# Civil Engineering
# ABET Evaluation Summary
# 2018-2019

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Civil Engineering undergraduate program for 2018-19. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, Tullis, and Ball) in June 2019.

## Program Educational Objectives

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

Table 1: PEO Review Process and Schedule for CE 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 2019 | Fall semester 2019 |
| | Junior design course (CEE 3880) | Every junior class (Spring) | Spring 2019 | Spring 2020 |
| | Senior exit interview | Every graduating class (Spring) | April 2019 | April 2020 |
| Employers | Advisory Board meeting | Annually (typically late Fall) | November 2018 | November 2019 |
| Faculty | CEE Faculty Retreat | Annually (August) | August 2018 | August 2019 |

**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). PEOs are again shown to the juniors in CEE 3880. This reminds continuing students about the PEOs and allows transfer students (who sometimes 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. Student comments related to the PEOs (Appendix B) were very positive.

**CEE Advisory Board**: The CEE Advisory Board met on November 6, 2018 (see Appendix C 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 2018 faculty retreat (see Appendix D for meeting minutes). The PEOs will continue to be reviewed and discussed at all future annual faculty retreats.

**Student Outcomes**

Assessment of the Student Outcome attainment is conducted by the CEE Assessment Committee on a specified schedule with approximately half 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, Outcomes b and f were re-assessed in 2017 because the program did not meet the performance goals in 2015-16. For the 2018-2019 school year, we changed to the new ABET Outcomes 1-7 instead of a-k so Outcomes 1, 2, 3, and 4 were evaluated.

Table 2: Evaluation Schedule for Student Outcomes

| Evaluation Date | School Year | Outcomes Evaluated |
|---|---|---|
| May 2015 | 2014-15 | a, b, c, d |
| May 2016 | 2015-16 | b, e, f, g |
| May 2017 | 2016-17 | b, f, h, i, j, k |
| May 2018 | 2017-18 | a, b, c, d |
| **May 2019** | **2018-19** | **1, 2, 3, 4** |
| May 2020 | 2019-20 | 5, 6, 7 |

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2018-19 Assessment of Student Outcomes includes data from Fall 2018 and Spring 2019.

**Student Coursework**: Outcomes 1, 2, 3, and 4 were reviewed in 2018-19 (Table 2). Assessment data are summarized in Table 3 and Figure 1; detailed evaluation of each outcome is presented in Appendix E. 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 CE 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 CE Classes, Fall 2018 and Spring 2019

| Outcome | Sample size | 2 | 1 | 0 | Sum of 1&2 ratings |
|---|---|---|---|---|---|
| 1 | 657 | 75% | 17% | 8% | 92% |
| 2 | 680 | 80% | 13% | 7% | 93% |
| 3 | 462 | 92% | 7% | 1% | 99% |
| 4 | 178 | 76% | 13% | 11% | 89% |

Both Goals 1 and 2 were met for all four Outcomes (Figure 1). Last year (2017-18) the CE program did not meet the goals for the former Outcome c ("design within constraints") but this year we are pleased that we did meet the goal for the new Outcome 2 which has similar content ("design with considerations"). The capstone design sequence was also significantly revised this year. Instructors will continue to expand assignments to include consideration of all six factors (public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors). We will also continue to emphasize "complex engineering problems" as part of Outcome 1 and include additional assessment of the ASCE Code of Ethics for Outcome 4 (see individual outcome reports in Appendix E).

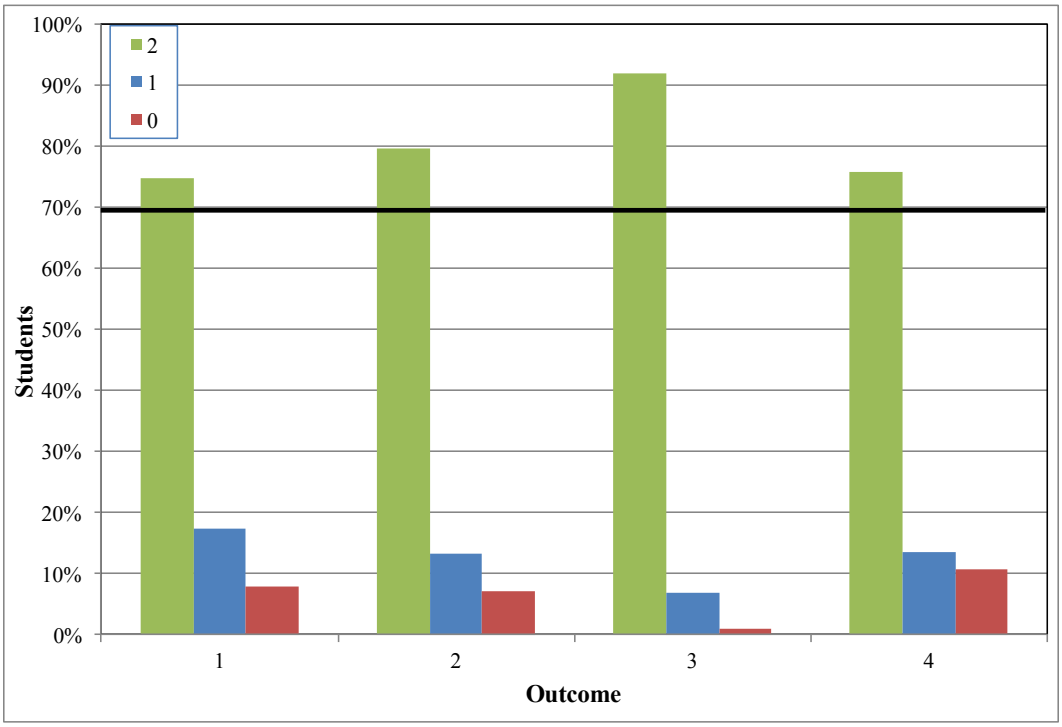


Figure 1: Aggregated Assessment Results for CE Classes for Fall 2018 and Spring 2019

**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 CE pass rate has been between 90% and 100%, well above the national average.

