Academic Assessment Report

BEST PRACTICES IN STUDENT LEARNING OUTCOMES
(B.S. DEGREE/ ENVIRONMENTAL, SOIL, AND WATER SCIENCE)
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CSES Mission

The mission of the Department of Crop, Soil, and Environmental Sciences is to provide superior education programs at the undergraduate and graduate levels, conduct innovative research and extension programs in the crop, soil, and environmental sciences and provide superior service for citizens of Arkansas and the nation.

Program Goals

(Program goals are broad general statements of what the program intends to accomplish and describes what a student will be able to do after completing the program. The program goals are linked to the mission of the university and college.)

1. Graduates have the discipline-specific knowledge in soil, water, and environmental sciences required to perform successfully in private, government, or academic entry-level positions.
2. Graduates are able to critically analyze, synthesize, and evaluate new information to make informed decisions.
3. Graduates have the ability to solve complex, multidisciplinary problems.
4. Graduates are able to prepare and synthesize information to effectively communicate, both orally and in writing.

Student Learning Outcomes

(Student Learning Outcomes are defined in terms of the knowledge, skills, and abilities that students will know and be able to do as a result of completing a program. These student learning outcomes are directly linked to the accomplishment of the program goals.)

1. Students will demonstrate the discipline specific knowledge required to function as environmental, soil, and/or water science professionals.
2. Students will demonstrate the ability to critically evaluate situations or scenarios to arrive at well thought out and supported decisions and outcomes.
3. Students will demonstrate the ability to work through and solve complex, multidisciplinary problems.
4. Communication skills
    a. Students will demonstrate the skills required to effectively communicate technical/scientific information in oral platforms.
    b. Students will demonstrate the ability to integrate, organize, and effectively present written reports of technical/scientific information.

Assessment Measure for Outcome 1

- Achievement is measured using **pre- and post-assessments**.
- This is a ***direct*** measure of student learning.
- Pre- and post-assessments of 20 test questions from the ESWS faculty represent essential discipline specific knowledge and skills of students completing an environmental, soil, and water science degree.
- The initial assessment was generated by ESWS faculty during the spring 2016. Following performance and feedback from students in 2016, the pre/post-test was reviewed and three questions were revised while two were deleted and replaced with new questions during 2017. Although content overlaps, questions could roughly be divided into 5 water, 7 environmental, and 8 soil science based questions. Questions were conceptual in nature or calculation based. If the calculation based questions are separated and considered a separate category, the tests consists of 4 water, 7 environmental, and 4 soil science based and 5 calculation based questions.
- Target populations are at least half of the incoming fall freshmen and half of the spring graduating ESWS class.
- Scores are calculated for each assessment with the range, average, and median calculated for the pre- and post-assessments to calculate the change in scores from pre- to post-assessment.

Acceptable and **Ideal Targets** (<u>not required</u> for indirect measures)

- The use of pre- and post-assessments is still a relatively new initiative for CSES; therefore, we are unsure of how "incoming" students in particular will perform on the pre-assessment.
- Acceptable: We are initially targeting a 50% increase in the mean and/or median test scores between the two populations (incoming and graduating students).
- Ideal: We are initially targeting an 80% increase in the mean and/or median test scores between the two populations (incoming and graduating students).

Key Personnel (who is responsible for the assessment of this measure)

- ENSC 1001L Environmental Science Laboratory (FA, SP) or CSES 1203 (FA, SP), required courses for all ESWS students, are the target courses for the pre-test.
- ENSC 4263 Environmental Soil Science (SP even), CSES 4553 Wetland Soils (SP odd), ENSC 4034 Analysis of Environmental Contaminants (SP even), optional advanced courses for ESWS students that should capture at least half of the senior population, are the target courses for the post-test.

