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# Improving teaching: Instructional self-assessment across a large introductory undergraduate class

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**Abstract:**
Researchers have suggested that pretests might be a useful approach for self evaluating instruction. However, to our knowledge, few studies have collected pretest and posttest data beyond a single semester and have not used pretest results to inform subsequent versions of the same class across semesters. Over two semesters and using a two-stage approach, we collected data from undergraduate students enrolled in a large introductory natural resource course. In the first stage, all students were given a pretest consisting of 20 multiple-choice questions to assess their prior knowledge of the subject matter. Additionally, five Likert-scale questions were given to assess feelings about popular environmental issues. In the second stage, conducted at the end of the semester, students were given an identical posttest and a required questionnaire regarding course improvement. Following the first semester, course modifications were made based on results from the course improvement questionnaire. Results of the multiple-choice test indicated learning occurred both semesters and results of the Likert-scale test indicated a positive change in attitude regarding environmental issues. Additionally, course satisfaction increased from the first to the second semester. Pretests and student feedback are a useful method for informing formative course redesign, improving teaching, and enhancing student learning.

**Keywords:**
natural resources, pretesting, self-assessment, teaching improvement, undergraduate

## Introduction

Although student evaluation of instruction is one of the cornerstones of teaching evaluation in higher education and often used to assist in decisions related to reappointment, promotion, and tenure, instructors are prone to focus primarily on the overall results of the data rather than to use student evaluations to improve future versions of their courses (Arthur *et al*., 2003, Centra, 1973). Certainly, generic evaluation forms shed light on how students perceive particular courses, instructors, and instructional approaches, but evaluations have tended to be interpreted as summative rather than formative instruments. This article focuses on how instructors can evaluate their teaching by employing a pretest and posttest design and outlines how student course evaluations can be used for on-going instructional self-assessment.

*Why and how to evaluate teaching?*

Broadfoot and Black (2004) have noted that we are experiencing an "assessment revolution" in higher education: "… We have become an "assessment society" as wedded to our belief in the power of numbers, grades, targets and league tables to deliver quality and accountability, equality and defensibility as we are to modernism itself. History will readily dub the 1990s … — as well as the early years of the new millennium — 'the assessment era', when belief in the power of assessment to provide a rational, efficient and publicly acceptable mechanism of judgment and control reached its high point" (p. 19). Although evaluation and assessment have gained increased recognition and importance in higher education, how the two are similar and different from one another is not always clear. According to Herron and Wright (2006) assessment is distinct from evaluation because assessment focuses on student learning and evaluation focuses on programmatic issues. Further, assessment measures learner readiness, formative progress, and summative learning outcomes. Common assessment strategies include behavioral observation, project grading, and testing (Anderson and Krathwohl, 2001, Orlich *et al*., 2006).

Notably, several researchers have explored the use of evaluation for instructor learning, rather than for summative purposes (Kemp and Kumar, 1990, Marsh, 1987). This distinction is important in the context of learning, teaching, and assessment because — while much attention is paid to the outcomes of activities in terms of student results — less energy is expended in discovering how well they are implemented (Macdonald, 2006). That is, we define self-evaluation after Macdonald (2006), who describes a professional, reflective practitioner curious about the impact of efforts to improve the quality of student learning (p. 11). The benefits of systematically attending to our instruction are numerous, including the production of more positive, engaged interactions with learners, the clarification of conceptual principles critical to the communication of our discipline, and the facilitation of the multiple professional roles that higher education faculty are increasingly expected to inhabit (Beaty, 1999).

Within higher education, a common and institutionally-supported approach to
teacher-evaluation is to have students complete generic scantron-ready answer sheets in response to standardized questions that are not specific to a particular course or instructor (Abrami, *et al*., 1991). Of these student course evaluation processes, Watrous (2003) asks

> What do I learn from these surveys when they are returned to me? Not much. It is true that after answering a number of multiple choice questions, students are asked if they want to write a sentence or two about what they liked or disliked about the classes being reviewed. If I generally find these responses less than enlightening, perhaps it is because students usually rush to complete the forms and because the questions asked in the forms are not specific to my classes or my teaching. Typical responses in the past have included: "This class rocked," or "I didn't deserve that 'C' last term." These questionnaires may help the college to evaluate my work in a global sense, but they add little to my understanding of how I should proceed as a teacher (p. 54).

Thus, course-end generic evaluation-questionnaires may not fully serve the need of professionals who want to improve their teaching standards. These types of professionals are interested in what Fink (2003) refers to as "forward-looking assessment," the careful consideration of how students will use what they teach and how they need to organize their materials to facilitate student learning fully. Beaty (1999) recommends that instructors reflect carefully on their instructional practices as part of the teaching process: "In order to improve, a teacher needs to learn from experience over time. Experience does not of itself improve practice. Rather, thoughtful and critical reflection on previous practice invokes the necessary learning and change" (p. 52). Finally, in addition to teacher reflection, Kolb's (1984) experiential learning cycle stresses that the roles of experience, reflection, and the formalization of abstract concepts are not sufficient to initiate change — ultimately, active experimentation is a critical part of the instructional learning cycle.

Although most evaluation in higher education takes the form of end-of-semester standardized questions that evaluate general past-performance, it is important to note that faculty are not resistent to the use of formative evaluation to improve their teaching (Schmelkin, *et al*., 1997). Indeed, several models designed to improve teaching do exist. Hirst and Blomquist (1994) describe a peer-coaching model for professional educators to help improve their teaching but the drawbacks of this model are the need to find another educator with the same goals who is willing to work in a collaborative manner. Hubball *et al*.(2004), similarly, describe how faculty learning communities can provide an informal means of supporting instructional development, sharing, and self- and peer-assessment. Activities related to what they refer to as "authentic assessment" involve on-going engagement in one's teaching process, careful planning and follow-up related to instructional activities, and individual and social interactions related to teaching (p. 91). Other models used to improve instruction include peer coaching with specific feedback, instructional consultation, action learning research, situated learning strategies, and alternative strategies (Watrous, 2003, Hirst and Blomquist, 1994, Beaty, 1999, Weston and McAlpine, 1999).

