

Environmental Engineering ABET Evaluation Summary 2014-2015

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Environmental Engineering undergraduate program for 2014-15. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2015.

Program Educational Objectives

The Environmental Engineering (EnvE) Program Educational Objectives (PEOs) are reviewed by each of the program's three constituencies (Table 1).

Table 1: PEO Review Process and Schedule for EnvE Program Constituency

Constituency	Review opportunity	Frequency	Most recent reviews	Date of next review
Students	Freshman Orient. (CEE 1880)	Every freshman class (Fall and Spring)	Spring semester 2015	Fall semester 2015
	Junior design course (CEE 3880)	Every junior class (Spring)	Spring 2015	Spring 2016
	Senior exit interview	Every graduating class (Fall and Spring)	April 2015	November 2015
Employers	Advisory Board meeting	Annually (typically late Fall)	November 2014	November 2015
Faculty	CEE Faculty Retreat	Annually (August)	August 2014	August 2015

Students: The PEOs are introduced to the freshman class in CEE 1880 as part of a lecture on the accreditation and licensing processes (see the slides in Appendix A). The CEE Assessment Committee met in January 2015 to evaluate assessment results from the Fall 2014 semester. With respect to students and PEOs, the committee recommended that the PEOs be introduced in the first class of the capstone design sequence (CEE 3880) beginning Spring semester 2015. This will remind continuing students about the PEOs and also allow transfer students (who typically do not take CEE 1880) to see the PEOs. Finally, as part of the senior exit interview process, graduating seniors are given an opportunity to review the PEOs in an effort to establish some big picture career goals. No feedback was received from students related to the PEOs.

CEE Advisory Board: The CEE Advisory Board met on November 7, 2014 (see Appendix B for meeting minutes). The Advisory Board unanimously approved keeping the current PEOs. The PEOs will continue to be reviewed and discussed at all future annual Advisory Board Meetings.

Program Faculty: The PEOs are reviewed and discussed with the program faculty at the annual faculty retreat, which takes place every August just prior to the Fall semester. The faculty unanimously approved keeping the current PEOs during the 2014 faculty retreat (see Appendix C for meeting minutes). The PEOs will continue to be reviewed and discussed at all future annual faculty retreats.

Student Outcomes

Evaluation of the Student Outcome attainment is conducted by the CEE Assessment committee on a specified schedule with approximately one-third of the Student Outcomes assessed every year (Table 2). When deficiencies are identified, recommendations are made to fix specific problems and support continuous improvement. For example, Outcome f was re-assessed this year because the program did not meet the performance goals in 2013-14.

Table 2: Evaluation Schedule for Student Outcomes

Evaluation Date	School Year	Outcomes evaluated
May 2015	2014-15	a, b, c, d, f
May 2016	2015-16	e, f, g
May 2017	2016-17	h, i, j, k
May 2018	2017-18	a, b, c, d
May 2019	2018-19	e, f, g
May 2020	2019-20	h, i, j, k

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2014-15 Assessment of Student Outcomes includes data from Fall 2014 and Spring 2015.

Student Coursework: Outcomes a, b, c, d, and f were reviewed in 2014-15 (Table 2). Assessment data are summarized in Table 3 and Figure 1; detailed evaluation of each outcome is presented in Appendix D. Student assignments are evaluated on a 0-1-2 scale, which corresponds to the student's performance not meeting, partially meeting, and meeting the Outcome Objective, respectively. The EnvE program has two goals for student performance:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

Note the "sample size" in Table 3 refers to the number of individual examples of student work that were assessed for each outcome, not the number of students.

Table 3: Aggregated Assessment Results for EnvE Classes, Fall 2014 and Spring 2015

Outcome	Sample size	2	1	0	Sum of 1&2
a	286	73%	12%	15%	85%
b	85	93%	7%	0%	100%
c	235	82%	11%	7%	93%
d	238	86%	11%	3%	97%
f	241	72%	25%	3%	97%

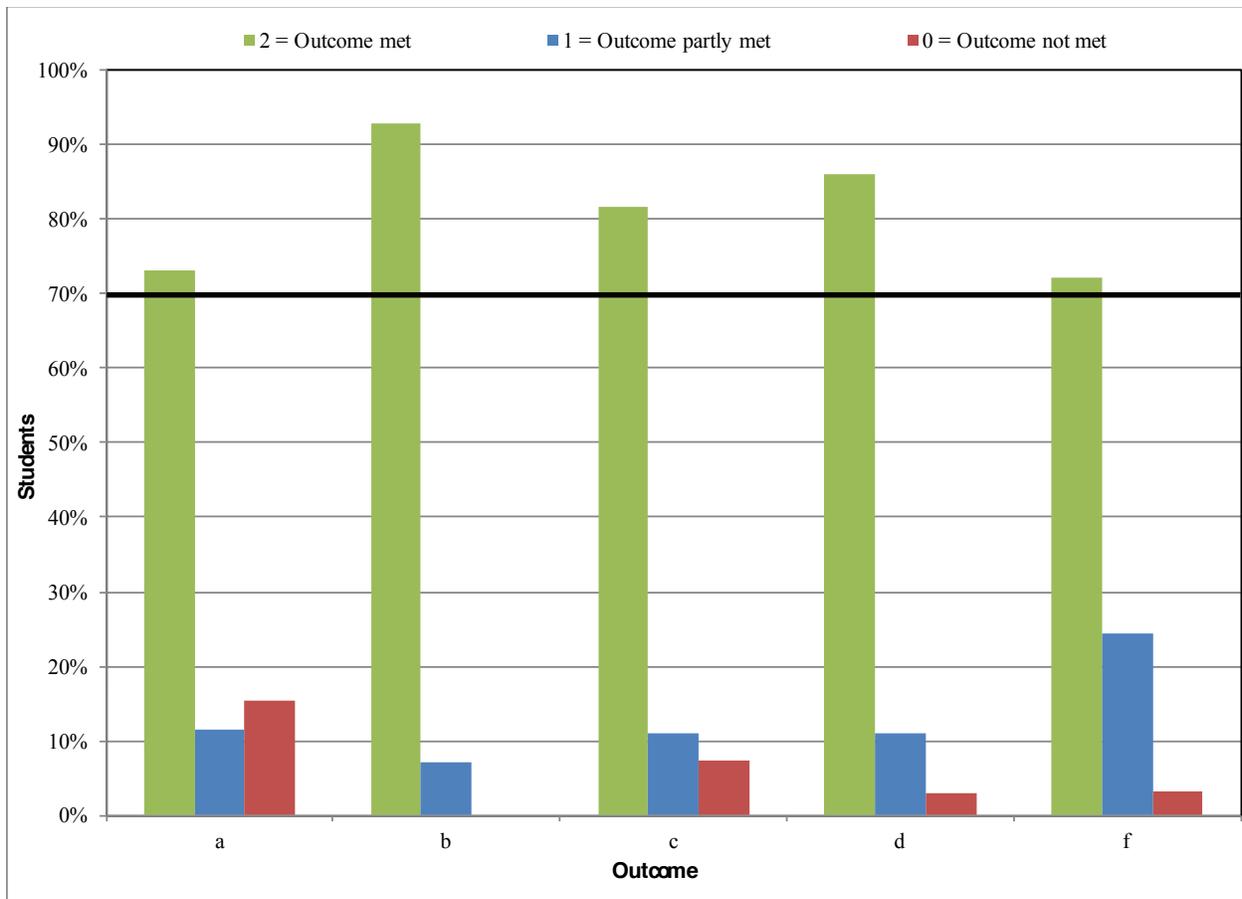


Figure 1: Aggregated Assessment Results for EnvE Classes for Fall 2014 and Spring 2015

Both goals were met for the five outcomes assessed this year. As noted in the 2013-14 report, previous assessment for Outcome b focused on students' ability to conduct experiments and analyze/interpret data, but not on design of experiments. Based on the Assessment Committee's recommendation, during Spring 2015 we intentionally introduced assignments requiring students to design (not just conduct) experiments. This was the first time such exercises have been included in CEE 5610 and 5750 (see Appendix D), and the instructors and students were enthusiastic about this type of assignment.