Summary of Findings

- The pre-assessment was administered to ten ESWS students enrolled in CSES 1203 in the spring of 2018. Scores ranged from 30 to 55% with an average of 39% and a median of 37.5%. Mean scores were 30% in environmental, 50% in soil, 37% in water science, and 8% in calculations.
- Thirteen students enrolled in ENSC 4263 Environmental Soil Science (SP even) took the post-assessment in the spring 2018. Student scores on the post-assessment ranged from 35 to 75%, similar to the 2016 post-assessment results (30 -75%). The mean was 57% and median was 55%.
- The mean and median scores increased 46 and 47%, respectively, from the pre-assessment, not quite reaching the acceptable target increase in scores of 50%.
- The mean and median increased from 2016 post-assessment results which were a 47% average and a 45% median.
- Scores on individual post-assessment questions ranged from 0% on one question to 100% on three questions. Mean scores were 57% in environmental, 67% in soil, and 71% in water science

if calculation based questions are considered a separate category. Mean score on calculations was 37%. Students in 2016 had complained about being given computation-based questions, and felt that they should not be required to know how to do those since they would "look up" equations when they needed one. Student performance on calculations continues to be below expectation.

Recommendations

- A challenge in the ESWS degree plan is that students have flexibility in course choice, so not all graduates completed the same courses. The ESWS faculty need to continually review and articulate expectations of ESWS related knowledge within the knowledge dimension (factual, conceptual, procedural, and metacognitive). Faculty also need to review essential knowledge in ESWS for the target cognitive (remembering, understanding, applying, analyzing, evaluating, and creating) and affective levels (receiving, responding, valuing, organizing, and internalizing/characterizing).
- Faculty should continue to review the questions on the ESWS pre/post-assessment to determine if the questions address the most important concepts and technical skills in ESWS. Questions span from straight knowledge based questions that required only memorized information to answer correctly to comprehension, application, and analysis questions.
- The pre/post-assessment is an evolving assessment; the assessment was revised prior to 2018 and will likely be revised again as faculty gather data about achievement.

Assessment Measure for Outcome 2

- Achievement will be measured using a critical thinking scenario and rated using a **critical thinking rubric**.
- This is a ***direct*** measure of student learning.
- Assessment scenarios will be generated to cover application of critical thinking in environmental, soil, water, or ecological contexts.

Acceptable and **Ideal Targets** (<u>not required</u> for indirect measures)

- Acceptable: 50% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure)

- ENSC 4023 Water Quality (FA), ENSC 4263 Environmental Soil Science (SP even), CSES 4553 Wetland Soils (SP odd), ENSC 4034 Analysis of Environmental Contaminants (SP even), optional advanced courses for ESWS students that should capture at least half of the senior population, are the target courses for the critical thinking assessment.

Summary of Findings

- Team performance in two advanced ESWS courses was assessed. In ENSC 4034, four teams of three students was assessed. Students were placed in teams and given a real-world problem to tackle in the applied sciences. As part of a semester-long project, they had to assess management of a site and published literature and develop a research question and hypothesis and approach to test their hypothesis. They had to interpret data and then evaluate potential scenarios of herbicide fate given based on soil and land management characteristics, herbicide properties, and published data.

- In ENSC 4263, sixteen students participated in one of eight teams of 2-3 (although one final report was submitted by a single student due to extraordinary circumstances). Students researched a problem in environmental soil science, evaluated elements, potential impacts and solutions, and proposed a solution, for such situations as biosolids disposal and utilization, remediation of lead and arsenic, heavy metal remediation at military installations, mountain-top mining problems, radon regulations, and phytoremediation of closed smelting operations.
- Scores for explanation of issues and conclusions and related outcomes ranged from basic to proficient, with median performance at a proficient level. Evidence, influence of context and assumptions, and in generating the students' position (perspective, thesis/hypothesis), ratings ranged from developing to proficient or mastery for developing a thesis. Means and medians for those three categories hovered around basic level.
- Students tended to state issues, although not always clearly or completely. Evidence was not deeply questioned, frequently taken as fact, and students need to work on developing interpretations from information. There was a lack of questioning of assumptions, especially students' own assumptions, while they did identify some relevant contexts for scenarios. Students tended to simplify, even if they acknowledged complexities, and demonstrated a lack of logical evaluation. Students did relate outcomes, but some did fall into the trap of relating conclusions to information chosen to fit a desired conclusion.

