Assessment Report: Environmental Studies

2019

I. Assessment Cycle and Introduction

The Environmental Studies (ES) program is currently transitioning from a past Strategic Action Plan (StrAP 2014) to a revised and updated Strategic Action Plan (StrAP 2019). Based on StrAP 2014, we assessed Goal 1 in 2014 and Goal 9 in 2015. Plans to assess Goal 3 in 2016 were delayed as the program went through its external review process, then further delayed by faculty absences, although collection of data continued during that time. The current report was meant to both complete those plans by assessing Goal 3 and also restart the assessment process by simultaneously assessing Goal 2 (as reported in YeAP 2018).

In the meantime, Environmental Studies has transitioned to StrAP 2019. According to this document, Goals 1-3 will be assessed every year, with one of the remaining goals (4-9) assessed sequentially each year. According to this model, we are in the first year of our current six-year assessment cycle, as described in StrAP 2019. By assessing Goals 2 & 3, we will lay the groundwork for successfully meeting our assessment goals, to be next reported in 2022.

Beginning in the 2015-2016 academic year, Environmental Studies began collecting data that could be used to directly assess Learning Goals 2 & 3, as described in StrAP 2014:

" A student majoring in Environmental Studies at Illinois Wesleyan will have acquired: Foundational Knowledge of

- *Ecological principles (goal 1)*
- *Earth science concepts (goal 2)*
- *The relationship between human beings, society and the environment (goal 3)"*

Further data was collected in the 2016-2017, 2017-2018 and 2018-2019 academic years. This provides us with more complete data for assessing student progress through the program.

II. Assessment Measures Used

1. "Pre-program" questions: To assess Goal 3, multiple choice questions specific to the goal were administered on the first day of class in ENST 100 Environment and Society in the Fall 2015 semester. This test was administered to 13 ES students and 20 non-ES students.
   To assess Goal 2, multiple choice questions specific to the goal were also administered to students in ENST 230 (previously 110) Earth Systems Science in the Spring semesters of 2016, 2017, 2018 and 2019. The test was administered to 24 ES students and 65 non-ES students.

2. "Post-program questions: The same multiple choice questions for both goals were administered to a majority of graduating ES majors as part of an exit survey in the Spring 2019 semester. These questions were administered to 10 ES students who graduated in 2019. Questions for Goal 3 only were administered to 13 ES students in 2016.

3. Indirect measures: As part of the exit survey administered to graduating ES majors, students are also asked about their perception of how well the program met all programmatic goals. These surveys have been administered annually under StrAP 2014, therefore for this assessment report, we will be making use of data from ES majors graduating in 2014 through 2019, for a total of 60 ES majors.

All test questions administered as a part of the "pre-program" and "post-program" assessments are included in Appendix A.

III. Results of Assessment Measures

1. Direct measures: The results of direct measures are summarized in Figures 1 & 2.

   A. Goal 2: With respect to Goal 2 (Knowledge of Earth Science concepts), the results of the direct evaluation reveal that in general, ES students come into ENST 110/230 Earth Systems Science with a knowledge of earth science that exceeds that of their peers who are not a part of ES (Figure 1). This difference is statistically significant (p=0.001), with ES students answering 3.57 of the six questions correctly on average (54.5%), and non-ES students answering 2.12 questions correctly on average (35.3%).

   By graduation, ES majors answered 3.77 of the six questions correctly (62.8%), on average, demonstrating improvement on knowledge of earth science concepts. However, progress varied between questions. Overall, the improvement was not statistically significant (p=0.377).