During the 2013-14 evaluation of Outcome f (ethics), it was noted that 94% of student assessments rated a 1 or 2, which met Goal 2. However, Goal 1 was not met, as only 66% of the students performed at a 2 level. This was mainly due to poorer performance on the ethics quiz in CEE 3880 (Design I). Based on this evaluation, we added additional information on professional ethics and brought in a guest speaker from the Utah Division of Occupational and Professional Licensing for the Fall 2014 CEE 4870 (Design II) class. During 2014-15, student performance on Outcome f was improved and both goals were met.

Fe Exam: Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table 4 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU EnvE pass rate has been either 100% or comparable to the national average (considering the small number of USU EnvE graduates).

Table 4: EnvE Graduates Passing FE Exam vs. National Pass Rate

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
USU EnvE graduates	10	6	10	4	5	2
USU EnvE pass rate at graduation	80%	100%	80%	100%	100%	100%
National EnvE pass rate	84%	85%	83%	88%	84%	77%

FE Exam performance by first-time test takers for various engineering topics is summarized in Figure 2. Only one student’s FE Exam performance by topic was reported. This student performed well above the national average on all fundamental engineering topics except materials science (Figure 2). Given only one data point, however, it is difficult to draw any conclusions from this result. Nevertheless, the fact that all of the EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

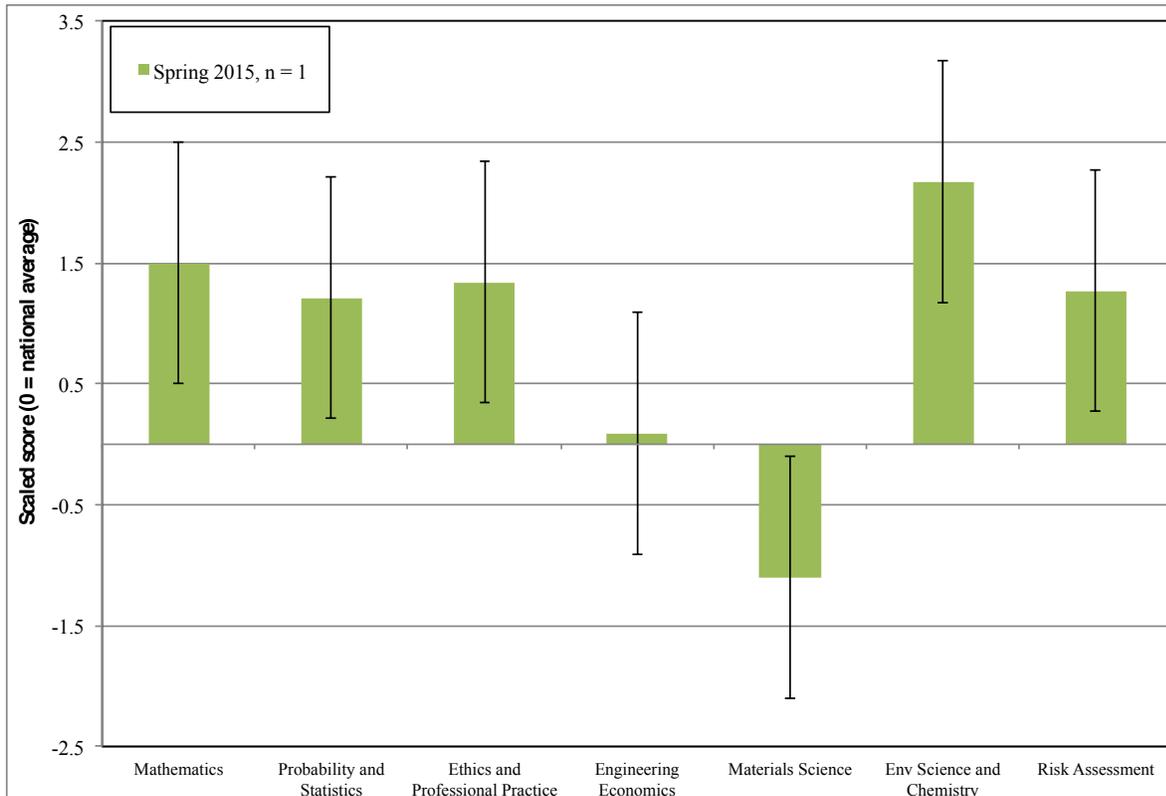


Figure 2: Scaled Fe Exam results (math, science, engineering fundamentals). Error bars represent uncertainty range for scaled scores.

Senior exit interview: During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome fully met). The performance goal is to have at least 80% of the students rating their attainment as “fully met” (2) or “partly met” (1). Only two students graduated this year, and the small sample size makes it difficult to draw conclusions. Overall, responses were positive and both students rated Outcomes a, c, d, and f as “fully met.” For outcome b, one student rated the outcome as “fully met” and the other rated it as “partly met” (Figure 3). Acknowledging that this is a subjective self-evaluation with a small sample size, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

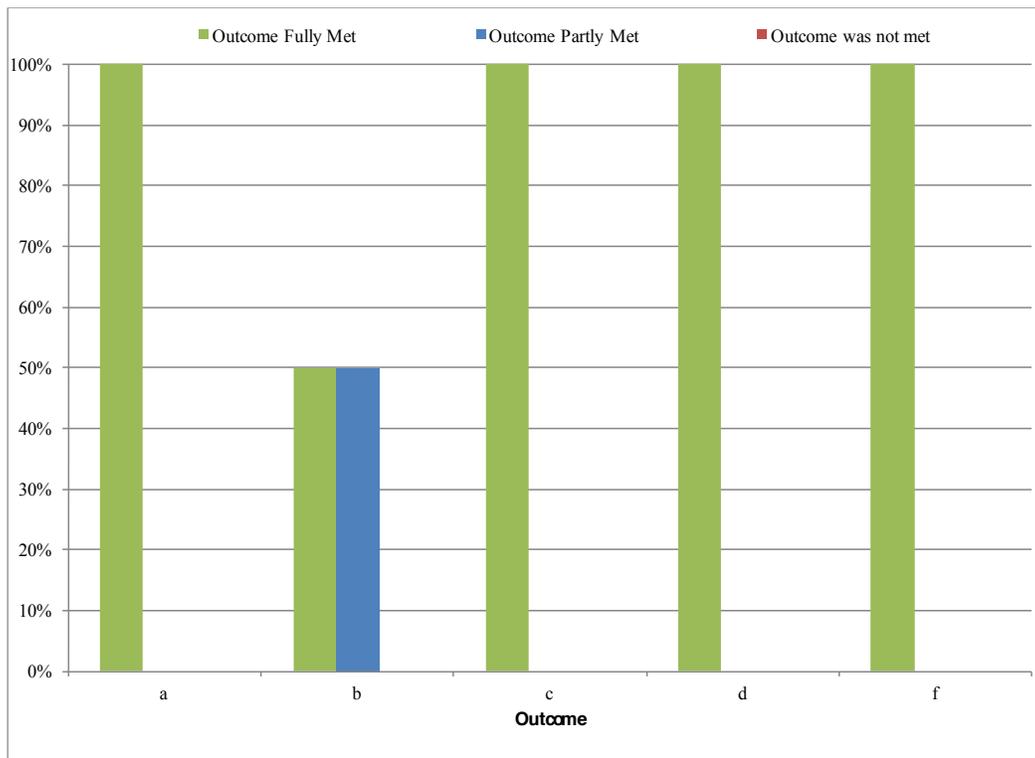


Figure 3: Student exit interview ratings of progress on Outcomes a, b, c, d, and f

Summary: The CEE Assessment Committee met in January and May 2015 and evaluated all of the assessment data presented herein.

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes a, b, c, d, and f are being met. Performance on Outcome f was improved due to inclusion of additional material on ethics and professional licensure in senior design.

Recommendations

Evaluate Outcomes a, b, c, and d as planned during the 2017-18 school year, and evaluate Outcome f as planned in the 2015-16 school year. Continue to implement new experimental design activities for Outcome b.