Recommendations

- Critical thinking requires analysis, synthesis, and evaluation, i.e. learning at high cognitive levels. Faculty need to consider and articulate where and when students have opportunities to develop (learn and repeatedly practice) those cognitive skills within the curriculum. If assessment continues to show students achieving at lower than proficient level, learning opportunities within the curriculum should be enhanced.

Assessment Measure for Outcome 3

- Achievement will be measured using a problem based scenario and scored using a **problem solving rubric**.
- This is a ***direct*** measure of student learning.
- Assessment scenarios will be generated to cover application of problem solving in environmental, soil, water, or ecological contexts.

Acceptable and **Ideal Targets** (<u>not required</u> for indirect measures)

- Acceptable: 50% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure)

- ENSC 4023 Water Quality (FA), ENSC 4263 Environmental Soil Science (SP even), CSES 4553 Wetland Soils (SP odd), ENSC 4034 Analysis of Environmental Contaminants (SP even), optional advanced courses for ESWS students that should capture at least half of the senior population, are the target courses.

Summary of Findings

- Problem solving ability was assessed for team performance of four teams of three students in ENSC 4034. Students were placed in teams and given a real-world problem to tackle in the applied sciences. As part of a semester-long project, they had to assess management of a site

and published literature and develop a research question and hypothesis and approach to test their hypothesis. They had to collect, analyze, and interpret their data. Students had to propose a solution to their "client" based on incomplete data, and evaluate potential outcomes given their data and analysis from the literature integrated with characteristics of the soil they were working with, the herbicide, and the research others have conducted.

- In ENSC 4263, sixteen students participated in one of eight teams of 2-3 (although one final report was submitted by a single student due to extraordinary circumstances). Students researched a problem in environmental soil science, evaluated elements, potential impacts and solutions, and proposed a solution, for such situations as biosolids disposal and utilization, remediation of lead and arsenic, heavy metal remediation at military installations, mountain-top mining problems, radon regulations, and phytoremediation of closed smelting operations.
- Student teams rated basic to proficient in problem definition; developing to mastery level in strategy identification, solution proposal, and solution evaluation; and developing to proficient in solution implementation, and outcome evaluation. Median student achievement was proficient for problem definition and solution proposal, but at a basic level for strategy identification, solution evaluation, solution implementation, and outcome evaluation.

Recommendations

- Continued assessment should highlight areas where students are achieving at lower than proficient level, and learning opportunities within the curriculum should be enhanced.
- However, caution must also be exercised to ensure that the rubrics are applicable to the scenarios being evaluated. In ENSC 4034, students were constrained by instructors and the limitations of the class and academic semester structure during strategy identification. The students were also not necessarily focused on outcome evaluation, but were more focused on solution evaluation, given the nature of the problem that they were evaluating in ENSC 4034.
- Problem solving does require comprehension, application, analysis, synthesis, and evaluation, i.e. learning at high cognitive levels; therefore, in general, faculty should continue to consider and articulate where and when students have opportunities to develop (learn and repeatedly practice) those cognitive skills within the curriculum.

Assessment Measure for Outcome 4a

- Achievement will be assessed using an **oral communication rubric** during oral presentations where the student has compiled and evaluated the scientific literature as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class.
- This is a ***direct*** measure of student learning.

Acceptable and **Ideal Targets** (<u>not required</u> for indirect measures).

- Acceptable: 70% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure).

- CSES 3023 CSES Colloquium (FA), an upper division, professional development, communication-intensive course that should capture at least capture at least half of the senior population, is the target course for the assessment.

- CSES 462V Internship, Special Problems, and Honors thesis defenses provide other opportunities where students present and the oral communication rubric can be used to evaluate communication skills.
- ENSC 4034 (SP Even), Analysis of Environmental Contaminants is an optional, advanced, upper division course in ESWS capturing seniors in the degree program.