In the specific feedback model, two instructors meet before a lecture and discuss specific objectives and teaching strategies, whereupon the peer observes the lecture to provide comments and feedback on the specific goals (Hirst and Blomquist, 1994). Instructional consultation takes the generic consultation process which generally targets individuals and is conducted by staff to a more integrated discipline-based approach with departmental and faculty involvement (Weston

and McAlpine, 1999). Situated learning is an active approach to teaching improvement where the instructors learn the instructional design process of identifying learning outcomes, instructional strategies, and evaluation of learning by attending an intensive workshop. At the workshop the attendees implement their learning by re-designing one of their courses to reflect the principles being taught. Situated learning follows the belief that, as Weston and McAlpine (1999) summarize, "generic principles are understood and implemented much more readily when they have been contextualized and situated through immediate application to the teacher's own situation" (p. 88). Action learning is a peer-based approach to teaching consultation and is a continuous process of learning and reflection, with an intent to promote change and improvement (Beaty, 1999). Finally, Watrous (2003) describes an alternative strategy of having students write evaluation letters, using Gartrell's (1997) compliment-sandwich, where students start and end the letter with a brief overview of what they liked in the class related to teaching methods and a detailed middle filled with what they did not like about the course and instruction and how it can be improved. Watrous (2003) thus concludes, "I not only asked for constructive criticism, I required it" (p. 54).

*Use of Pretests and Posttests for Student Learning and Self-Evaluation*

Self-evaluation follows the basic principles of instructional design. The focus is on content (what is the subject matter of the course), learning outcomes (what should the students learn about each concept), instructional strategies (what approaches are used to facilitate learning), and evaluation of learning (assessment of whether the desired learning has occurred) (Weston and McAlpine, 1999).

Research suggests that pre-instructional strategies significantly aid and facilitate subsequent learning (Hartley and Davies, 1976, Jonassen *et al*., 1990). Hence, pre-instructional strategies such as, pretests, behavioral objectives, advance organizers, and course overviews are useful for facilitating learning. As Hartley and Davies (1976) suggest, "In this sense, pretests, *alert*, behavioral objectives *inform*, overviews *prepare*, and advance organizers *clarify*" (p. 246).

Of all the pre-instructional strategies, pretests have a sound theoretical base, with much research devoted to their value, efficacy, construction, and drawbacks with regards to evaluating student learning. They give direction to learning by providing an anticipatory or introductory role, and by setting the psychological expectation (Hartley and Davies, 1976). Further, pretests may be defined as related questions, administered before instruction, that are directly relevant to the knowledge, attitude, or skill domain to be acquired (Hartley and Davies, 1976). Also, pretests stress major points and alert learners to important issues (Rodin *et al*., 1978). Pretests are occasionally used as motivational instruments to encourage enthusiasm and acceptance of the program, mostly because they enhance cognitive learning during the length of the course and result in improved learner attitudes (Rodin, *et al*., 1978).

Thus, pretests and posttests, similar to other pre-instructional strategies, have been used to measure learning and knowledge acquisition. However, limited research has been conducted to assess their use as a self-evaluation tool that benefits teaching, apart from their empirical

usefulness. Elkins (1978) used pretests in an introductory course consisting of students with diverse educational backgrounds, with the goal of obtaining a knowledge-baseline of what the students already knew about the subject. The study showed that most students were ill-equipped to fully comprehend terminology used in the introductory courses. Evaluations from the pretests were then used to adjust teaching methods by developing supplemental self-instructional materials, including additional statements to explain a procedure or emphasizing key words and developing a hand-out of definitions (Elkins, 1978). Another study by Simkins and Allen (2000), involving 179 students enrolled in a principle of macroeconomics course, evaluated student knowledge prior to the course with their end of semester final examination performance. Results were used to redesign the course organization and focus, however, Simkins and Allen (2000) did not report on whether or not the redesign of their course resulted in improved student learning beyond a single semester. Finally, Leckey and Neill (2001) recommend collecting information about the effectiveness of a course. They note the information "can be used as diagnostic feedback to academic staff to assist them in the enhancement of the quality of their teaching performance" (p. 25), but do not support their argument with empirical data.

Our research builds on the work of Elkins (1978) and incorporates contemporary instructional design principles to evaluate student learning using pretests and posttests. Our goal is to contribute to the growing body of research related to student course evaluations (Feldman, 1997, Kember *et al*., 2002) and to explore one particular approach to formative evaluation — pretesting and posttesting — of instruction across semesters.

**Methods**

The research was conducted at a large, Southeastern Land grant university and was a quasi-experimental study where qualitative and quantitative survey instruments were used. Data were collected over two semesters (Spring 2005 and Fall 2005), with identical collection processes and instruments organized into two stages.

The first study involved a large introductory undergraduate natural resource course with students enrolled from numerous majors. The instructional format was primarily lecture-based and, originally, the lecture notes were not provided to students. Student grades were determined from two examinations consisting of approximately 75 questions that included true/false, multiple choice, fill-in-the-blank, listing, short answer, and essay questions. In addition, a comprehensive final examination was administered at the end of the semester that consisted of 100 multiple-choice questions. A written project was assigned that required students to select a natural resource issue of their choosing and, using eight empirical sources, compose an 8-page double-spaced paper that included a pro, con, and opinion section. The attendance policy for the course was ten random paragraphs assigned throughout the semester that contributed to approximately ten percent of the overall grade.

In the first stage of this study, all students present during the first day of class were given a pretest. The pretest contained 20 multiple-choice questions, reflecting the salient points of what was to be learned in the course and a five-question Likert-scale test to assess the level of agreement or

disagreement of students with five natural resource conservation issues (i.e., recycling, world hunger, hunting and fishing regulations, alternative energy and water and air pollution). The pretest served as the baseline for student knowledge of natural resource conservation issues. The pretest and Likert-scale test were not returned to the students.