Appendix A Slides from CEE 1880

(introducing freshmen students to ABET PEOs and outcomes)

CEE Degrees offered at USU

- Bachelor of Science Accredited Degrees
 - Civil Engineering
 - Environmental Engineering
- Masters Degrees
- Doctor of Philosophy Degrees (PhD)

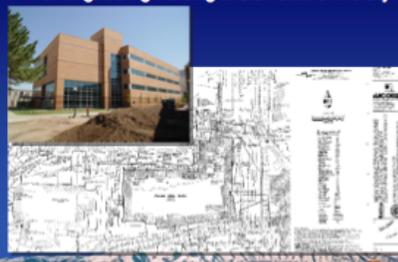


ABET Accreditation is important

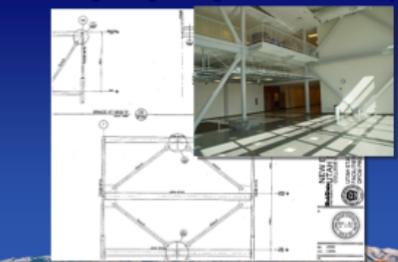
- Accreditation Board of Applied Sciences, Computing, Engineering, and Technology
- Required ABET degree to achieve a Professional Engineers License (PE) to practice as a professional engineer



New Engineering Building at Utah State University



New Engineering Building at Utah State University



**NEW ENGINEERING BUILDING
UTAH STATE UNIVERSITY**

COLLEGE OF ENGINEERING LOGAN, UTAH 84322-4111

UTAH STATE DIVISION OF
FACILITIES CONSTRUCTION & MANAGEMENT
DFCM PROJECT NO. 01020300




**Western Schools with ABET Accredited
Degrees in Both Civil and in Environmental Engineering**



- Oregon State University
- Utah State University
- University of California at Berkeley
- University of Nevada at Reno
- Colorado State University
- University of Colorado
- United States Air Force Academy
- California Polytechnic State University
- University of Southern California
- Northern Arizona University
- University of Oklahoma
- University of Texas at Austin





ABET is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accredits over 3,300 programs at more than 600 colleges and universities in 24 countries. ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating an institution as a whole.

ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students. ABET is recognized by the Council for Higher Education Accreditation (CHEA).



Utah State University Mission Statement

The mission of Utah State University is to be one of the nation's premier student-centered and grant and space-grant universities by fostering the principles that academics come first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

College of Engineering Mission Statement

The mission of the USU College of Engineering is to foster a diverse and creative learning environment that will empower students and faculty with the necessary knowledge and facilities to be international leaders in creating new technologies and services that will improve.

Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the **Civil Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in civil engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the **Environmental Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in environmental engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

Student Outcomes

The Civil Engineering and Environmental Engineering Programs use 11 student outcomes to prepare graduates of the programs to attain the program educational objectives. By the time of graduation, students will have:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) the recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

ABET Accreditation at Utah State University leads to proficiency in at least 4 areas of Civil and Environmental Engineering

- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

Most USU graduates will achieve proficiency in 5 to 6 areas

Code of Ethics (from ASCE)

Fundamental Principles
Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

- using their knowledge and skill for the enhancement of human welfare and the environment;
- being honest and impartial and serving with fidelity the public, their employers and clients;
- striving to increase the competence and prestige of the engineering profession; and
- supporting the professional and technical societies of their disciplines.

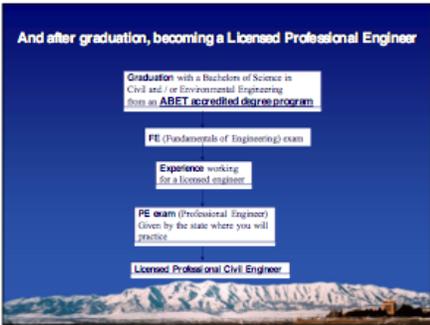


Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession.
- Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.



And after graduation, becoming a Licensed Professional Engineer



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graph TD; A["Graduation with a Bachelor's degree in Civil and/or Environmental Engineering from an ABET accredited degree program"] --> B["FE (Fundamentals of Engineering) exam"]; B --> C["Experience working for a licensed engineer"]; C --> D["PE exam (Professional Engineer) Given by the state where you will practice"]; D --> E["Licensed Professional Civil Engineer"];
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Note: non-ABET related items have been removed from these minutes

Appendix B

Utah State University Civil and Environmental Engineering Advisory Board Meeting

November 7, 2014

8:30 – 2:30 – Library Room 101

Faculty					
X	Craig Adams	X	Neil Allen	X	Paul Barr
X	James Bay		Bruce Bishop	X	Joe Caliendo
	Anthony Chen		William Doucette	X	Ryan Dupont
X	Marv Halling		Jeff Horsburgh		Jagath Kaluarachchi
	Marc Maguire		Randy Martin		Mike McFarland
X	Mac McKee	X	Laurie McNeill		Christopher Neale – on leave
	Beth Neilson – on sabbatical	X	Richard Peralta		Bill Rahmeyer
	John Rice		David Rosenberg – on sabbatical	X	Ziqi Song
X	David Stevens		David Tarboton – on sabbatical		Blake Tullis – on sabbatical
	Gilberto Urroz				
Staff					
	Sheila Jessie		Marlo Bailey		Rebeca Olsen
	Paul Rew		Ken Jewkes	X	Michelle Lerwill
Advisory Board					
	Todd Adams	X	Mav Allen		Mark Bowen
X	Bruce Brotherson		Carlos Braceras		Shelley Dyer
	Dee Hansen		Adam Murdock	X	Zan Murray
X	Mark Neilson		Larry Peterson	X	Rick Rosenberg
X	Brent White	X	Brandon Jones	X	Cheryl Heying
X	Barbara Hall		Jon Ginn	X	Boyd Wheeler

Items

8:30 – 9:00

Continental Breakfast

9:00 – 9:25
9:25 – 10:00

Welcome and Introductions
ABET Assessment (Sr. Design)

Craig Adams
Laurie McNeill

Laurie McNeill's presentation is attached.

ABET is important to us not only because we want the accreditation, but also because we want our students to have the best education possible.

We assess 3 things:

Student Course Work

We assess each class by using the ABET a-k student outcomes. See handout.

FE exam

We want to have a 100% pass rate. We currently have a very high pass rate and feel like we are meeting our goal.

Senior Exit Interviews

We are using a new qualtrics survey rating 0, 1 or 2. Information is obtained from the students and calculated to show us how they are feeling about their CEE experience. It also gives us the information for ABET.

What's our "to do" list?

Keep assessing

We are reevaluating our "f" outcome which involves ethics.

We are making some changes on having students design experiments instead of just doing experiments

We are looking at outcomes a and j to assess some improvements that might be needed.

Lab improvements

Clean up

Safety – no safety issues in our labs at this time, but we want to keep it that way.

- The Advisory Board agreed that the current PEOs are adequate and had no suggestions for changes.
- The comment was made about getting the engineer's voice in the community. Increase community involvement to improve our experience with the community.
- Right now we have several student groups. For more information on our groups you can check them out on our website. Student groups get them out in the field more and expand opportunities.
- If student groups are receiving monies for their organization they must do outreach. Each group that is receiving money is working on outreach possibilities on an ongoing basis.
- Once a student does a design project in the senior design course, the students are required to go out and present their design to the community.
- For those of you that hire our students, how are our students doing as far as communicating with the public? Some new hires seem scared. They may need more exposure to the public to better develop their communication skills. We could set up mock public hearings then debrief. We could possibly video tape them so they can see how they are doing.
- Some students just have a natural talent for speaking and that should be encouraged. For some students it is more of a struggle. Those who are struggling can be given more opportunities to improve.

- So many students are communicating through social network now so real life communication skills can suffer.
- Have them go to public hearings and have them report on it. Students could discuss how they would have responded to the people's questions? How would they handle hostile comments? This could be an eye opening opportunity for students.
- The senior design class does have a communication component to their course. Besides being able to present a design they should have a clear concept of the entire project. What kind of pipe? What type of concrete? etc. When they are working in the field they will need to understand more of the project. The class does have professors of practice taking a percentage of class time to come and do presentations in the class.
- Video conferencing would allow them to talk to people outside of Cache Valley. This could help students have a broader concept of other areas.