Summary of Findings

- Twelve students in ENSC 4034 presented results and conclusions from a research project to the class and their "client" in a team presentation where each student contributed to the presentation. Each student was placed in a team of three students at the beginning of the semester and given a real-world problem to tackle in the applied sciences. As part of a semester-long project, they had to assess management of a site and published literature and develop a research question and hypothesis and approach to test their hypothesis. They had to collect, analyze, and interpret their data. Students had to propose a solution to their "client" based on incomplete data, and evaluate potential outcomes given their data and analysis from the literature integrated with characteristics of the soil they were working with, the herbicide, and the research others have conducted. Each student had to contribute to presentation development, slide generation, oral delivery, and composition of an executive summary. Scores were assessed for organization, language, delivery, supporting material, and central message. The breakdown is as follows:

  Organization, Supporting material, and Central message: basic to exemplary with an average and median of proficient achievement;

  Language: basic to above proficient with an average and median in between basic and proficient level;

  Delivery: developing to above proficient with an average and median in between basic and proficient.

Recommendations

- Initial assessment suggests that most students have at least a basic level of achievement in oral communication skills with achievement greater than basic and closer to proficient for most oral communication skills.
- We will continue to collect data during the next few years to assess performance in oral communication. Supporting and delivering a concise, well supported scientific presentation can be difficult, especially when working with others. However, the development of these skills are critical to functioning in the workforce in the applied sciences.

Assessment Measure for Outcome 4b

- Achievement will be assessed using a **written communication rubric** for laboratory reports and technical/scientific proposals or term papers where the student has analyzed, synthesized and evaluated information from independent sources as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class.
- This is a ***direct*** measure of student learning.

Acceptable and **Ideal Targets** (<u>not required</u> for indirect measures).

- Acceptable: 70% of seniors assessed will score proficient or greater.
- Ideal: 90% of seniors assessed will score proficient or greater.

Key Personnel (who is responsible for the assessment of this measure).

- ENSC 3263 Environmental Soil Conservation (FA even), ENSC 4021L Water Quality Laboratory (FA), ENSC 4263 Environmental Soil Science (SP even), CSES 4553 Wetland Soils (SP odd), and ENSC 4034 Analysis of Environmental Contaminants (SP even), optional advanced courses for ESWS students that should capture at least half of the senior population, are the target courses for assessment of writing.
- CSES 462V Internship, Special Problems, and Honors thesis research provide opportunities where students have completed independent research projects provide other opportunities where students have to write papers in which they organize data and information they have analyzed, synthesized and evaluated to clearly and fluently convey a message.

Summary of Findings

- Sixteen students in ENSC 4263 Environmental Soil Science (SP even) working in one of eight teams of 2-3 (although one final report was submitted by a single student due to extraordinary circumstances) wrote a paper during the spring 2018 semester. The written communication rubric was applied to the papers and the following learning outcomes were assessed using the rubric: 1) Context of and Purpose for Writing, 2) Content Development, 3) Genre and Disciplinary Conventions, 4) Sources and Evidence, and 5) Control of Syntax and Mechanics.
- Ratings for each outcome ranged from developing to proficient except for context and purpose in which students were rated as basic to proficient. The average and median for each outcome was at least basic and the median for context and purpose and content development was proficient, while the median for the other three skills was basic.

Recommendations

- Initial assessment in 2016-2017 suggested that most students averaged a basic level of achievement in written communication skills. Assessment in 2017-2018 indicates that while most students may be proficient at expressing context and purpose in their writing, most writing skills remain at a basic level.
- We will continue to collect data during the next few years to assess performance in written communication. If assessment supports these initial results, curriculum revision to include more opportunities for development of writing skills should be supported by administration.

Overall Recommendations

- Current assessment approaches are beginning to provide enough data to establish baseline understanding of student achievement given the measures implemented in 2016. Continued data collection during the 2018-2019 academic year will allow faculty to better evaluate if and where changes to the student learner outcomes, and/or curriculum would better serve ESWS students.

Action Plan

- Continued use and evaluation of the pre- and post-assessment and student learning outcome rubrics.
- ESWS faculty discussion about whether the pre- and post-assessment accomplishes assessment as desired or if further revision would facilitate assessment of student learning outcomes within the framework of the existing ESWS curriculum.

Supporting Attachments

- Pre-/post-assessment for ESWS program
- Critical thinking rubric adapted from Association of American Colleges and Universities
- Problem solving rubric adapted from Association of American Colleges and Universities
- Oral communication skills rubric adapted from Association of American Colleges and Universities
- Written communication skills rubric adapted from Association of American Colleges and Universities