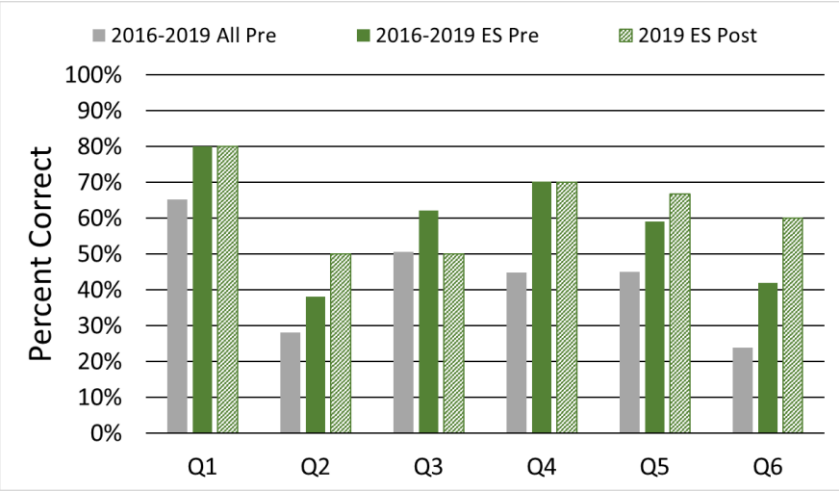


Figure 1. Percentage of correct answers on six questions (Q1-Q6) related to Goal 2 (Foundational Knowledge in Earth Science) administered to students at the beginning of ENST 110/230 (labeled as "Pre") and as a part of a graduation exit survey (labeled as "Post"). Results on the pre-test have been subdivided for all students who took the test, all ES students taking the pre-test and just those ES students who graduated in 2019. *n* = 89 for "2016-2019 All Pre"; *n* = 24 for "2016-2019 ES Pre"; *n* = 10 for "2019 ES Post".

B. Goal 3**:** With respect to Goal 3, the results of the direct evaluation reveal that in general, ES students begin ENST 100 with a similar or lower level of knowledge of this topic than other students in that class. On the pre-test, non-ES students answered 1.90 out of five questions correctly, while ES students only answered 1.62 out of five correctly, although this was not a significant difference (p=0.554).

By graduation, ES majors were answering 2.38 (2016—47.6%) to 2.89 (2019—57.8%) correctly, on average (Figure 2). This improvement, although arguably noticeable, was highly variable between questions and therefore not statistically significant (p-values=0.298 and 0.151 for 2016 and 2019, respectively). Again, percentages for different questions was highly variable (Figure 2).