Note: non-ABET related items have been removed from these minutes

Appendix C

CEE Annual Faculty/Staff Retreat Minutes

Monday, August 18, 2014; 8:30 am - 3:00 pm

Logan Country Club, Sage Room

Attendance

X	Craig Adams	X	Neil Allen	X	Paul Barr
X	James Bay	X	Bruce Bishop	X	Joe Caliendo
X	Anthony Chen	X	William Doucette		Ryan Dupont
X	Marv Halling		Tony Castronova		Jeff Horsburgh
X	Jagath Kaluarachchi	X	Marc Maguire	X	Randy Martin
X	Mike McFarland		Mac McKee	X	Laurie McNeill
	Christopher Neale – leave of absence		Beth Neilson - sabbatical	X	Richard Peralta
	Bill Rahmeyer	X	John Rice		David Rosenberg - sabbatical
	Ziqi Song	X	David Stevens		David Tarboton - sabbatical
	Blake Tullis - sabbatical	X	Gilberto Urroz		
X	Sheila Jesse		Marlo Bailey	X	Rebeca Olsen
X	Paul Rew	X	Ken Jewkes	X	Michelle Lerwill
X	Matt Jensen	X	Monica Kessel	X	Kathy Bayn

8:15 – 9:00

Breakfast on the veranda

1. 09:00 - Welcome and let's get going

2. 09:02 - ABET – Laurie McNeill

- a. Summary of ABET evaluation results and action items
- b. Update self-study materials
- c. Preparing for the ABET visit
- d. Other

See Laurie's attachments.

Action item: review PEOs. The faculty unanimously agreed that the PEOs are sufficient and no changes are required at this time.

Action item: FE exam – required to pass?

We will require students to pass the FE exam. They will be given 3 chances to pass it on their own. If they don't pass we will have them meet with Craig and or faculty to take an oral exam.

Post FE exam results on the website. Tell a little about the exam.

Can we find FE exam help online – practice test?

3. 10:00 - Selected informational

a. Sr. exam interview discussion

If they are being charged through course fees for labs – then the labs should be updated to show that we are using their course fees for them.

Senior Design assignment to do the senior exit exam online.

We want to show that their feedback is important to us.

More description on senior exit questions – ethics

ASCE ethics posters posted in different areas – on website

Appendix D
Detailed Evaluation for Outcomes a, b, c, d, and f

See following pages

Environmental Engineering
ABET Outcome Summary
2014-2015

Outcome a: an ability to apply knowledge of mathematics, science, and engineering

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

- 0 = student did not understand the fundamental principle or component
- 1 = student applied some but not all of the fundamental principles in their solution
- 2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

This outcome was assessed in 9 classes, including lower- and upper-division classes, using 286 samples of student work including homework, exams, quizzes, and a pre/post-test (see Table A-1 on the next page). Student performance met both goals, with 73% of students rating a 2 and 85% rating a 1 or 2 (Figure A-1).

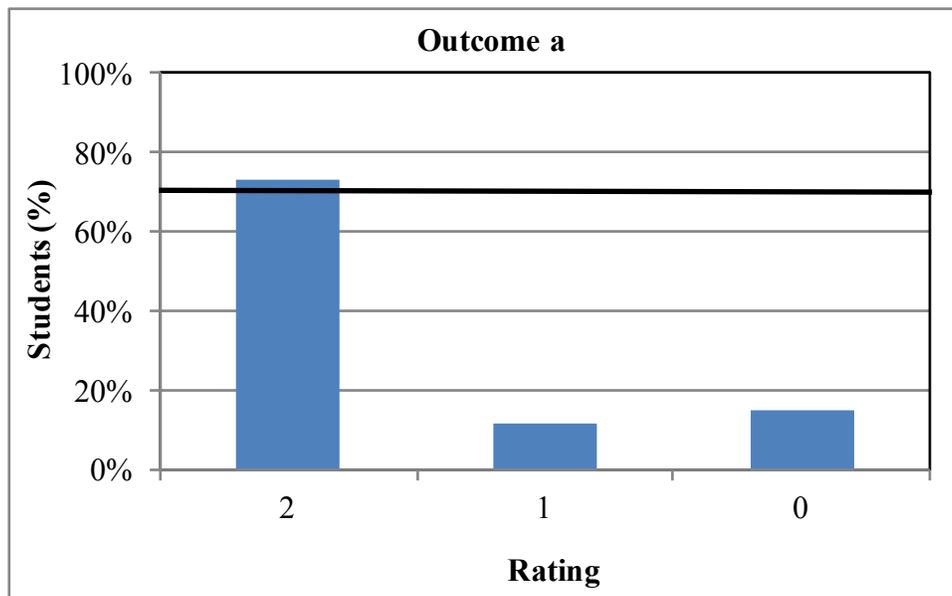


Figure A-1: Summary of ratings of student work on Outcome a

Table A-1: List of student work assessed for Outcome a

Class		Name	Instructor	Term	Enrol	Method	Description	2	1	0
CEE	2620	Env Microbiology	Sorenson	Sp2015	8	exam question	sketch electron transport chain	50%	0%	50%
CEE	3430	Engineering Hydrology	Castronova	Sp2015	67	exam	calc hydrograph using unit hydrograph	75%	22%	3%
CEE	3610	Environmental Mgmt	McNeill	F2014	67	HW	calc PM2.5 conc, limiting reactant - basic math/science	81%	12%	7%
CEE	3640	Water and Wastewater Trt	McNeill	Sp2015	14	HW	population calculation (Math)	79%	21%	0%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F2014	55	pre/post test	integrated solid waste management	65%	0%	35%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F2014	55	pre/post test	role of source reduction vs recycling in ISWM	74%	0%	26%
CEE	5430	Groundwater Engineering	Kaluarachichi	F2014	14	HW	soil water profile content in unsaturated soil	79%	21%	0%
CEE	5620	Aquatic Chemistry	Doucette	Sp2015	7	quiz	draw pC-pH diagram and calc pH of water	43%	57%	0%
CEE	5730	Analysis/fate Org Contam	Doucette	F2014	1	quiz	partitioning of compound between air/water/sediment - basic science	100%	0%	0%
CEE	5730	Analysis/fate Org Contam	Doucette	F2014	1	quiz	partitioning of compound between air/water/sediment - basic science	0%	0%	100%

FE Exam Results

Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table A-2 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU EnvE pass rate has been either 100% or just below the national average. Realistically, these values are considered comparable to the national average, considering the small number of USU EnvE graduates.

Table A-2: EnvE Graduates Passing FE Exam vs. National Annual Pass Rate

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USU EnvE pass rate at graduation	80%	100%	80%	100%	100%	100%
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Only one student's FE Exam performance by topic was reported. This student performed well above the national average on all fundamental engineering topics except materials science (Figure A-2). Given only one data point, however, it is difficult to draw any conclusions from this result. Nevertheless, the fact that all of the EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a, e, f, and k. It is also a strong indication of a good foundation for life-long (independent) learning skills.