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

| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|---|
| Total CE degrees | 56 | 59 | 53 | 68 | 72 | 57 |
| Graduates passing FE (%) | 93% | 100% | 98% | 100% | 100% | 100% |
| National CE pass rate | 72% | 70% | 69% | 68% | 70% | 67% |

*first time test-takers in that testing period

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures 2 through 6. During the Fall 2018 and Spring 2019 testing periods, students performed at or above the national average (considering the error bars) on all fundamental engineering topics. Probability/statistics is below average although the scores overlap the national average given the error bars. Over the past five years performance has often been statistically below the national average (Figure 2). We identified this trend several years ago and it's not surprising given that CE students do not take a standalone probability and statistics course. Starting in Fall 2018, we have added one credit to the CEE 4200 course which will be used to provide a basic introduction to probability and statistics. We are also adding exercises into several CEE courses to provide some of this content. Overall, the fact that all CE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes 1 and 4. It is also an indication of a good foundation for life-long (independent) learning skills.

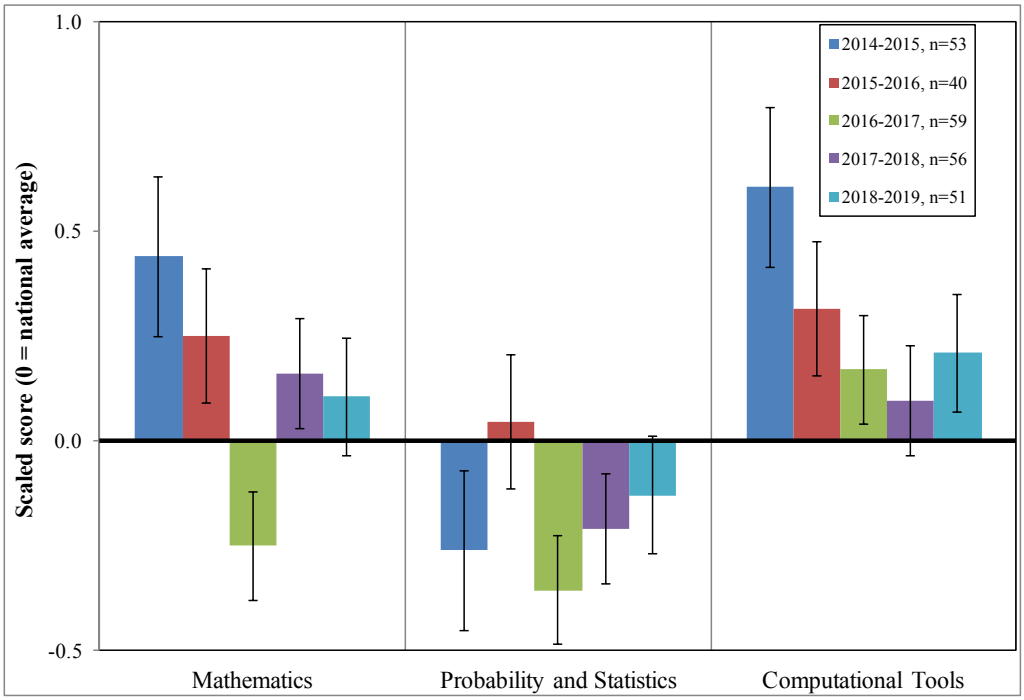



Figure 2: Scaled Fe Exam results (math, probability/statistics, and computational tools). Error bars represent uncertainty range for scaled scores.

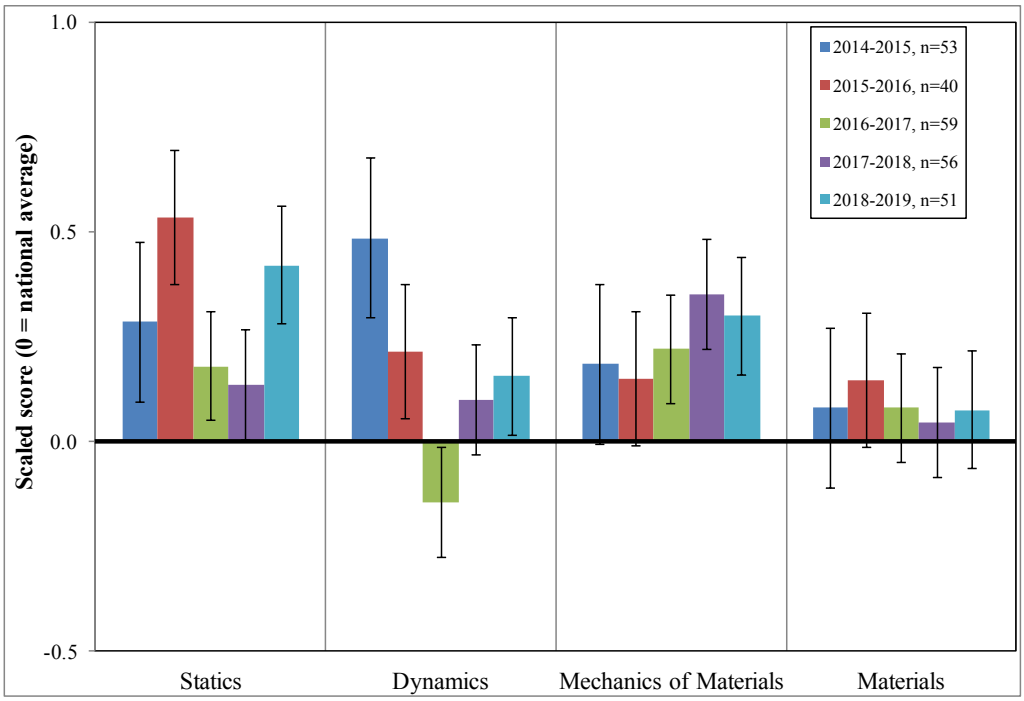



Figure 3: Scaled Fe Exam results (statics, dynamics, mechanics, and materials). Error bars represent uncertainty range for scaled scores.