The second stage was conducted at the end of the semester. All students present were given a posttest identical to the pretest consisting of the exact 20 multiple-choice questions and the five Likert-scale questions. Additionally, a questionnaire regarding course improvement was administered in which students were required to answer and explain their stance. The answers were intended to evaluate certain aspects of the course and aimed at improving the course in the future.

The course-improvement questionnaire consisted of the following questions:

1. Did the lecture format used in this class help you understand the material?
    i. If yes, why?
    ii. If no, why?

2. Did the paper project help you understand the pros and cons of environmental issues?
    i. If yes, why?
    ii. If no, why?

3. Do you believe the exam format fairly assess your knowledge of the course material?
    i. If yes, why?
    ii. If no, why?

4. Changes for next semester may include;
    a. Posting notes on the web or emailing them in advance
    b. Altering the paper project
    c. Changing attendance requirements
    d. Requiring participation in local environmental activity.

    Do you believe these changes will positively or negatively impact the course?
    i. If yes, why?
    ii. If no, why?

Following the first semester (Spring 2005), changes were made to the course based on results from the course improvement questionnaire. Changes included posting half of the lecture notes online and e-mailing them to the students, shortening the exams from 75 to 50 questions, instituting an exam review period, and focusing and reducing the paper project from eight to four pages.

For the 20 multiple-choice questions, data were summarized for the entire class. Additionally, a paired t-test was conducted to compare test results for students that took both the pretest and pos-test. The Likert-scale questions were summarized as percent responses. Also, answers to the course-improvement questionnaire were summarized as percents.

**Results**

The pretest and posttest scores for the 20-question subject test are shown in Appendix 1 for Spring 2005 and in Appendix 2 for Fall 2005. Also, the table indicates the number and percent of correct and incorrect responses for each of the 20 questions and the totals of the Pre-Right, Pre-Wrong, Post-Right and Post-Wrong. Graphical representations of the pre- and post-tests results for both semesters are represented in Figures 1 and 2.

*Spring 2005 Semester*

Pre- and Post-Test

During Spring 2005, a total of 74 students took the pretest with an average score of 15 out of 27 (55.56%) correct (range 9-21) (Figure 1). Conversely, a total of 60 students took the posttest with an average score of 19 out of 27 (70.37%) correct (range 10 - 24). When direct comparisons were made between students (n = 47) that took both the pretest and posttest, the scores were 15 (55.56%, range 9-20) and 19 (70.37%, range 10-24), respectively. Additionally, when a paired t-test was conducted the pretest and posttest were significantly different ($t = 8.089$, $df = 46$, $p < 0.001$).

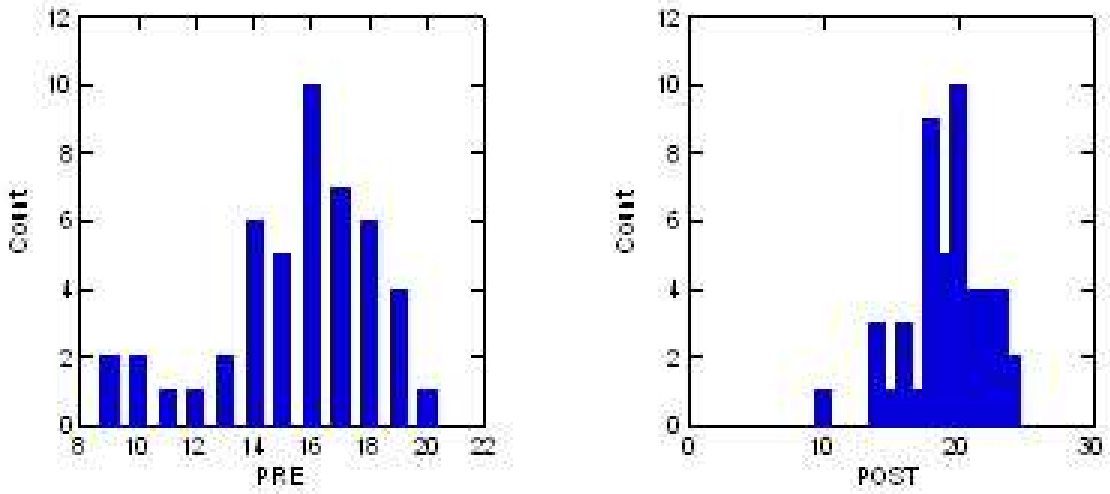


Figure 1. Results of the 20-question pre- and post-test for Spring 2005.

Likert-scale Multiple-Choice

Results of the five Likert-scale multiple-choice test regarding the student's stance on natural conservation issues during Spring 2005 is represented in Table 1. A total of 74 students took the pretest and 60 students took the posttest. Students indicated a stronger level of agreement during the posttest compared to the pretest concerning important local and global issues.

Table 1. Likert-scale (percent) responses for the pretest and posttest during Spring 2005.

| Pretest | Strongly Agree | Somewhat Agree | Neutral | Somewhat Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| | | | | | |
| Question 1 | 40.8 | 50.0 | 7.9 | 1.3 | 0.0 |
| Question 2 | 40.8 | 48.7 | 5.3 | 3.9 | 1.3 |
| Question 3 | 68.4 | 26.3 | 5.3 | 0.0 | 0.0 |
| Question 4 | 67.1 | 28.9 | 3.9 | 0.0 | 0.0 |
| Question 5 | 64.5 | 23.7 | 10.5 | 1.3 | 0.0 |
| | | | | | |
| Posttest | A | B | C | D | E |
| | | | | | |
| Question 1 | 54.1 | 36.1 | 6.6 | 1.6 | 1.6 |
| Question 2 | 52.5 | 27.9 | 9.8 | 6.6 | 3.3 |
| Question 3 | 83.6 | 14.8 | 1.6 | 0.0 | 0.0 |
| Question 4 | 72.1 | 23.0 | 1.6 | 3.3 | 0.0 |
| Question 5 | 73.8 | 18.0 | 6.6 | 1.6 | 0.0 |

Teaching Improvements

During Spring 2005, 68 out of 91 students responded to the questionnaire. Results of the course-improvement questionnaire were as follows:

1) Did the lecture format used in this class help you understand the material?
    1) If yes, why?
    2) If no, why?