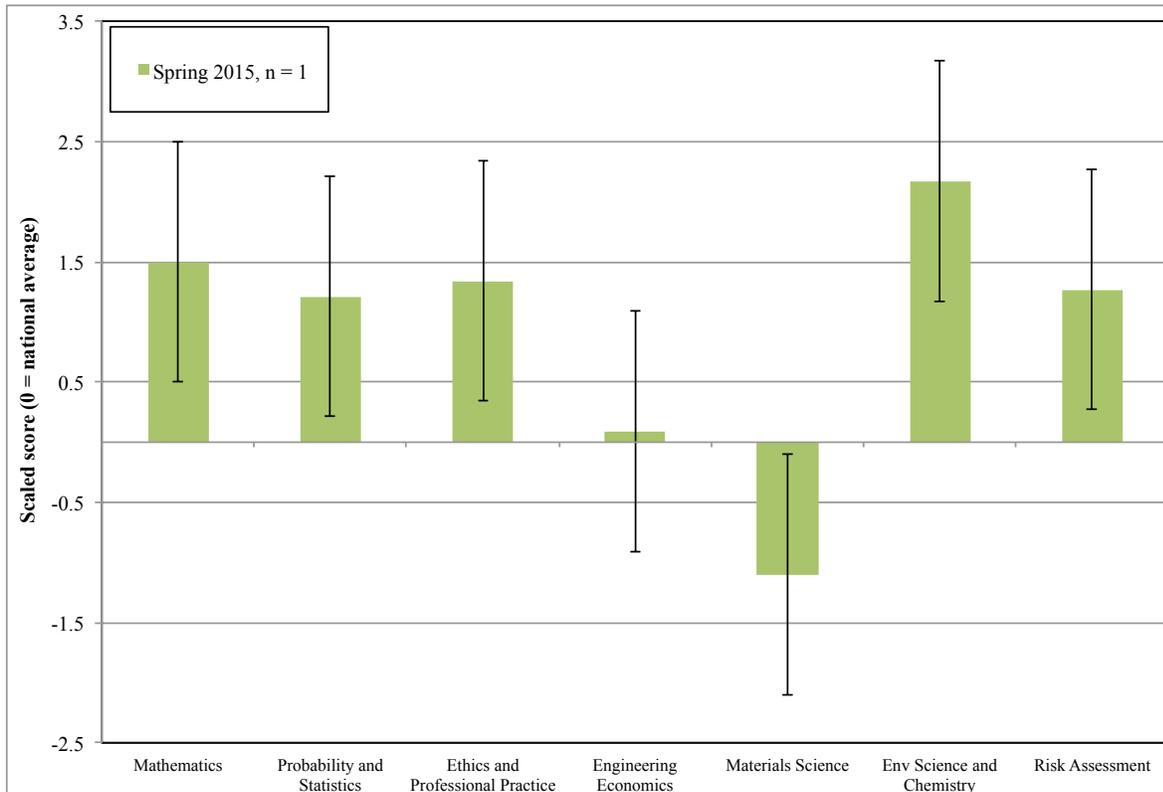


Figure A-2: Scaled Fe Exam results (math, science, engineering fundamentals). Error bars represent uncertainty range for scaled scores.

Senior Exit Interviews

During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome met). The response rate to the senior exit interview is always high (90 – 100%). The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 100% of students rating Outcome a as “met” (Figure A-3). Acknowledging that this is a subjective self-evaluation and the sample size is small (n = 2 for Spring 2015), these exit interview results are taken as a general indication that students feel they are meeting the outcome.

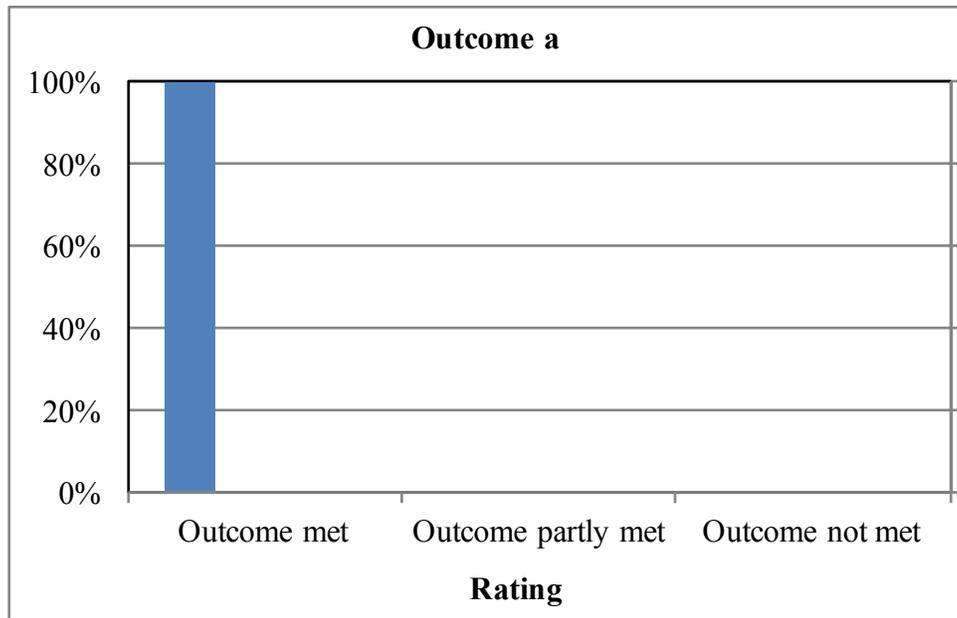


Figure A-3: Student exit interview ratings of progress on Outcome a

Summary

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcome a is being met.

Recommendations

Evaluate Outcome a as planned during the 2017-2018 school year.

Environmental Engineering
ABET Outcome Summary
2014-2015

Outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

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The EnvE program has two goals for student performance for student course work assessment:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
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This outcome was assessed in three lab-based courses (see Table B-1 on the next page), using 85 samples of student work. Overall student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure B-1). As noted in the 2013-14 report, previous assessment focused on students' ability to conduct experiments and analyze/interpret data, but not on design of experiments. Based on the Assessment Committee's recommendation, during Spring 2015 we intentionally introduced assignments requiring students to design (not just conduct) experiments. This was the first time such exercises have been included in CEE 5610 and 5750 (Table B-1), and the instructors and students were enthusiastic about this type of assignment.

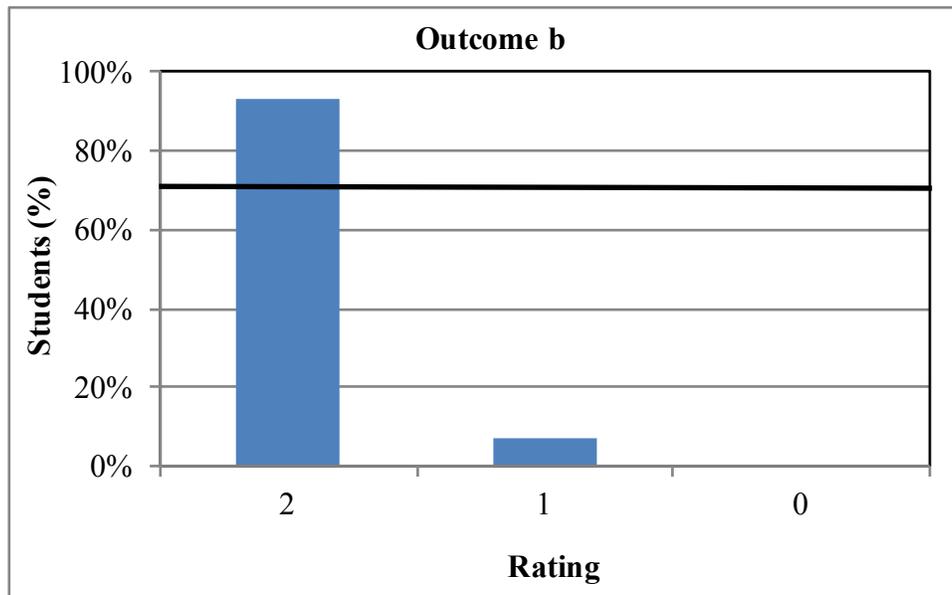


Figure B-1: Summary of ratings of student work on Outcome b

Table B-1: List of student work assessed for Outcome b

Class		Name	Instructor	Term	Enrol	Method	Description	2	1	0
CEE	3510	Hydraulics	Urroz	Sp2015	67	lab exercise	Design an expt for hydraulic structure	94%	6%	0%
CEE	5610	Env Quality Analysis	McLean	F2014	5	lab report	analyze data: dissolved O2 lab report	60%	40%	0%
CEE	5610	Env Quality Analysis	McLean	F2014	5	lab report	analyze data: hardness lab report	100%	0%	0%
CEE	5610	Env Quality Analysis	McLean	F2014	5	lab exercise	develop exp plan for field sampling projects	100%	0%	0%
CEE	5750	Air Quality Measurements	Martin	Sp2015	3	lab exercise	design expt to measure CO from vehicles	100%	0%	0%

FE Exam Results

Not applicable to this outcome.

Senior Exit Interviews

During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome met). The response rate to the senior exit interview is always high (90 – 100%). The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”. This goal was achieved with one student rating Outcome b as “met” and the second student rating it as “partly met” (Figure B-2). Acknowledging that this is a subjective self-evaluation and that student numbers are small (n = 2 for Spring 2015), these exit interview results are taken as a general indication that students feel they are meeting the outcome.

