon sequence based on given soil properties.
14. The student will be able to describe the general conditions that led to the development of a given soil profile.
15. Identify and describe the 12 soil orders, and the defining characteristics of each.
16. Locate where different soil orders are found (national, state, local scale) and identify current land use.
17. To identify and describe the roles/functions of soil in the global ecosystem.
18. Describe cultural and Environmental Factors that Enhance or Degrade Soil Quality
19. To identify defining characteristics of the 12 soil orders and locate their occurrence using the world soil regions (orders) map.

Web Address For Online Lessons

WEB URL: http://plantandsoil.unl.edu/cropstechnology2005/soil_sci/



IMPLEMENTATION & ASSESSMENT

Lesson Implementation

Implementation varied by institution

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

Assessment of Learning

- Voluntary/partial implementation of lessons began in Fall 2005 (UNL), with preliminary results and student input used to edit and upgrade lesson functionality and utility.
- Full implementation of lessons made in Fall 2006 at UNL, CSU, and OSU.

Assessment Tools

- o Pre-Test.

50 objective questions covering set of 21 learning objectives identified for the lessons. Given before students began any work on the lessons, and before presentation of any related material in the course. Taken via computer using online 'EDU' testing system.

- o Post-Test.

Same as pre-test, taken immediately upon completion of three e-application lessons (case-studies).

- o Learning Styles Inventory: Kolb, LSI.

A self-taken survey of 12 questions intended to describe the way a person learns, and how they deal with ideas and day-to-day situations in life (D.A. Kolb, 1993).

- o Post-lesson user survey.

In-depth survey covering lesson-users experience with the online lessons. 54 questions.

- o Course grades (UNL only).

Student grades for the entire semester soils course correlated with the student performance using the online lessons.

- o Student demographic information.

ASSESSMENT OUTCOMES

Table 1. Pre and Post Test Scores and Descriptive Statistics From Colorado State (CSU), Oregon State (OSU), and the University of Nebraska (UNL).

	CSU			OSU			UNL		
	Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff
Mean	29	31	2	26	33	7	21	35	14
Median	29	32	2	26	34	7	21	36	13
std dev	7	8	6	7	10	7	5	6	7
Note: Min Score = 0									
Mean %	58	63	4	52	65	14	42	71	29
Median%	58	64	4	52	68	14	42	72	26
Std Dev%	13	16	12	15	19	14	9	12	13
Note: Max % = 100%									

Statistical Comparisons Within and Among Institutions

1 Pre-Test Comparisons

- For CSU and OSU, there was no difference in pre-test scores (p-value=0.1917), CSU ave. = 28.6/50, and OSU ave. = 25.8/50
- UNL pretest scores were significantly lower than either CSU or OSU UNL ave. = 20.9 (p-value<0.0001)

Interpretation:

Students utilizing the online lessons at both CSU and OSU began the lessons with significantly greater background knowledge of the subject than did students at UNL. This could be attributed to students at those schools being enrolled in a more advanced academic class (100 level at UNL, 200 level at CSU, and >200 level at OSU) and/or to having a greater percentage of upperclassmen enrolled in their courses than UNL.

2. Post-Test Comparisons

- For institutions using the web lessons as homework, there was a moderate difference between CSU and OSU (p-value=0.0521), with OSU students seeing an average improvement of 3.95 points more than CSU students.
- For all web sections (CSU, OSU, UNL), there was a difference between institutions (p-value<0.0001). A contrast of web lessons in class versus homework showed that in-class lessons (i.e. UNL) showed an improvement of 9.55 points more than homework lessons (p-value<0.0001).
- UNL showed significantly more improvement than either OSU or CSU.

3. Post-Test Analyses Using ONLY UNL Data

- There was no effect of Class standing (p-value=0.1288). Sophomores saw the most improvement (LSMean=16.5), but it was not significantly different from the others.
- There is a correlation of 0.42540 between posttest score and final course grade. This correlation is significantly different from 0 (p-value<0.0001).

CONCLUSION

- Online lessons can be a useful tool to soil science educators.
- Student learning as measured by post-lesson testing showed that the greatest gains were made when online lessons were used as required coursework, in the classroom, with the instructor present.
- Student motivation is an important element of the learning process, and online lessons can help to stimulate motivation, but cannot serve as a substitute for individual interest and effort.