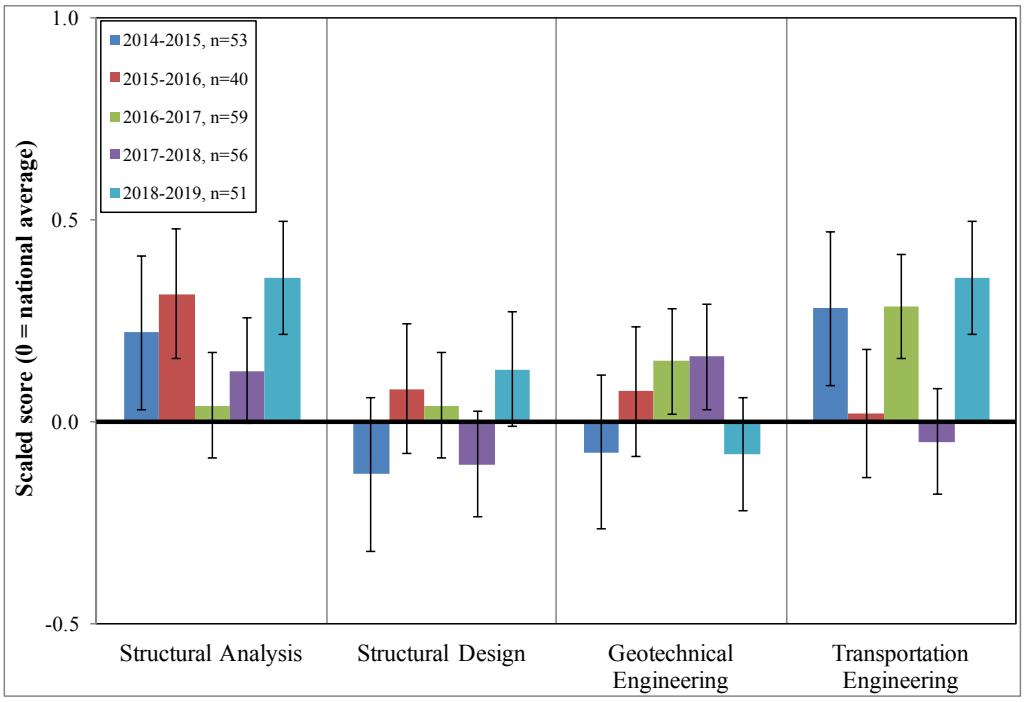



Figure 4: Scaled Fe Exam results (structural analysis and design, geotechnical engineering, transportation engineering). Error bars represent uncertainty range for scaled scores.

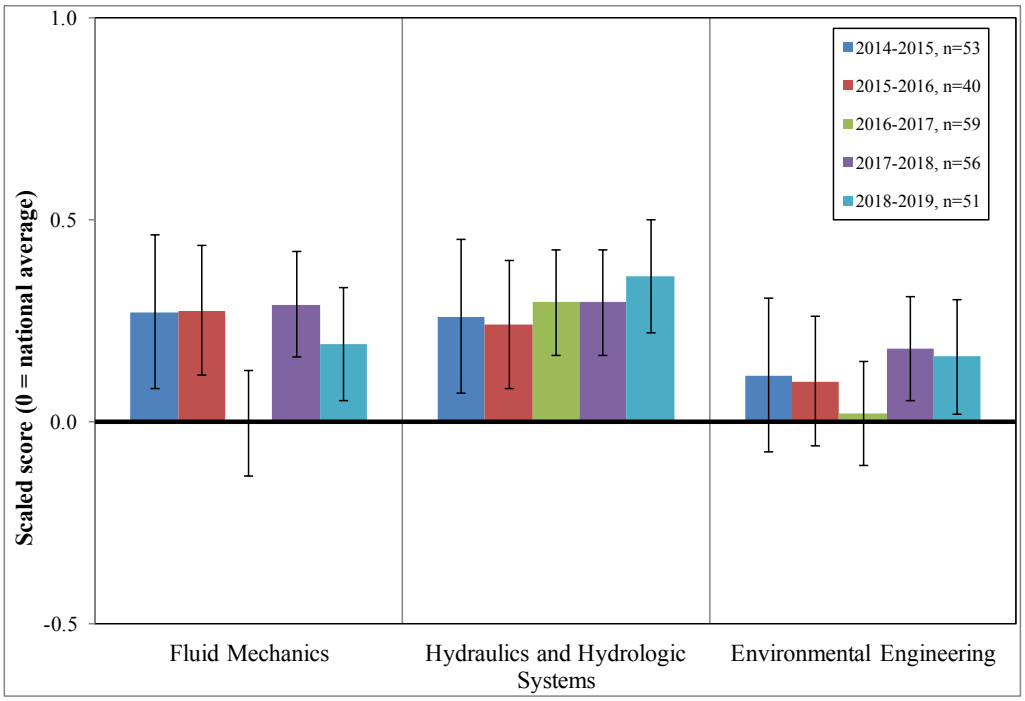



Figure 5: Scaled Fe Exam results (fluids, hydraulics, environmental engineering). Error bars represent uncertainty range for scaled scores.