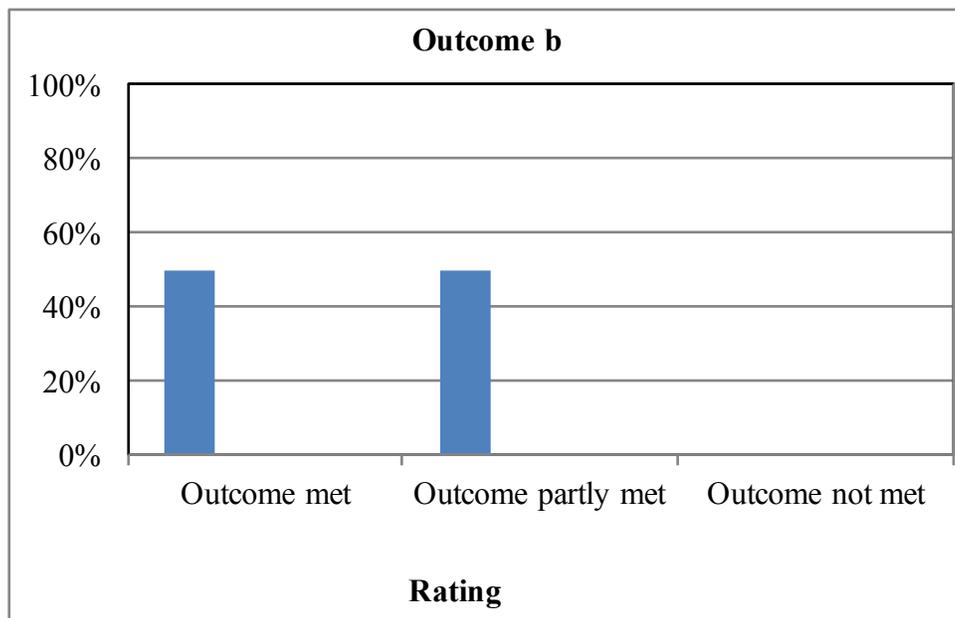


Figure B-2: Student exit interview ratings of progress on Outcome b

Summary

The evaluation of student work and senior exit interviews indicates that Outcome b is being met. New activities requiring students to design (not just conduct) experiments were successful.

Recommendations

Continue to implement new experimental design activities. Evaluate Outcome b as planned during the 2017-2018 school year.

Environmental Engineering
ABET Outcome Summary
2014-2015

Outcome c: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

- 0 = student did not understand the fundamental principle or component
- 1 = student applied some but not all of the fundamental principles in their solution
- 2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

This outcome was assessed in several upper-level classes as well as through the capstone design experience (culminating in CEE 4880), using 235 samples of student work (see Table C-1 on the next page). In particular, students in the design class must specifically address the “health and safety” and “constructability” aspects of their project, as well as three of the six other constraint areas (economics, environmental, social, political, ethical, and sustainability). Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure C-1).

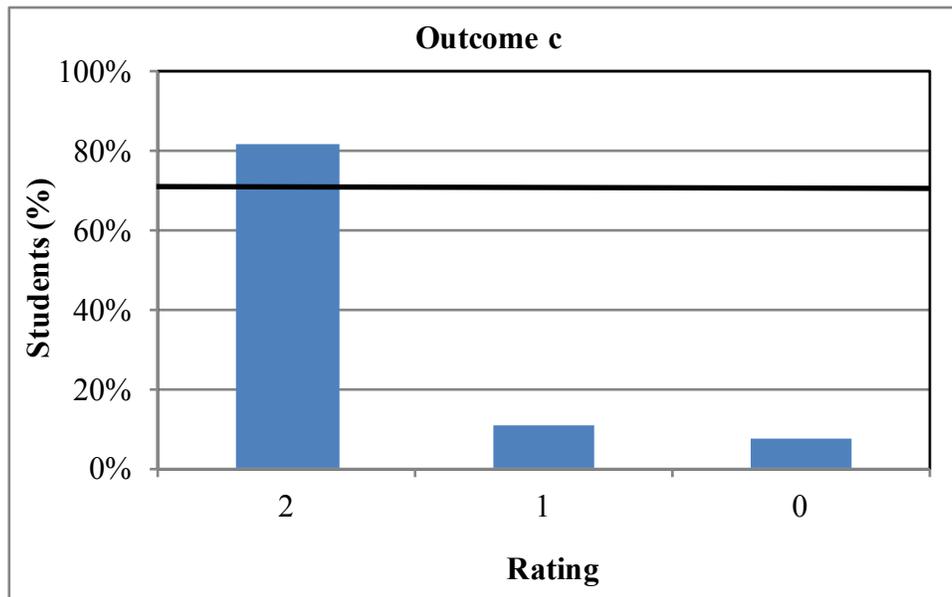


Figure C-1: Summary of ratings of student work on Outcome c

Table C-1: List of student work assessed for Outcome c

Class		Name	Instructor	Term	Enrol	Method	Description	2	1	0
CEE	3640	Water and Wastewater Trt	McNeill	Sp2015	14	mini-design	design within env constraints: coag/floc/sed	57%	36%	7%
CEE	3640	Water and Wastewater Trt	McNeill	Sp2015	14	mini-design	design within env constraints: filtration/sorp/IX	93%	7%	0%
CEE	3640	Water and Wastewater Trt	Dupont	Sp2015	14	mini-design	design within tech, econ, env, H+S constraints: WWTP	71%	21%	7%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F2014	55	HW	design waste transfer station within economic constraint	82%	13%	5%
CEE	4200	Engineering Economics	Stevens	F2014	53	exam	design within economic constraint	72%	8%	21%
CEE	4880	CEE Design III	Peralta	Sp2015	72	group project	design within constraints	94%	6%	0%
CEE	5860	Air Quality Management	Martin	F2014	13	exam	design an incinerator within physical/environ/cost constraints	77%	15%	8%

FE Exam Results

Not applicable to this outcome.

Senior Exit Interviews

During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome met). The response rate to the senior exit interview is always high (90 – 100%). The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 100% of students rating Outcome c as “met” (Figure C-2). Acknowledging that this is a subjective self-evaluation and that student numbers are small (n = 2 for Spring 2015), these exit interview results are taken as a general indication that students feel they are meeting the outcome.

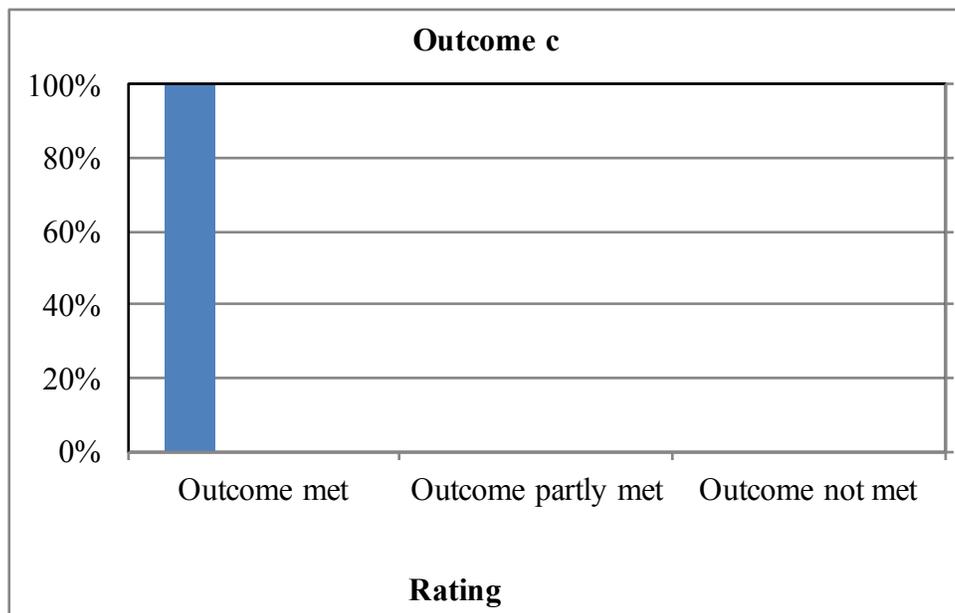


Figure C-2: Student exit interview ratings of progress on Outcome c

Summary

The evaluation of student work and senior exit interviews indicates that Outcome c is being met.

Recommendations

Evaluate Outcome c as planned during the 2017-18 school year.