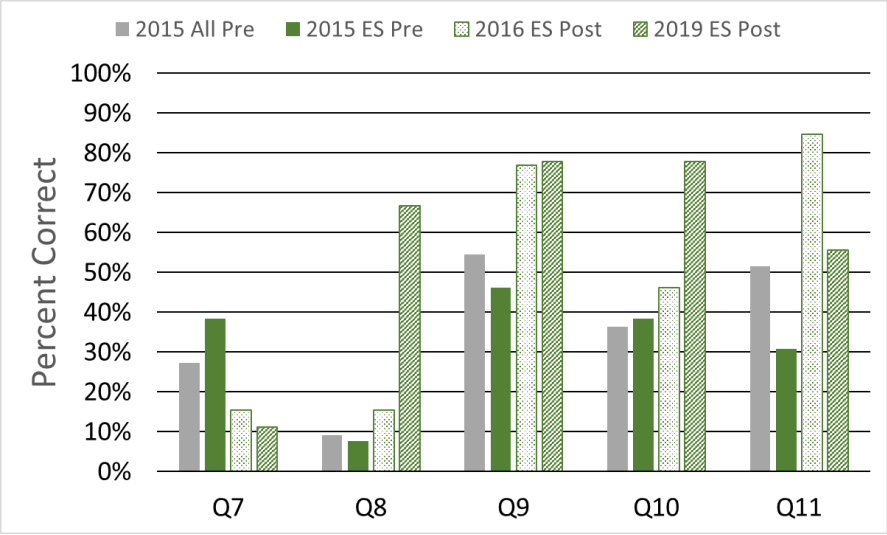


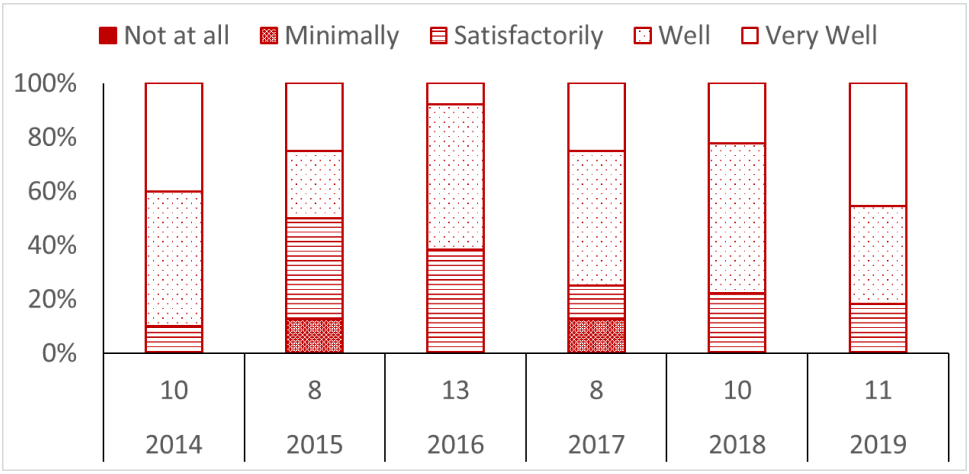
Figure 2. Percent correct answers on five questions related to Goal 3 (Foundational Knowledge in the relationship between human beings, society and the environment) administered to students at the beginning of ENST 100 (labeled as "Pre") and as part of an exit survey (labeled as "Post"). Results on the pre-test have been subdivided for students who were not in ES ("All"), and ES students taking the pre-test ("ES"). The results for the post-test have been divided between year the post-test was administered (2016 and 2019). *n* = 20 for "2015 All Pre"; *n* = 13 for "2015 ES Pre"; *n* = 13 for "2016 ES Post"; *n* = 10 for "2019 ES Post".

2. Indirect measures: The results of the indirect measures are summarized in Figures 3 & 4.

A. Goal 2: The majority of students reported that they felt that they acquired Foundational Knowledge in Earth Science concepts either "very well" or "well" in all years that they were polled, except in 2015 (Figure 3). In fact, the year 2015 marked the lowest self-assessment by students for this goal. Since that time, the self-evaluations have improved, leading to the highest self-evaluations in the data set (2019 graduates).

B. Goal 3: Students graduating from the ES major uniformly felt that they had acquired knowledge of the relationship between human beings, society and the environment "very well". The lowest responses came from 2016, when a minority of students reported that they only acquired this knowledge "satisfactorily".

Figure 3. The percentage of students providing each answer on a graduation exit survey in response to the question "Please rate how well you have acquired knowledge in the following areas through your ES courses: Foundational knowledge of earth science concepts." The y-axis shows year of the survey and the number of respondents.



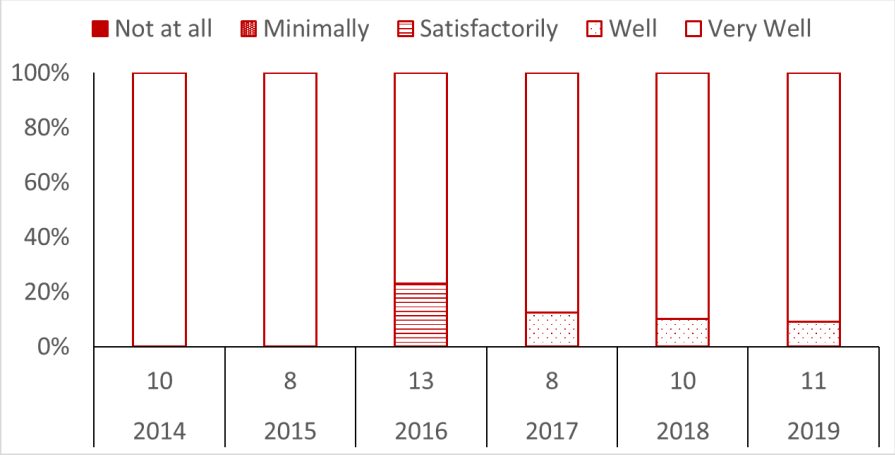


Figure 4. The percentage of students providing each answer on a graduation exit survey in response to the question "Please rate how well you have acquired knowledge in the following areas through your ES courses: Foundational knowledge of relationships between human beings, society and the environment." The y-axis shows year of the survey and the number of respondents.