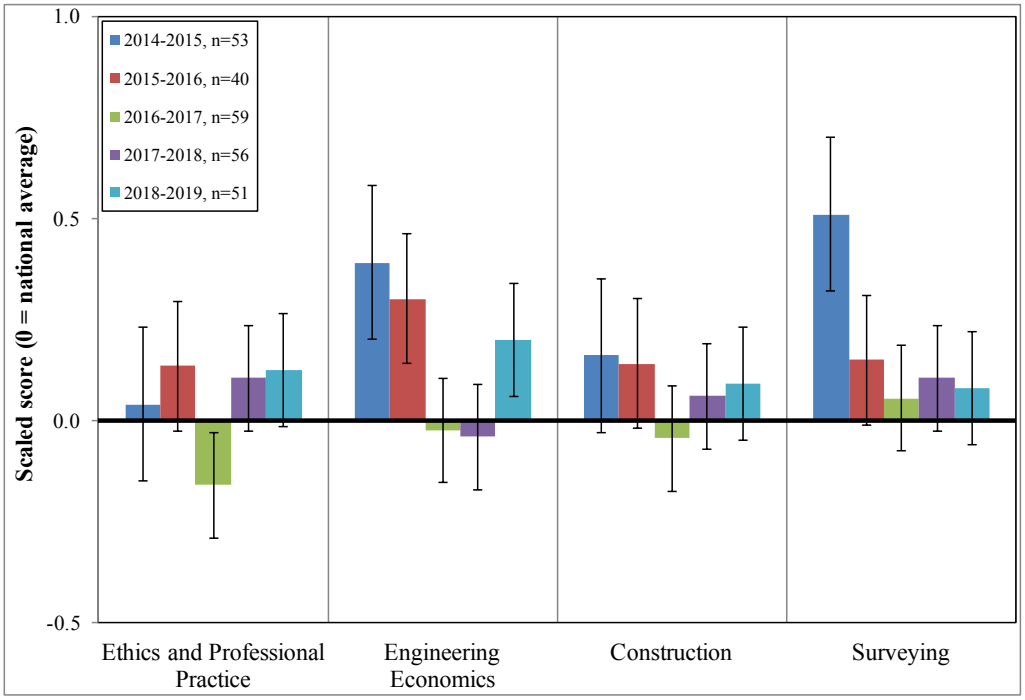



Figure 6: Scaled Fe Exam results (ethics and professional practice, economics, construction, surveying). Error bars represent uncertainty range for scaled scores.

**Senior exit interview**: Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. 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 for all four outcomes (Figure 7). Response rate for the surveys was 76% (47 out of 62 students). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcomes.

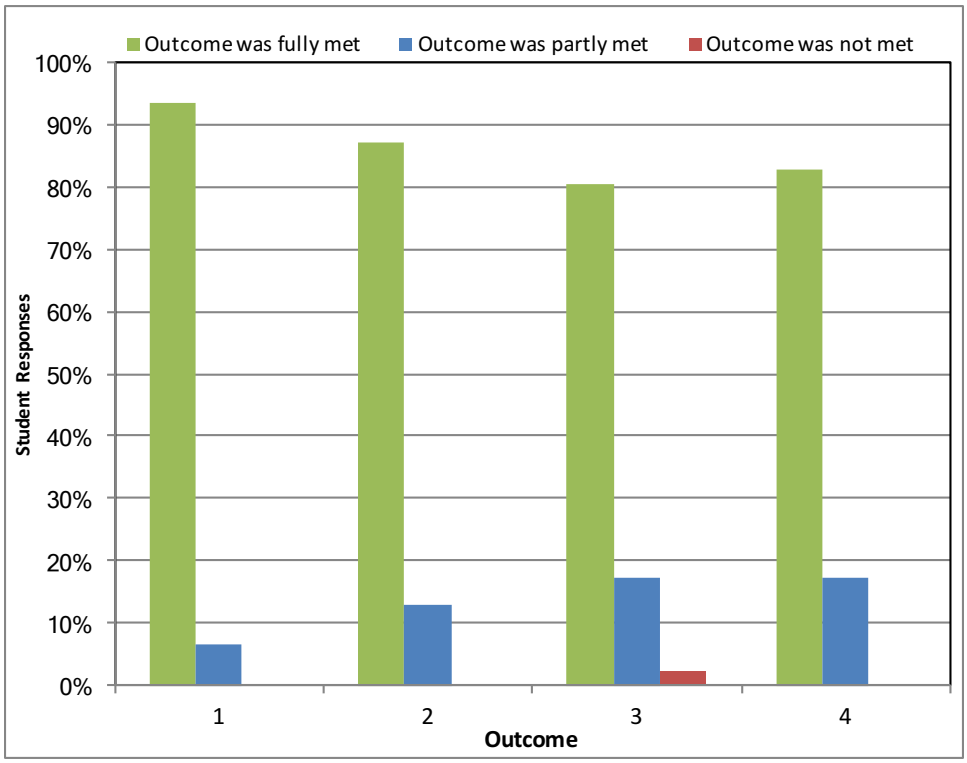



Figure 7: Student exit interview ratings of progress on Outcomes 1, 2, 3, and 4

***Summary***: The CEE Assessment Committee met in June 2019 and evaluated all of the assessment data presented herein.

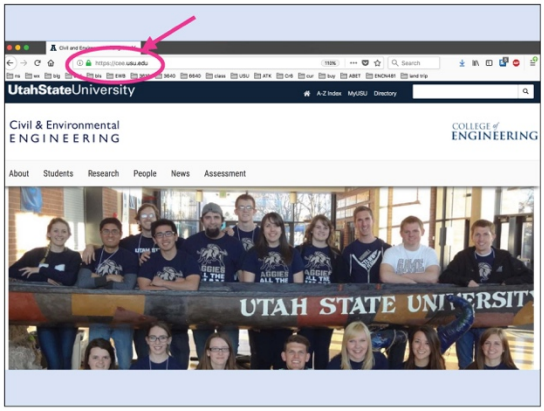
The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes 1, 2, 3, and 4 are being met. However, we need to monitor performance on probability/statistics (Outcome 1), ensure that all six considerations are addressed during design problems (Outcome 2), and make sure that students consider all four contexts for engineering solutions and that the ASCE Code of Ethics is specifically assessed (Outcome 4).