A total of 58 (85.3%) individuals indicated the lecture format used in this class helped them understand the material. A total of 4 (5.9%) individuals indicated *yes and no* the lecture format used in this class helped them understand the material. Comments included that it was difficult to rush to write down the notes, especially at 8:00 am, and lectures were sometimes lengthy and difficult to hear. A total of 6 (8.8%) indicated the lecture format used in this class did not help them understand the material. Comments included that class ended up being dominated by note-taking, that little time was left for questions, that notes should be made available online, and that notes contained too much information.

2) Did the paper project help you understand the pros and cons of environmental issues?
    1) If yes, why?
    2) If no, why?

A total of 63 (92.6%) individuals indicated the paper project helped them understand the pros and cons of environmental issues. A total of 5 (7.4%) individuals indicated the paper project did not

help them understand the pros and cons of environmental issues. Comments included the paper felt random, it was difficult to understand the arguments against protecting wildlife, and that writing the paper was disliked in general.

3) Do you believe the exam format fairly assessed your knowledge of the course material?
    1) If yes, why?
    2) If no, why?

A total of 45 (66%) individuals indicated the exam format fairly assessed their knowledge of the course material. A total of six (8.8%) individuals indicated the exam format somewhat fairly assessed their knowledge of the course material. Comments included that a few questions were confusing, but for the most part that they were fair, yes and no, some of the material was hard and we had to know details but there was so much material on each test, for the most part, yes, essays counted too much, some questions were too difficult for this level, and that the variety of questions was overwhelming. A total of 17 (25%) individuals indicated the exam format did not fairly assess their knowledge of the course material. Comments included that the exams were extremely hard, contained too much information, too many questions, were too long, that only two exams were given, that they were very challenging, too broad, too detailed, and obscure, involved too much memorization, were unfair, were weighted unevenly, were not multiple choice, involved questions taken directly from the book, and were too hard.

4) Changes for next semester may include
    1) Posting notes on the Web or e-mailing them in advance
    2) Altering the paper project
    3) Changing attendance requirements
    4) Requiring participation in a local environmental activity

    Do you believe these changes will positively or negatively impact the course?
    If yes, why? If no, why?

A total of 64 students responded to 4(1). A total of 49 (76.6%) individuals indicated that posting notes on the Web or e-mailing them in advance would positively benefit the course. However, eight (16%) of the individuals that answered that posting notes on the Web or
e-mailing them in advance would positively benefit the course qualified their answer by stating the attendance policy would need to be adapted to account for skipping class. A total of 15 (30.6%) individuals indicated that posting notes on the Web or e-mailing them in advance would negatively benefit the course.

A total of 44 students responded to 4(2). A total of 14 (31.8%) individuals indicated that altering the paper project would positively benefit the course. A total of 30 (68.2%) individuals indicated that altering the paper project would negatively benefit the course.

A total of 40 students responded to 4(3). A total of 19 (47.5%) individuals indicated that changing attendance requirements would positively benefit the course. Additionally, 4 (21%) of those individuals that indicated changing attendance requirements would positively benefit the course

qualified their answer by stating the attendance policy would need to be stricter. A total of 21 (52.5%) individuals indicated that changing attendance requirements would negatively benefit the course.

A total of 50 students responded to 4(4). A total of 35 (70%) individuals indicated that requiring participation in a local environmental activity would positively benefit the course. Additionally, two (5.7%) of those individuals that indicated requiring participation in a local environmental activity would positively benefit the course qualified their answer by stating only if for extra credit. A total of 15 (30%) individuals indicated that requiring participation in a local environmental activity would negatively benefit the course. Additionally, two (6.7%) of those individuals that indicated requiring participation in a local environmental activity would negatively affect the course qualified their answer by stating only if for extra credit.

*Fall 2005*

Pre- and Post-Test

During Fall 2005 a total of 75 students took the pretest with an average score of 14 out of 27 (51.95%) correct (range 7-23) (Figure 2). Conversely, a total of 53 students took the posttest with an average score of 21 out of 27 (76.24%) correct (range 8-25). However, when direct comparisons were made between students (n=47) that took both the pre- and post- tests, the scores were 15 (55.71%, range 7-23) and 21 (76.67%, range 8-25), respectively. Additionally, when a paired t-test was conducted the pretest and posttest were significantly different
($t = 11.256$, $df = 46$, $p < 0.001$).

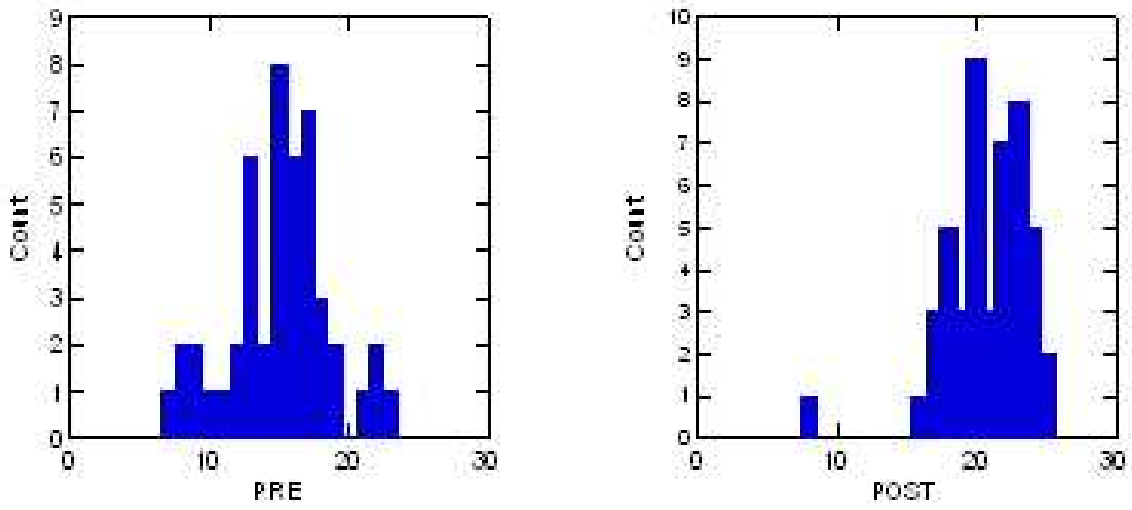


Figure 2. Results of the 20-question pre- and post-test for Fall 2005.