IV. Data Evaluation Process

The data were evaluated by the Assessment Coordinator, Aaron Wilson. Prior to submission to the Assessment Committee, the Assessment Report was shared with faculty members within ES and feedback was sought regarding the content of the report and what that meant for our department. Suggestions from ES faculty were incorporated into the report.

To determine significance of differences in percentage of correct questions answered between different groups of students, paired t-tests were used. A significance threshold (α) was not assumed, but p-values were reported so that readers could draw their own conclusions about test results.

V. Implications of Data

It should be noted that for both of these goals, results varied between questions and, for the most part, drew responses from a small number of students (<25 students in all

cases for direct measurements and an average of 10 per year for indirect measurements). This limited the power of the statistical tests that could be conducted, making it more likely that differences would not be significant.

1. Goal 2: Graduating ES majors did not uniformly feel strongly confident about their knowledge of earth science concepts, although confidence has increased over time. ES students attending Earth Systems Science have a significantly better understanding of key earth science comments compared to their non-ES peers. At the same time, little difference was seen between correct answers for the earth science pre-test and post-test among ES majors. This implies that (A) ES students have a greater understanding of earth science than their non-ES peers, and (B) that knowledge was retained through to graduation. While we would like to see greater improvement in the number of correct answers, the data suggest successful teaching of earth science concepts.

2. Goal 3: Graduating ES majors were extremely confident about the degree of knowledge that they obtained in this subject area. According to our instruments, ES majors knowledge in this area is comparable to their non-ES peers, or slightly lower, when entering ENST 100 Environment and Society; this similarity between ES and non-ES majors may be explained by the fact that ES students in this class are generally in their very first year of college, whereas non-ES students in the course are generally upper-level students.

   The data show that knowledge of goal 3 material improves by graduation, however that improvement varies widely by question, resulting in a statistically non-significant improvement. Close examination of the data, however, reveals that this may largely be due to Question 7 (Q7). One possibility is that the wording of Q7, a complex question, may be confusing for graduating ES students who have not recently studied the specific material, as in general questions 8 through 11 suggest students gain and retain an increased knowledge in this area. This knowledge gain may in part explain the high confidence students report with regard to achievement of knowledge in this learning goal and demonstrate the strength of the ES program in providing students with knowledge in this area.

VI. Academic Unit Responses to Data

ES has already used this process to create a revised StrAP (StrAP 2019). The updated StrAP has further broken down each Knowledge Goal (1-3) into four sub-goals that are more specific. These sub-goals will be used to create appropriate questions for pre- and post-tests, as well as to update the exit survey to better understand what areas of knowledge students feel most comfortable about.

Foundational knowledge pre- and post-tests for goals 1 through 3 will also be administered every year, in order to provide longitudinal data about these critical goals. Prior to administering the next pre-test for goal 2 and goal 3, we will consider whether to revise the wording of Q3 and Q7 (respectively), substitute alternative questions, or retain the questions as is.

ES also plans to begin administering some pre-test questions in all knowledge areas at the beginning of Environment and Society (a fall semester course), in order to better understand the knowledge level of students as they initially enter the ES program. Taking these steps will improve data quality for future analysis.

Further, a disconnect appears to exist between students' confidence about their knowledge of earth science and their ability to answer questions in that subject area (although their confidence has risen since a low in 2015). ES will be evaluating the format of the Exit Survey questions, in order to determine if changes could be made to get more meaningful responses from students.

Summary

Our unit investigated the acquisition of knowledge in earth science and in the relationship between human beings, society and the environment, among ES majors. We found that ES majors' knowledge in both areas improved. Our analysis suggested that one of our pre-test/post-test questions may be poorly worded, which may account for the contradictory assessment results for goal 3. We also found that students were extremely confident about their knowledge of the relationship between human beings, society and the environment, and, over time, confident about their knowledge of earth science. ES has used this data to update our StrAP, and will also use it to improve our assessment instruments.