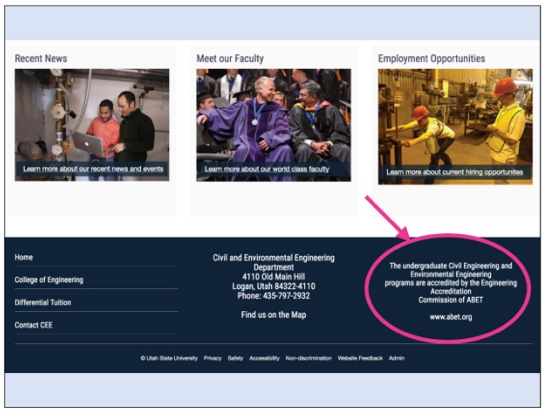
***Recommendations***

Evaluate outcomes 5, 6, and 7 as planned during the 2019-2020 school year, and evaluate Outcomes 1, 2, 3, and 4 in 2020-2021. In anticipation of our site visit in Fall 2020, collect additional data during the 2019-2020 school including material for course binders (samples of 0/1/2 rated work for each class) and other material needed for the self-study report (due July 2020) such as course syllabi and faculty CVs.

# Appendix A
# Slides from CEE 1880

## (introducing freshmen students to ABET PEOs and outcomes)



UTAH STATE LEGISLATURE

Audits | Bills | Budget | Code | Committees

Index **Utah Code**
Title 58 **Occupations and Professions**
Chapter 22 **Professional Engineers and Professional Land Surveyors Licensing Act**
Part 3 **Licensure**
**Section 302 Qualifications for licensure.** ***(Effective 7/1/2017)***

***Effective 7/1/2017***
**58-22-302. Qualifications for licensure.**
(1) Each applicant for licensure as a professional engineer shall:
(a) submit an application in a form prescribed by the division;
(b) pay a fee determined by the department under Section 63J-1-504;
(c) provide satisfactory evidence of good moral character;
(d) (i) have graduated and received a bachelors or masters degree from an engineering program meeting criteria established by rule by the division in collaboration with the board; or
(ii) have completed the Transportation Engineering Technology and Fundamental Engineering College Program before July 1, 1998, under the direction of the Utah Department of Transportation and as certified by the Utah Department of Transportation;
(e) have successfully completed a program of qualifying experience established by rule by the division in collaboration with the board;
(f) have successfully passed examinations established by rule by the division in collaboration with the board; and
(g) meet with the board or representative of the division upon request for the purpose of evaluating the applicant's qualification for licensure.

**https://dopl.utah.gov/eng/**

# So what does it mean to have an accredited program?

# Program Educational Objectives

Within five years of graduation:

**PEO 1:** Graduates will be successfully employed in Civil (Env) 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 (env) 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.

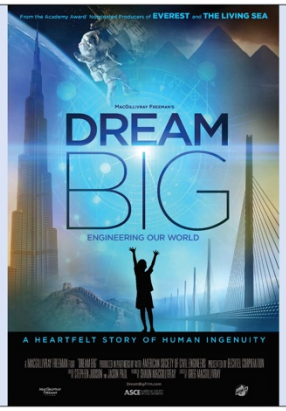
# Student Outcomes

By the time of graduation, students will have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

# ABET timeline

- ABET is a 6 year cycle
- Data collection: 2018-2019, 2019-2020
  - submit examples of your course work
  - fill out a survey about our programs
  - fill out a survey about summer and permanent jobs
  - meet with our industrial advisory board
- Next site visit: Fall 2020 semester
  - meet with the Program Evaluator
  - spruce up your lab/office/hallway
  - help with a tour



## Appendix B
## Student Comments on PEOs from Exit Interviews

- Having professors that have worked in the industries we are applying to is a great help. Having professors that are experienced in practicing engineering with PE licenses makes PEO #4 much more of a focus to students. Lots of professors focus on the research but never bridge the gap to how this will apply to our jobs.
- I feel like the PEOs are a guiding forces for the college. I have appreciated the focus on my future devolpment as an engineer as opposed to just getting a letter grade.
- I feel that my classes all lead to the PEO's.
- I feel that overall, the program was geared to meet these objectives.
- I hope it doesn't take me five years to accomplish most of these objectives.
- Looks great
- Overall, I believe this program has prepared me for these objectives in my career.
- These are all effective and achievable.
- These objectives are certainly personal objectives that I possess and perhaps that is in part because of the influences of the program here at USU. However, I would say there are also a number of students with whom I have associated who do not share all these same objectives.
- These objectives are reasonable and great goals to strive towards.