Likert-scale Multiple-Choice

Results of the five Likert-scale multiple-choice test regarding the students' stance on natural conservation issues during Fall 2005 is represented in Table 2. A total of 74 students took the

pretest and 60 students took the posttest. Regarding questions 1 and 2, students indicated equivalent levels of agreement between the pretest and posttest. However, on questions 3, 4 and 5, students indicated a stronger level of agreement during the posttest compared to the pretest concerning important local and global issues.

Table 2. Likert-scale (percent) responses for the pretest and posttest during Spring 2005.

| Pretest | Strongly Agree | Somewhat Agree | Neutral | Somewhat Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| | | | | | |
| Question 1 | 44.0 | 50.7 | 2.7 | 2.7 | 0.0 |
| Question 2 | 54.7 | 33.3 | 9.3 | 2.7 | 0.0 |
| Question 3 | 69.3 | 26.7 | 4.0 | 0.0 | 0.0 |
| Question 4 | 65.3 | 28.0 | 4.0 | 2.7 | 0.0 |
| Question 5 | 72.0 | 24.0 | 1.3 | 2.7 | 0.0 |
| | | | | | |
| Posttest | A | B | C | D | E |
| | | | | | |
| Question 1 | 28.3 | 66.0 | 1.9 | 3.8 | 0.0 |
| Question 2 | 58.5 | 30.2 | 5.7 | 5.7 | 0.0 |
| Question 3 | 79.2 | 15.1 | 1.9 | 3.8 | 0.0 |
| Question 4 | 69.8 | 26.4 | 3.8 | 0.0 | 0.0 |
| Question 5 | 81.1 | 18.9 | 0.0 | 0.0 | 0.0 |

Teaching Improvements

During Fall 2005, 53 out of 74 students responded to the questionnaire. Results of the course-improvement questionnaire were as follows:

1) Did the lecture format used in this class help you understand the material?
    1) If yes, why?
    2) If no, why?

A total of 50 (94.3%) individuals indicated the lecture format used in this class helped them understand the material. A total of three (5.7%) individuals indicated *yes and no* the lecture format used in this class helped them understand the material. Comments included that it was nice to have the notes but that they felt discouraged from reading the textbook material, that the short Powerpoint titles made the material hard to review, and that the lecture format made it much easier to skip class.

2) Did the paper project help you understand the pros and cons of environmental issues?
    a. If yes, why?
    b. If no, why?

A total of 47 (88.7%) individuals indicated the paper project helped them understand the pros and cons of environmental issues. A total of four (7.5%) individuals indicated the paper project did not help them understand the pros and cons of environmental issues. Comments included that they already knew or wrote about the topic in another class and that they did not spend as much time on the paper as they should have. A total of two (3.8%) individuals indicated yes and no when asked whether or not they found the paper project helpful with regard to understanding the pros and cons of environmental issues. Comments included that it was hard for me to present the information gathered in my project and I found it frustrating because other students with the same topic were able to find information that I was unable to find. One individual of the 47 indicated that a peer review session for the paper would be beneficial to provide exposure to other environmental topics.

3) Do you believe the exam format fairly assessed your knowledge of the course material?
    a. If yes, why?
    b. If no, why?

A total of 41 (77.4%) individuals indicated the exam format fairly assessed their knowledge of the course material. A total of 10 (18.9%) individuals indicated the exam format somewhat fairly assessed their knowledge of the course material. Comments included yes and no, the exam required more memorization than anything, the multiple choice was good but the essay questions were too broad, and the exam was fair but I knew more of the information than my grades reflected. Other comments included, I don't like essays, the open ended seemed unfair because you were looking for something in the answer that was not asked for in the question, and the essays were worth a little much. Various other comments included, yes the exam format was fair, however it was hard for me to study for the tests because there was too much information, the number of open ended questions were too many, the exam had too much writing, and sometimes it seemed like the material I studied most was not on the exam.

A total of 2 (3.8%) individuals indicated the exam format did not fairly assess their knowledge of the course material. Comments included, the exams covered too much material and were hard to prepare for, more true/false and multiple choice questions would be helpful and no, I did not like listing a given number of examples, I would know the topic but only be able to come up with three out of four examples, I prefer short answer. Two (3.8%) individuals felt the exam format fairly assessed their knowledge of the course material and suggested possibly adding an essay bank and a pre-exam review session.

4) Changes for next semester may include;
    a. Posting notes on the web or e-mailing them in advance
    b. Altering the paper project
    c. Changing attendance requirements
    d. Requiring participation in a local environmental activity

    Do you believe these changes will positively or negatively impact the course? If yes, why? If no, why?

A total of 51 students responded to 4 (1). A total of 39 (76.5%) individuals indicated that posting notes on the web or e-mailing them in advance would positively benefit the course. However, eight (15.7%) of the individuals answered that posting notes on the web or e-mailing them in advance would positively benefit the course but also stated attendance would decrease. A total of four (7.8%) individuals indicated that posting notes on the Web or e-mailing them in advance would negatively impact the course. Comments included, posting the notes would negatively effect how we absorb the information, not posting the notes forces you to go to class, write down the notes, and pay attention to the material, therefore, you know more about it and understand it better.

A total of 43 students responded to 4(2). Eight (18.6%) individuals indicated that altering the paper project would positively benefit the course. Comments included, listing the topics that are available to write on and adding a peer review session would help. A total of 29 (67.4%) individuals indicated that altering the paper project would negatively benefit the course. A total of six (14%) individuals were either neutral or unsure of whether altering the paper project would positively or negatively benefit the class.