Environmental Engineering
ABET Outcome Summary
2014-2015

Outcome d: an ability to function on multidisciplinary teams

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

- 0 = student did not understand the fundamental principle or component
- 1 = student applied some but not all of the fundamental principles in their solution
- 2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

Nearly all of the upper-division courses require some sort of team project, as does the capstone design sequence. Outcome d is assessed via peer evaluations of student groups in six of these classes, wherein students rate the performance of their teammates in a variety of areas (238 samples; see Table D-1 on the next page). We note that the first design class (CEE 3880) now includes a guest speaker from the USU Psychology Department who talks about effective teamwork, which was an intentional effort to provide instruction on how to function on a team, rather than just expecting the students to “figure it out.” Student feedback has been positive regarding this guest speaker. Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure D-1).

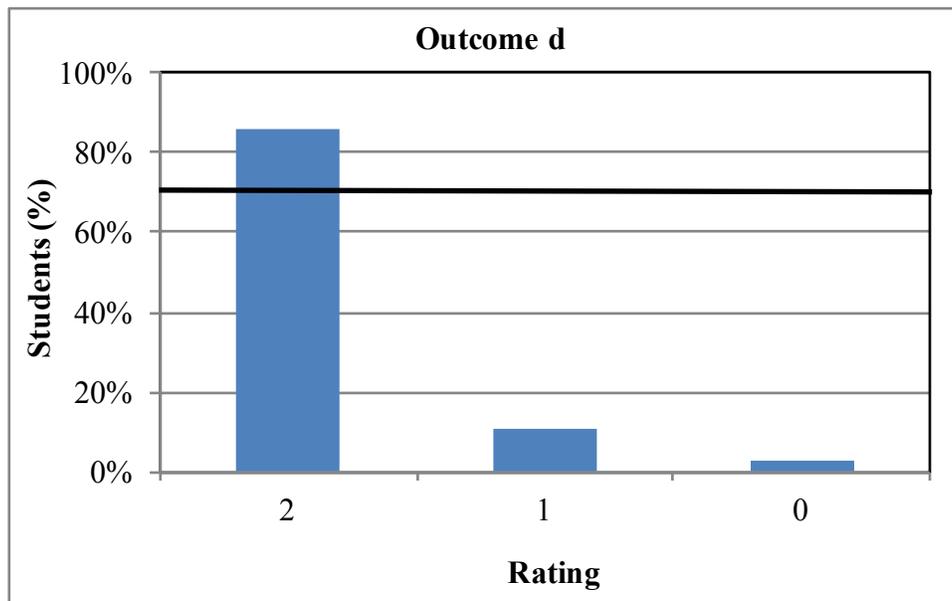


Figure D-1: Summary of ratings of student work on Outcome d

Table D-1: List of student work assessed for Outcome d

Class		Name	Instructor	Term	Enrol	Method	Description	2	1	0
CEE	3640	Water and Wastewater Trt	McNeill	Sp2015	14	group report	peer eval for group project	100%	0%	0%
CEE	3780	Solid and Haz Waste Mgmt	Dupont	F2014	55	group report	peer eval for group project	95%	2%	4%
CEE	4870	Civil Engineering Design II	Peralta	F2014	72	group report	group design report	64%	29%	7%
CEE	4880	CEE Design III	Peralta	Sp2015	72	group project	group design report	94%	6%	0%
CEE	5670	Haz Chem Safety/Handling	Doucette	Sp2015	13	group project	develop team training exercise	100%	0%	0%
CEE	5860	Air Quality Management	Martin	F2014	13	group project	peer eval for group project	100%	0%	0%

FE Exam Results

Not applicable to this outcome.

Senior Exit Interviews

During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome met). The response rate to the senior exit interview is always high (90 – 100%). The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 100% of students rating Outcome d as “met” (Figure D-2). Acknowledging that this is a subjective self-evaluation and that student numbers are small (n = 2 for Spring 2015), these exit interview results are taken as a general indication that students feel they are meeting the outcome.

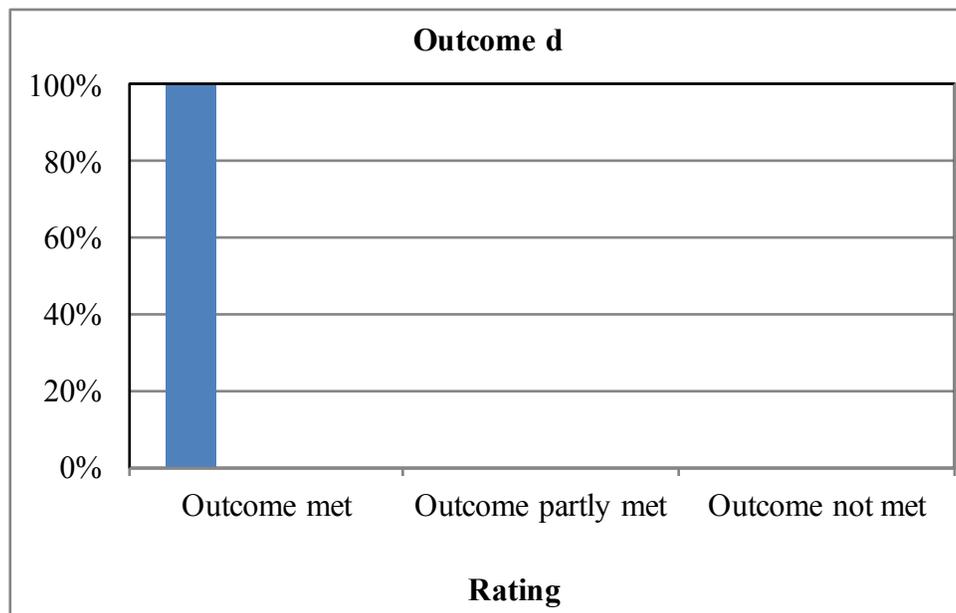


Figure D-2: Student exit interview ratings of progress on Outcome d

Summary

The evaluation of student work and senior exit interviews indicates that Outcome d is being met.

Recommendations

Evaluate Outcome d as planned during the 2017-18 school year. Include assessment of guest speaker (team building skills) in CEE 3880.

Environmental Engineering
ABET Outcome Summary
2014-2015

Outcome f: an understanding of professional and ethical responsibility

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

- 0 = student did not understand the fundamental principle or component
- 1 = student applied some but not all of the fundamental principles in their solution
- 2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

During the 2013-14 evaluation, it was noted that 94% of student assessments rated a 1 or 2, which met Goal 2. However, Goal 1 was not met, as only 66% of the students performed at a 2 level. This was mainly due to poorer performance on the ethics quiz in CEE 3880 (Design I). Based on this evaluation, we added additional information on professional ethics and brought in a guest speaker from the Utah Division of Occupational and Professional Licensing for the Fall 2014 CEE 4870 (Design II) class. For 2014-15, student attainment was assessed in three classes through a group writing assignment on the ethics associated with an engineering failure, an essay about ethics, and quizzes (241 samples of student work; see Table F-1 on the next page). Results indicate that student performance improved and both performance goals were met (Figure F-1).