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

**Appendix C**
**Minutes of the CEE Advisory Board Meeting Nov 6, 2018**

Welcome and Introductions

- Mitch Dabbling
- Bruce Brothersen
- Paul Lindhart
- Brian Barton
- Marv Allen
- Zan Murray
- Shelley Dyer
- B Hall
- Larry Peterson
- Brandon Jones
- Brent White
- Todd Adams
- Cheryl Heying
- Shaun Dustin

ABET-Laurie McNeill

- timeline
    - Next submission is in 2020
    - We are in year 4 of the current 6-year cycle
    - Self-study report due July 1 2020
    - 2019-2020 school year is heavy on data collection
- PEO within 5 years of graduation
    - Be successfully employed
    - Will incorporate economic, environmental, social, ethical, and sustainability considerations
    - Will engage in life-long learning by pursuing advanced degrees
    - No suggested changes from the Board
- FE exam
    - Number of CE degrees has increased since 2012
    - National pass rate has stayed consistent
    - 100% pass rate is required for graduation
    - Subject areas of exam
        - Fluid mechanics: always at or above national average on performance
    - Our students scored at or above national average in all FE exam topics except probability/states (fall 2017)
    - Student outcomes (what we want students to be able to do when they graduate)
        - These have changed from A-K to 1-7
        - May 2019 outcomes 1,2,3, & 4
        - Complex engineering
    - How can the advisory board help?
        - Case studies and examples!
    - Suggestions
        - List ABET goals so the students understand why you're doing these projects.
        - Add complexity by relating problems and projects to complex problems
        - The projects don't have to be number crunching, they can be general thought processes which can be done in any course with multiple components

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

**Appendix D**
**CEE Annual Faculty/Staff Retreat Minutes**
**August 20, 2018**

ABET (Laurie McNeill)

- [packet pages 8-13]
- ABET timeline
    - 6-year cycle
    - Next visit is Fall 2020
    - Self study report due July 1 2020
    - 2019-2020 school year is heavy on data collection
        - Course binders (syllabus, sample work)
        - Faculty info (cv, data tables)

        - Timely assessment data
    - 2018-2019 school year is regular data collection
- Review program educational objectives (PEOs)
    - Look at these and be familiar with them
        - Information in packet
    - Students should be able to apply these within 5 years of graduation
    - No faculty comments or changes
- Evaluation of student outcomes (A-K)
        - What the students leave the program with
        - This prepares them for the PEOs
        - 2018-2019 evaluation schedule: e,f,g
    - Course work
    - FE exam
        - 100% pass rate is goal
        - Minimum acceptable is equal to or greater than national pass rate
        - National pass rate is for first-time test takers (70% 2017-2018)
            - Our students take the FE until they pass, so this number isn't comparable
        - Subject areas within FE exam
            - Our students were at or above national average in all exam topics EXCEPT probability and statistics
            - Topics above national average:
                - Mechanics of materials, fluid mechanics, surveying, hydraulics and hydrologic systems, environmental engineering, geotechnical engineering
    - Senior Exit Interviews
        - Collection of student feelings on how they learned the outcomes
        - Goals for exit interviews met, and are adding more software training to address student requests
- To-Do list for this year
    - Outcomes 1,2,3,& 4
    - Outcomes have changed from a-k to 1-7
    - See handout
    - Complex engineering problems
    - Engineering design definition
        - Designing within constraints
        - Are we appropriately doing engineering design
    - Assess at least two outcomes in all required UG classes
        - Preferably two different outcomes
        - Outcome 1: Ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
            - EVERYONE assess this!
        - Outcome 2: ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
            - All upper-division classes (not just senior design)

    - Electives, especially with “design” in the title
    - Considerations other than environment or cost
- Outcome 3: ability to communicate effectively with a range of audiences
    - CEE 2890 and 5610-Joan
    - CEE 3165-Andrw
    - CEE 3610 and 3640/3650/3780/5860
    - Jr/Sr design-Austin
    - Any other class with written or oral report
- Outcome 4: recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
    - All upper-division classes
    - This may involve a writing assignment-help is available from the engineering writing center
- Other specific assignments
- Program criteria for civil engineering:
    - Apply probability and statistics to address uncertainty.
    - Include principles of sustainability in design; explain basic concepts in project management, business, public policy, and leadership
        - We don’t formally assess these, but we do have to discuss these items

# Appendix E
# Detailed Evaluation for Outcomes 1, 2, 3, and 4

See following pages

# Civil Engineering
# ABET Outcome Summary
# 2018-2019

**Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics**

***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 CE 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 11 classes, ranging from 3000-level junior courses to 5000-level upper-division classes, using 657 samples of student work (mainly homework; see Table 1-1 on the next page). Instructors endeavored to use assignments that met the new ABET definition of "complex problems," such as problems that are open-ended, have conflicting constraints, or involve multiple steps or disciplines. Student performance met both goals, with 75% of students rating a 2 and 92% rating a 1 or 2 (Figure 1-1).