A total of 44 students responded to 4(3). A total of 18 (40.9%) individuals indicated that changing attendance requirements would positively benefit the course. Additionally, 8 (18.2%) of those individuals that indicated changing attendance requirements would positively benefit the course qualified their answer by stating the attendance policy should be stricter. Comments included, make it where you can't miss more than three days instead of randomly picking ten days, changes need to be made if notes are posted before class, and attendance should be required everyday. A total of 21 (47.7%) individuals indicated that changing attendance requirements would negatively benefit the course. A total of five (11.4%) individuals were either neutral or unsure of whether altering the attendance policy would positively or negatively benefit the class.

A total of 46 students responded to 4(4). A total of 23 (50%) individuals indicated that requiring participation in a local environmental activity would positively benefit the course. Additionally, one (2.3%) of those individuals that indicated requiring participation in a local environmental activity would positively benefit the course qualified their answer by stating only if for extra credit. One (2.3%) of the 23 individuals also suggested the addition of participation in an environmental activity, but if so the paper should not be required. A total of 14 (30.4%) individuals indicated that requiring participation in a local environmental activity would negatively benefit the course. Comments included, some students would not take the class if an environmental activity were required and this would be stressful because students have many other obligations. Additionally, three (6.8%) of those individuals that indicated requiring participation in a local environmental activity would negatively benefit the course qualified their answer by stating only if for extra credit. A total of 6 (13%) individuals answered both yes and no regarding the addition of an environmental activity. Comments included, the activity would be great but finding the time would be a hardship and the activity would make the class better but it would be annoying. A total of three (6.5%) individuals were unsure of whether the addition of an environmental activity would positively or negatively affect the class.

**Discussion**

*Overall Teaching Improvement*

The results of Spring 2005 and Fall 2005, pretests and posttests showed a marked increase in the average score. During Spring and Fall 2005, scores increased 15% and 25%, respectively. Additionally, during both semesters, direct comparisons for students that took the pretest and posttest showed increases of 15% and 21%. These results indicate that students retained knowledge and that learning had occurred, which is the primary motivation for teaching. As Watrous (2003) aptly states, "We teach people as well as subjects. No matter how well versed we are in our own fields, if we fail to communicate effectively, we fail to teach" (p. 59).

During Spring 2005, 85.3% indicated the lecture format helped them understand the material. However, following the Spring 2005 semester, changes were made and 50% of the lecture notes for every other lecture were e-mailed to students ahead of time. During Fall 2005 following this change, 94.3% of students believed the lecture format helped them understand the material. These results are an indication the lecture-format was satisfactory. However, and more importantly, the instructor responded to suggestions made by students in Spring 2005, made adjustments to how the material was delivered to students, and improved the positive responses of students. By providing the notes before the lecture, the instructor was still able to lecture and the students were able to concentrate more on listening than writing. The students could bring a printed copy of the material and jot down salient or additional points from the lecture. Thus, the class better served auditory learners as well as visual learners.

During Spring 2005, 92.6% indicated the paper project helped them understand the pros and cons of an environmental issue. However, following the Spring 2005 semester, changes were made and requirements for the paper project were more focused and reduced from eight to four pages. Although during Fall 2005 following this change, only 88.7% of students believed the paper project helped them understand the pros and cons of an environmental issue, only 18.6% suggested that altering the paper project would positively benefit the course [question 4(2)]; a 13.2% reduction from Spring 2005. The results indicate that working on a project was helpful in understanding the environmental issues. Further, refocusing the requirements and shortening the project resulted in a more positive response to the project as a whole.

During Spring 2005, 66.0% indicated that the exam format fairly assessed their knowledge of the material. However, following the suggestions from the Spring 2005 course-improvement questionnaire, changes were implemented to the exam format for Fall 2005. Specifically, the exams were reduced from 75 questions to 50 questions and an exam review period was instituted. During Fall 2005 following this change, 77.4% of students believed the exam format fairly assessed their knowledge of the material. These results are an indication that the exam reflected the learning of the course objectives. By asking and listening to student feedback, the instructor made positive adjustments to how student knowledge was assessed. Initially, many students were overwhelmed with the essay questions and many indicated that the exam covered too much material and it did not represent the material learned. The instructor addressed this concern by

instituting an exam review period to help define criteria and expectations.

During Spring 2005, 30.6% of the students believed that posting notes on the Web or e-mailing them in advance would negatively impact the course. For the Fall 2005 semester, half the notes were e-mailed before each lecture to the students. The results of the Fall 2005 evaluations indicate that only 7.8% of the students believed that posting notes on the Web or e-mailing them in advance would negatively impact the course, a 22.8% reduction from the earlier semester. Some students commented that posting notes would negatively affect the course because they would not feel pressured to attend class and listen to the lecture. However, when an attendance policy is used to require students to attend lecture, it appeared that students responded favorably to having the notes e-mailed to them.

A majority of the students in both semesters (68.2% in Spring 2005 and 67.4% in Fall 2005) indicated that keeping the paper project intact would benefit the course. However, during Spring 2005, 31.8% indicated that altering the paper project would benefit the course. For the Fall 2005 semester, requirements for the paper project were explained in greater detail and reduced from eight to four pages. Following this change, the evaluations for Fall 2005 indicate that only 18.6% of students believed the paper project should be altered — a reduction in 13.2%. These results are an indication that the change had a positive impact on student perceptions of project. In the future, the addition of a peer review session may benefit students by providing peer support and collaboration.

During Spring 2005, 47.5% indicated that changing the attendance requirements would positively benefit the course, whereas during Fall 2005 40.9% indicated a change would benefit the course. No change in attendance policy was made between semesters. The course is introductory level and is mandated by the university to have an attendance policy. Also, many students believed that by providing the lecture notes attendance may decline. To compensate for this concern, the attendance could be made stricter.