APPENDIX A – DIRECT ASSESSMENT QUESTIONS (Q1-Q11)

1. Imagine ice cubes placed in a glass of water. Which of the following is the *most correct and complete* description of the resulting phenomenon?
   A. The ice cubes displace heat energy from the glass into the surrounding air, condensing water on the outside of the glass
   B. Anti-heat in the ice cubes negates heat in the surrounding water
   C. The ice cubes absorb heat energy from the water, which causes them to melt and the water to cool
   D. The ice cubes transfer their lower temperature to the surrounding water
   E. The melting ice cubes release a lower temperature into the glass, lowering its overall temperature

2. The greenhouse effect refers to the process through which:
   A. Certain gases reflect light back towards the surface, warming the Earth's surface
   B. Certain gases absorb incoming light from the sun, warming the atmosphere
   C. Certain gases emitted by humans cause the atmosphere to warm
   D. Certain gases transmit more light from the sun, warming the Earth's surface
   E. Certain gases absorb outgoing thermal energy, warming the atmosphere

3. Without a tilted axis, the Earth:
   A. Would not have different climates at different latitudes
   B. Would not have a Coriolis effect
   C. Would not experience uneven heating from the Sun
   D. Would not experience a diurnal cycle
   E. Would not experience distinct seasons at most latitudes

4. Which of the following represents a *short-term* stock in geologic terms?
   A. Phosphorus stored in sedimentary rocks
   B. Carbon stored in deep-sea sediments
   C. Energy stored in the chemical bonds of fossil fuels
   D. Water stored in an aquifer underground
   E. Nitrogen stored in the tissues of plants

5. Because the Earth rotates:
   A. The troposphere experiences a greenhouse effect
   B. A greater percentage of radiation is reflected near the poles
   C. The Earth's different latitudes are heated unevenly
   D. The Earth experiences diurnal cycles
   E. The Earth experiences distinct seasons at most latitudes

6. An example of a *flow* or *flux* of matter into a stock *not* offset by rapid, significant flows out would be:
   A. Carbon accumulated by plants through photosynthesis
   B. Phosphorus in chemical fertilizers buried in ocean sediments
   C. Energy stored in the chemical bonds of molecules making up tree trunks
   D. Water taken up by crop roots
   E. Nitrogen fixation by soil microorganisms

7. Which of the following is ***false***?
   The concept of **wilderness** in Western society…
   A. signifies a pristine environment, devoid of humans.
   B. was adopted from Native American views of nature.
   C. has historically led environmentalists to prioritize conservation over pollution prevention.
   D. is socially constructed.

9. The **precautionary principle** states that with regard to environmental problems, we…
   A. must take all precautions to assure that conclusive scientific evidence is available before acting to prohibit production or use of a substance.
   B. must act before conclusive scientific evidence is available to prohibit production or use of a substance if potential environmental costs may be very high.
   C. must take all precautions to assure that legislation adopted to protect the environment does not pose prohibitive costs to business.
   D. must have faith that everything will be O.K.

11. Which of the following is ***true***?
   A. The Earth's carrying capacity grows as the population grows.
   B. The ecological footprint of a country's population is the environmental impact of the population's consumption of the country's natural resources.
   C. Over the long term, the ecological footprint of a country's population cannot exceed the carrying capacity of the country's ecosystem if that country is to support its population indefinitely.
   D. Over the long term, the ecological footprint of the global population cannot exceed the Earth's carrying capacity if the Earth is to support the human population indefinitely.

8. Garrett Hardin's theory of **Tragedy of the Commons** is significant for all of the following reasons ***except:***
   A. It helps explain the collapse of deep sea fisheries due to over-fishing.
   B. It helps explain why a scarce resource with a private property regime will always be destroyed.
   C. It has been widely accepted by policy makes as true and provides the justification for government intervention in environmental issues.
   D. It has been widely accepted by economists as true and provides the justification for privatizing natural resources.

10. All of the following are true of **Cap and Trade** systems ***except:***
   A. They assure a fair distribution of exposure to pollutants between localities.
   B. They provide for the most economically efficient way to reduce emissions.
   C. They privatize rights to common property resources.
   D. They are presently used in the U.S. for reducing sulfur dioxide (SO_2) emissions, which cause acid rain.