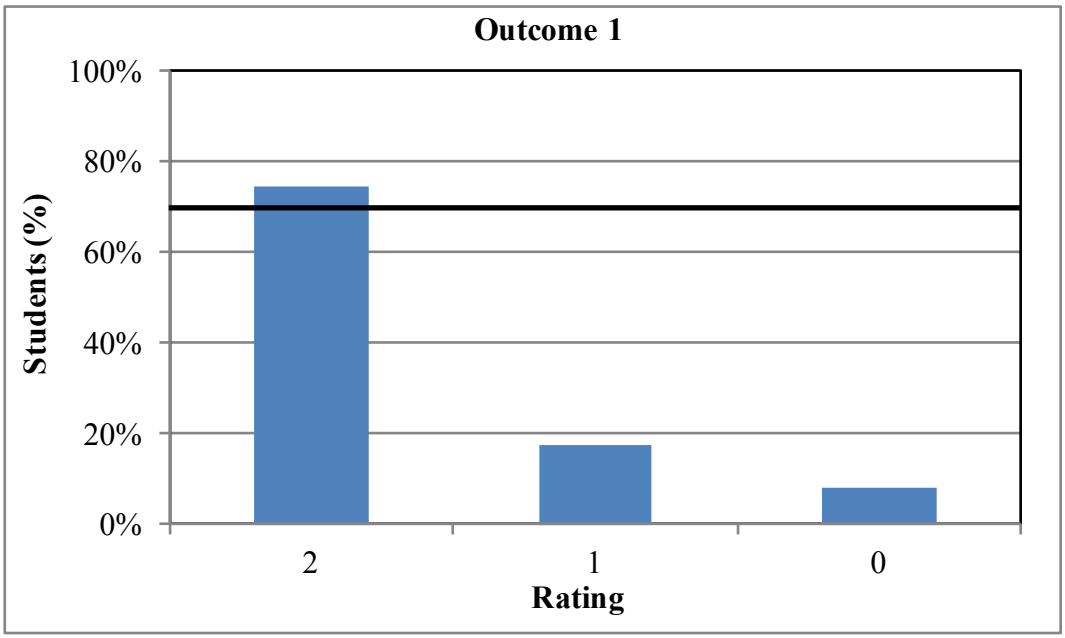



Figure 1-1: Summary of ratings of student work on Outcome 1

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

| Class | | Name | Instructor | Term | Enrol. | Method | Description | Assessment score 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CEE | 3020 | Structural Analysis | Halling | Sp 2019 | 62 | HW | column buckling | 68% | 25% | 7% |
| CEE | 3080 | Reinforced Concrete Design | Barr | Sp 2019 | 63 | HW | composite members - moments and loads | 81% | 13% | 6% |
| CEE | 3210 | Intro to Transportation | Mekker | Sp 2019 | 69 | design | destination and route choice | 58% | 35% | 7% |
| CEE | 3430 | Engineering Hydrology | Neilson | Sp 2019 | 73 | HW | unit hydograph problem | 93% | 4% | 3% |
| CEE | 3500 | Fluid Mechanics | Urroz | F 2018 | 80 | HW | pipeline flow analysis | 78% | 13% | 10% |
| CEE | 3610 | Environmental Management | McNeill | F 2018 | 83 | HW | risk assessment from chemical exposure | 72% | 12% | 16% |
| CEE | 3610 | Environmental Management | McNeill | F 2018 | 83 | HW | mass balance - phosphorus control strategies in lake | 71% | 18% | 11% |
| CEE | 3780 | Solid and Haz Waste Mgmt | Dupont | F 2018 | 41 | HW | optimize container based on statistical desc of variable waste | 88% | 10% | 2% |
| CEE | 4300 | Soil Mechanics | Caliendo | Sp 2019 | 63 | HW | one-dimensional consolidation problem using finite differen | 70% | 30% | 0% |
| CEE | 5010 | Matrix Analy./Finite Element | Barr | F 2018 | 24 | HW | calc beam deflection using SAP2000 | 75% | 8% | 17% |
| CEE | 5500 | Open Channel Flow | McKee | F 2018 | 18 | HW | open channel hydraulics problems | 67% | 22% | 11% |

***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 1-2 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 CE pass rate has been between 90% and 100%.

**Table 1-2: CE Graduates Passing FE Exam vs. National Annual Pass Rate**

| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|---|
| Total CE degrees | 56 | 59 | 53 | 68 | 72 | 57 |
| Graduates passing FE (%) | 93% | 100% | 98% | 100% | 100% | 100% |
| National CE pass rate | 72% | 70% | 69% | 68% | 70% | 67% |

FE Exam performance by topic for first-time test takers is summarized in Figures 1-2 through 1-6. For Fall 2018 and Spring 2019, students performed at or above the national average (considering the error bars) on all fundamental engineering topics. Probability/statistics is below average although the scores overlap the national average given the error bars. Over the past five years performance has often been statistically below the national average (Figure 1-2). We identified this trend several years ago and it's not surprising given that CE students do not take a standalone probability and statistics course. Starting in Fall 2018, we have added one credit to the CEE 4200 course which will be used to provide a basic introduction to probability and statistics. We are also adding exercises into several CEE courses to provide some of this content. Overall, the fact that all CE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes 1 and 4. It is also an indication of a good foundation for life-long (independent) learning skills.

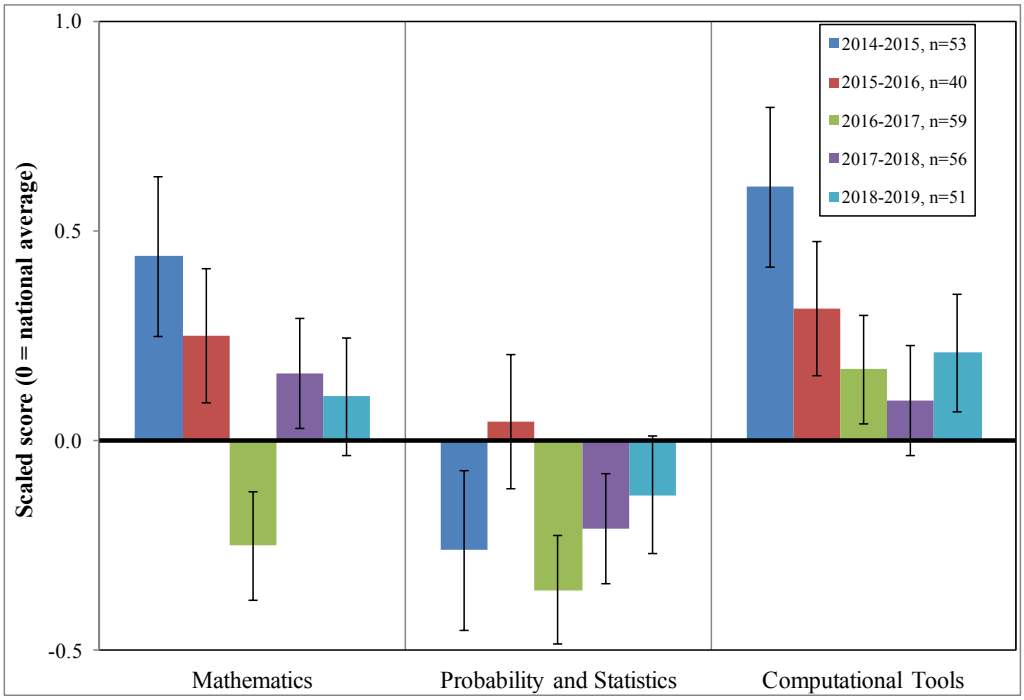



Figure 1-2: Scaled Fe Exam results (math, probability/statistics, and computational tools). Error bars represent uncertainty range for scaled scores.