Participating in a local environmental activity varied substantially. Although a majority of the students indicated that participation would positively benefit the course, some wanted extra credit for it. The students who were against the activity indicated the mandatory participation would deter them from signing up for the course, lack of time being the primary factor.

Likert-Scale Multiple-Choice

The results of Spring 2005 indicated a stronger level of agreement during the posttest compared to the pretest concerning important local and global issues for every question. However, in Fall 2005, only three questions show a stronger level of agreement during the posttest compared to the pretest. Interestingly, the first two questions for both semesters indicate controversy, that is, the scores for ‘Strongly Disagree’ have increased in the Spring posttest and the scores fell for ‘Strongly Agree’ in the Fall posttest. This may indicate that the two questions are highly debatable with personal-factors having significant influence over beliefs and that these topics may not be easily influenced by particular teaching strategies.

## Conclusion

This project was designed to a) evaluate teaching using the pretest and posttest format and b) use the course-improvement questionnaire to enhance instructional approaches across semesters. Quantitative data indicate that students have learned the material required for the course and were generally satisfied with the teaching, the format, and the paper project. Concerns were generally related to the essay-questions on the test and the mandatory participation in a local environmental activity.

This study revealed many logistic and realistic factors that must be carefully considered when developing any course for future semesters. The course-improvement questionnaire helped the instructor understand the gaps in teaching and how it could be improved. The results of the test indicate that learning had occurred and that the instructor was successful in presenting information in ways that were meaningful for the students. Exploring the use of alternative methods for the survey-based assessment of student learning is certainly in order (Biggs *et al*., 2001; Bransford *et al*., 2000).

While the initial results are promising, continued research is warranted. Our study suggests that teachers can makes changes in the way a course is taught by using and incorporating the results of pretests and posttests and course-improvement questionnaires. Because student course evaluations are a routine part of teaching evaluation in higher education, we encourage instructors and researchers to continue experimenting with formative
data-collection approaches to improve the effectiveness of their instruction.

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**Appendix 1**. Spring 2005 Pretest and posttest scores for the 20-question subject test.

1. Approximately how many people live on Earth today?

A. 1 billion
B. 3 billion
**C. 6 billion**
D. 9 billion
E. 12 billion

| **Question 1** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 16 | 34% |
| Right | Wrong | 3 | 6% |
| Wrong | Right | 12 | 26% |
| Wrong | Wrong | 16 | 34% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 40% | 60% |
| Post Right | Post Wrong | 60% | 40% |

2. Which factors should be considered when making natural resource decisions?

A. Economics
B. Ethics
**C. Both**

| **Question 2** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 46 | 98% |
| Right | Wrong | | |
| Wrong | Right | 1 | 2% |
| Wrong | Wrong | | |
| **Totals** | | | |
| Pre Right | Pre Wrong | 98% | 2% |
| Post Right | Post Wrong | 100% | 0% |

3. If one organism consumes another, what percent of the energy is transferred from one trophic level to another?

A. 3%
**B. 10%**
C. 30%
D. 55%

| **Question 3** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 18 | 38% |
| Right | Wrong | 5 | 11% |
| Wrong | Right | 13 | 28% |

| | | | |
|---|---|---|---|
| Wrong | Wrong | 11 | 23% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 49% | 51% |
| Post Right | Post Wrong | 66% | 34% |

4. Recently, global population has?

**A. Increased**

B. Decreased

C. Slowed

| **Question 4** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | | |
| Right | Wrong | 4 | 9% |
| Wrong | Right | 3 | 6% |
| Wrong | Wrong | 40 | 85% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 9% | 91% |
| Post Right | Post Wrong | 6% | 94% |

5. The Green Revolution can best be defined as?

A. Establishment of Greenpeace

**B. Efforts to develop high yield grains**

C. Efforts to globally protect the Rain Forests

| **Question 5** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 6 | 13% |
| Right | Wrong | 2 | 4% |
| Wrong | Right | 19 | 40% |
| Wrong | Wrong | 20 | 43% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 17% | 83% |
| Post Right | Post Wrong | 53% | 47% |

6. Soil quality can impact air pollution.

**A. True**

B. False

| **Question 6** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 43 | 92% |
| Right | Wrong | 1 | 2% |
| Wrong | Right | 3 | 6% |
| Wrong | Wrong | | |
| **Totals** | | | |

| | | | |
|---|---|---|---|
| Pre Right | Pre Wrong | 94% | 6% |
| Post Right | Post Wrong | 98% | 2% |

7. Effective methods of erosion control include? (Circle all that apply)

**A. Contour farming**

B. Strip Mining

**C. Strip Cropping**

**D. Conservation Tillage**

**E. Shelterbelts**

| **Question 7** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| 4 Wrong | 1 Wrong | 1 | 2% |
| 3 Wrong | 2 Wrong | 1 | 2% |
| 3 Wrong | 1 Wrong | 2 | 4% |
| 3 Wrong | 0 Wrong | 1 | 2% |
| 2 Wrong | 2 Wrong | 3 | 6% |
| 2 Wrong | 1 Wrong | 9 | 19% |
| 2 Wrong | 0 Wrong | 6 | 13% |
| 1 Wrong | 2 Wrong | 3 | 6% |
| 1 Wrong | 1 Wrong | 11 | 23% |
| 1 Wrong | 0 Wrong | 8 | 17% |
| 0 Wrong | 1 Wrong | 1 | 2% |
| 0 Wrong | 0 Wrong | 1 | 2% |
| **Totals** | | | |
| Improved | 59% | | |
| Stable | 31% | | |
| Declined | 8% | | |

8. Humans have increased pest problems by? (Circle all that apply)

A. **Simplify ecosystems**

B**. Planting large monoculture crops**

C. **Introducing exotics**

| **Question 8** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| 2 Wrong | 2 Wrong | 6 | 13% |
| 2 Wrong | 1 Wrong | 4 | 9% |
| 2 Wrong | 0 Wrong | 5 | 11% |
| 1 Wrong | 2 Wrong | 2 | 4% |
| 1 Wrong | 1 Wrong | 8 | 17% |
| 1 Wrong | 0 Wrong | 13 | 28% |
| 0 Wrong | 2 Wrong | 1 | 2% |
| 0 Wrong | 1 Wrong | 1 | 2% |
| 0 Wrong | 0 Wrong | 7 | 15% |

| **Totals** | | | |
|---|---|---|---|
| Improved | 48% | | |
| Stable | 45% | | |
| Declined | 8% | | |