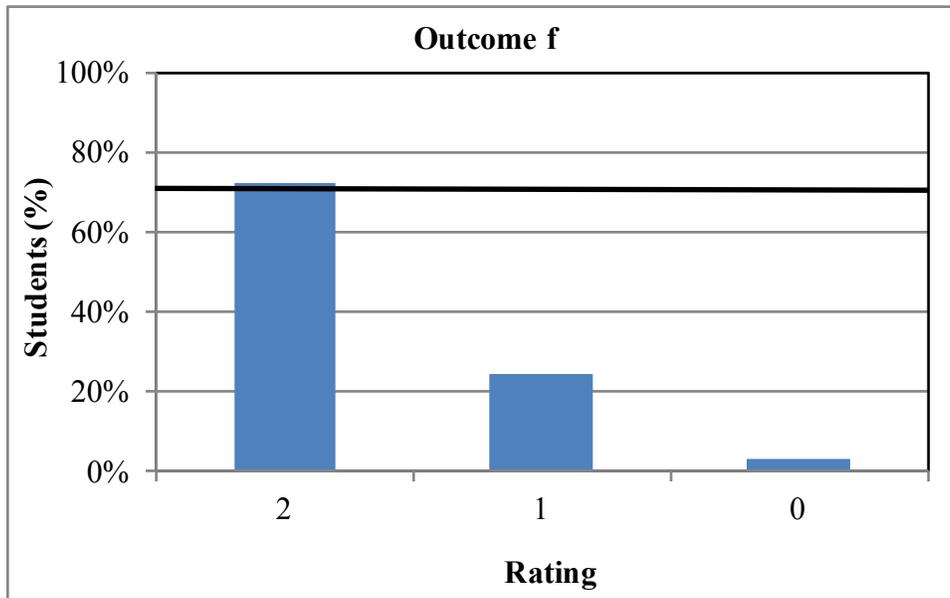


Figure F-1: Summary of ratings of student work on Outcome f

Table F-1: List of student work assessed for Outcome f

Class		Name	Instructor	Term	Enrol	Method	Description	2	1	0
CEE	1880	CEE Orientation	Rahmeyer	F2014	60	group report	summarize ethics of an engineering failure	52%	48%	0%
CEE	1880	CEE Orientation	Rahmeyer	Sp2015	35	group report	summarize ethics of an engineering failure	51%	49%	0%
CEE	2890	Sophomore Seminar	Stevens	Sp2015	6	quiz	quiz on ethics	50%	50%	0%
CEE	2890	Sophomore Seminar	Stevens	Sp2015	6	essay	essay on personal vs professional ethics	83%	17%	0%
CEE	4870	CEE Design II	Peralta	F2014	67	quiz	quiz after guest speaker on responsibilities of a professional engineer	88%	4%	7%
CEE	4870	CEE Design II	Peralta	F2014	67	quiz	quiz after guest speaker on ethics	87%	9%	4%

FE Exam Results

Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table F-2 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU EnvE pass rate has been either 100% or just below the national average. Realistically, these values are considered comparable to the national average, considering the small number of USU EnvE graduates.

Table F-2: EnvE Graduates Passing FE Exam vs. National Annual Pass Rate

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
USU EnvE graduates	10	6	10	4	5	2
USU EnvE pass rate at graduation	80%	100%	80%	100%	100%	100%
National EnvE pass rate	84%	85%	83%	88%	84%	77%

Only one student's FE Exam performance by topic was reported. This student performed well above the national average on the engineering ethics section (Figure A-2). Given only one data point, however, it is difficult to draw any conclusions from this result. Nevertheless, the fact that all of the EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a, e, f, and k. It is also a strong indication of a good foundation for life-long (independent) learning skills.

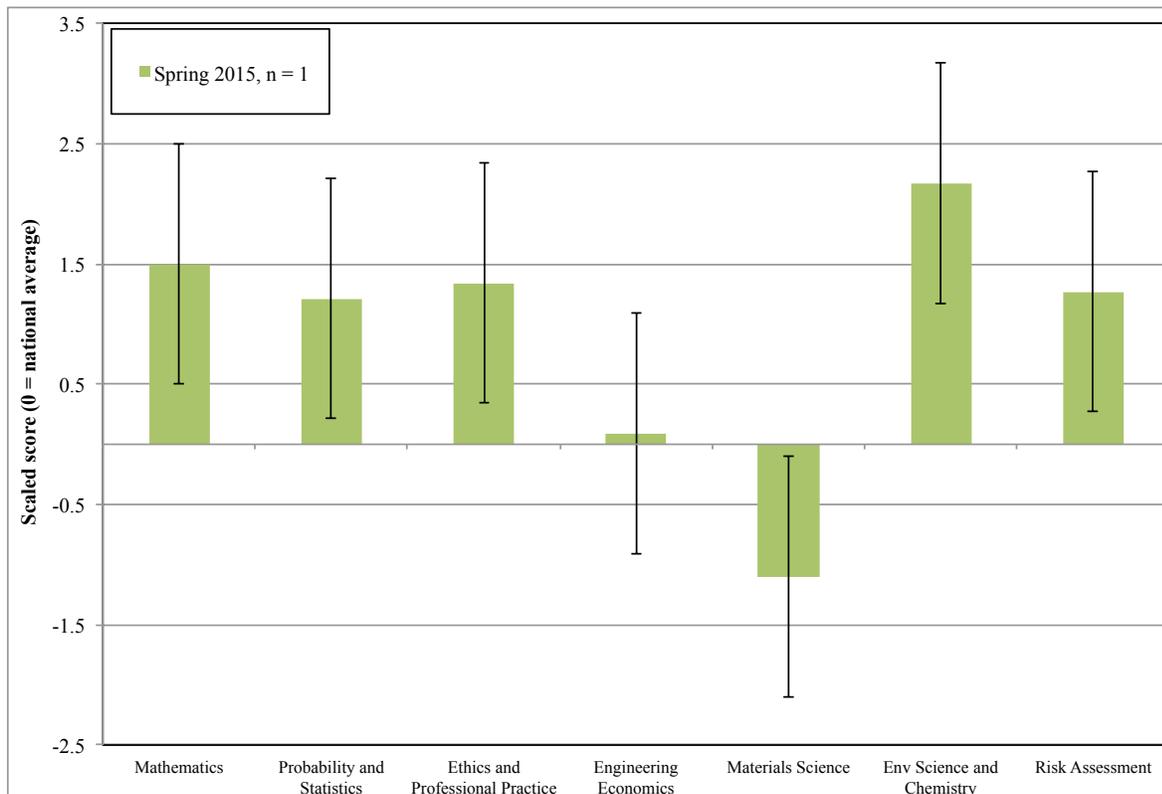


Figure A-2: Scaled Fe Exam results (math, science, engineering fundamentals, including ethics). Error bars represent uncertainty range for scaled scores.

Senior Exit Interviews

During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome met). The response rate to the senior exit interview is always high (90 – 100%). The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 100% of students rating Outcome f as “met” (Figure F-3). Acknowledging that this is a subjective self-evaluation and that student numbers are small (n = 2 for Spring 2015), these exit interview results are taken as a general indication that students feel they are meeting the outcome.

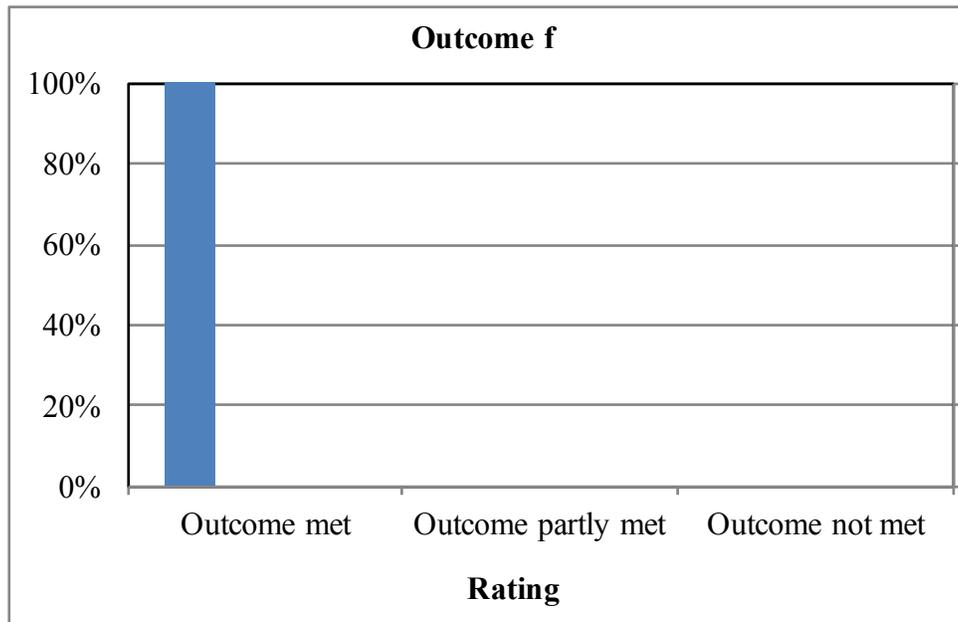


Figure F-3: Student exit interview ratings of progress on Outcome f

Summary

In 2013-14, the evaluation of student work indicated that Outcome f needed improvement; Goal 2 was met but Goal 1 was not. Changes were made to the CEE 4870 (Design II) class, which improved student performance. Both goals are now being met.

Recommendations

Evaluate Outcome f as planned during the 2015-2016 school year.