9. The best method to reduce beach erosion is?

A. Seawalls

B. **Vegetation**

C. Stone Piers

D. Dams

| **Question 9** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 27 | 57% |
| Right | Wrong | 2 | 4% |
| Wrong | Right | 12 | 26% |
| Wrong | Wrong | 6 | 13% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 61% | 39% |
| Post Right | Post Wrong | 83% | 17% |

10. Water shortage is a serious long range problem for the United States.

A. **True**

B. False

| **Question 10** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 31 | 66% |
| Right | Wrong | 4 | 9% |
| Wrong | Right | 8 | 17% |
| Wrong | Wrong | 4 | 9% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 75% | 26% |
| Post Right | Post Wrong | 83% | 18% |

11. Which is not a serious concern for pollution in the oceans?

A. Plastic

B. Oil

C. **Salt**

D. Sewage

| **Question 11** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 42 | 89% |
| Right | Wrong | 2 | 4% |
| Wrong | Right | 2 | 4% |

| | | | |
|---|---|---|---|
| Wrong | Wrong | 1 | 2% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 93% | 6% |
| Post Right | Post Wrong | 93% | 6% |

12. Which species has had a negative influence on lake trout in the Great Lakes?

A. Salmon

B. New Zealand Flatworms

C. Alewife

D. **Sea Lamprey**

| **Question 12** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 11 | 23% |
| Right | Wrong | 6 | 13% |
| Wrong | Right | 13 | 28% |
| Wrong | Wrong | 17 | 36% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 36% | 64% |
| Post Right | Post Wrong | 51% | 49% |

13. The major objective of the Taylor Grazing Control Act of 1934 was?

A. Stop cattle grazing on U.S. rangelands

B. Protect wildlife on U.S. rangelands

C. **Improve the quality of U.S. rangelands**

| **Question 13** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 12 | 26% |
| Right | Wrong | 2 | 4% |
| Wrong | Right | 12 | 26% |
| Wrong | Wrong | 21 | 45% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 30% | 71% |
| Post Right | Post Wrong | 52% | 49% |

14. The majority of America's forests are owned by public agencies?

A. True

B. **False**

| **Question 14** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 13 | 28% |
| Right | Wrong | 9 | 19% |
| Wrong | Right | 14 | 30% |
| Wrong | Wrong | 11 | 23% |

| **Totals** | | | |
|---|---|---|---|
| Pre Right | Pre Wrong | 47% | 53% |
| Post Right | Post Wrong | 58% | 42% |

15. Worldwide, the most endangered group of organisms is?

A. **Plants**

B. Birds

C. Mammals

D. Reptiles

| **Question 15** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 16 | 34% |
| Right | Wrong | | |
| Wrong | Right | 19 | 40% |
| Wrong | Wrong | 12 | 26% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 34% | 66% |
| Post Right | Post Wrong | 74% | 26% |

16. Wildlife Management may be defined as? (Circle all that apply)

A. **Use of wildlife**

B. **Protection of wildlife**

C. **Control of wildlife**

| **Question 16** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| 2 Wrong | 2 Wrong | 5 | 11% |
| 2 Wrong | 1 Wrong | 1 | 2% |
| 2 Wrong | 0 Wrong | 8 | 17% |
| 1 Wrong | 2 Wrong | 2 | 4% |
| 1 Wrong | 1 Wrong | 2 | 4% |
| 1 Wrong | 0 Wrong | 2 | 4% |
| 0 Wrong | 2 Wrong | 1 | 2% |
| 0 Wrong | 1 Wrong | 3 | 6% |
| 0 Wrong | 0 Wrong | 23 | 49% |
| **Totals** | | | |
| Improved | 23% | | |
| Stable | 64% | | |
| Declined | 12% | | |

17. On average, each American produces _____ pounds per day of solid waste?

A. 1 - 2

B. 2 - 3

C. 3 - 4

D. **4 - 5**

E. 5 - 6

| **Question 17** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 1 | 2% |
| Right | Wrong | 6 | 13% |
| Wrong | Right | 12 | 26% |
| Wrong | Wrong | 28 | 60% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 15% | 86% |
| Post Right | Post Wrong | 28% | 73% |

18. Air pollution is caused by human and natural sources.

A. **True**

B. False

| **Question 18** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 44 | 94% |
| Right | Wrong | | |
| Wrong | Right | 3 | 6% |
| Wrong | Wrong | | |
| **Totals** | | | |
| Pre Right | Pre Wrong | 94% | 6% |
| Post Right | Post Wrong | 100% | 0% |

19. The Kyoto Protocol is an agreement of nations to?

A. Reduce soil erosion

B. **Reduce carbon dioxide emissions**

C. Reduce water contaminants

D. Protect endangered species

| **Question 19** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 25 | 53% |
| Right | Wrong | 12 | 26% |
| Wrong | Right | 4 | 9% |
| Wrong | Wrong | 6 | 13% |
| **Totals** | | | |
| Pre Right | Pre Wrong | 79% | 22% |
| Post Right | Post Wrong | 62% | 39% |

20. The fastest growing energy source in the world is?

A. Oil

B. **Wind**

C. Solar Energy

D. Coal

| **Question 20** | | | |
|---|---|---|---|
| **Pre** | **Post** | | |
| Right | Right | 1 | 2 |
| Right | Wrong | 5 | 11% |
| Wrong | Right | 15 | 32 |
| Wrong | Wrong | 26 | 55 |
| **Totals** | | | |
| Pre Right | Pre Wrong | 13% | 87 |
| Post Right | Post Wrong | 34% | 66% |