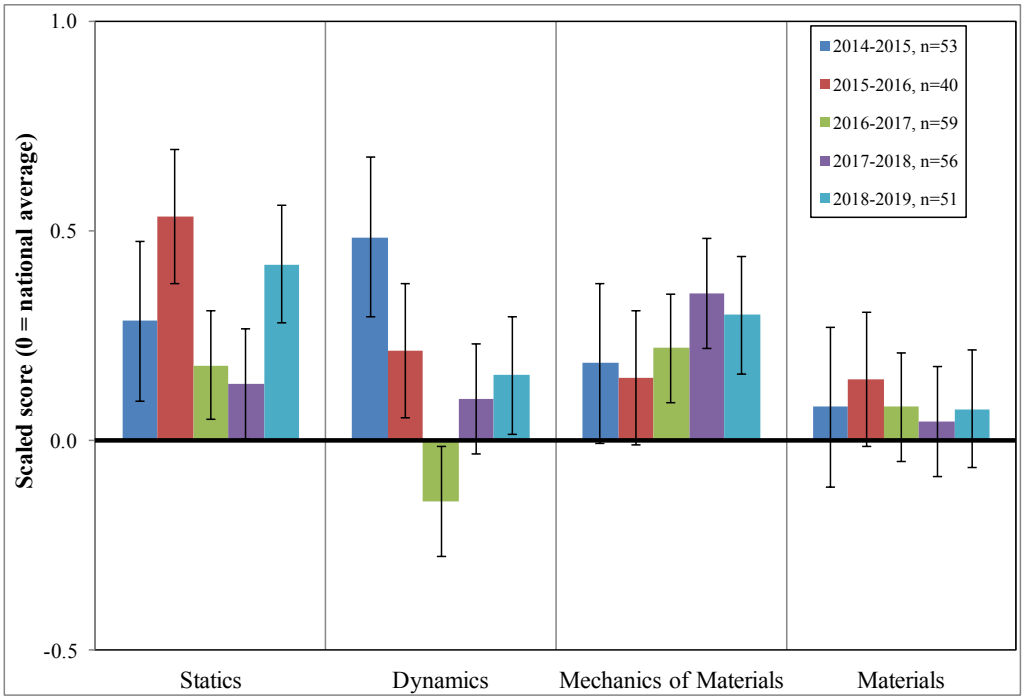



Figure 1-3: Scaled Fe Exam results (statics, dynamics, mechanics, and materials). Error bars represent uncertainty range for scaled scores.

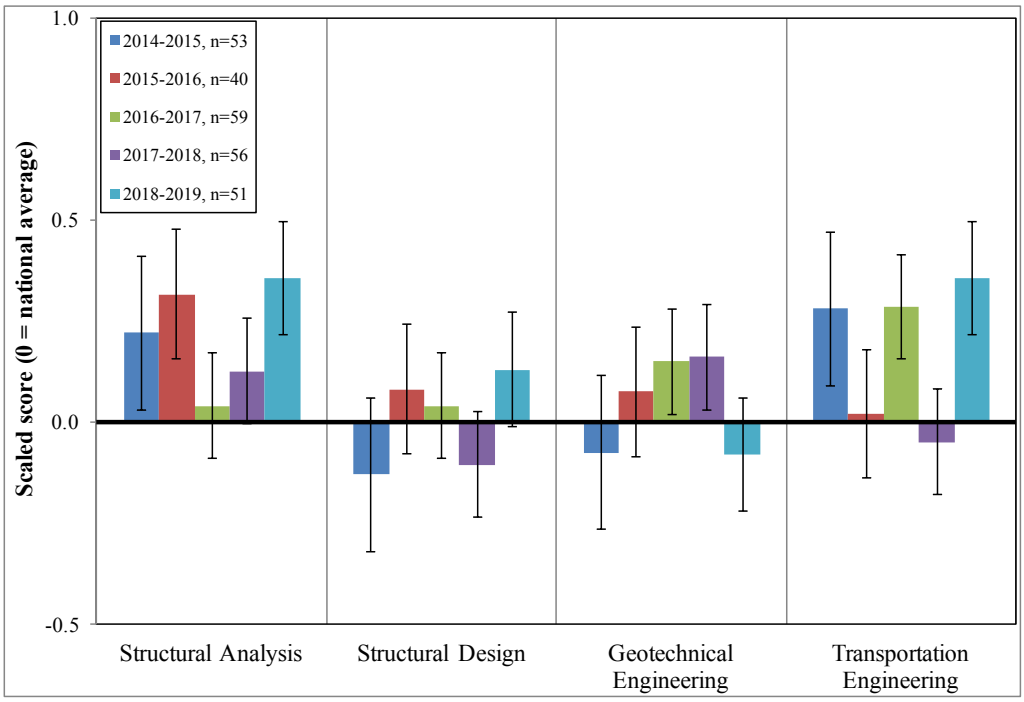



Figure 1-4: Scaled Fe Exam results (structural analysis and design, geotechnical engineering, transportation engineering). Error bars represent uncertainty range for scaled scores.

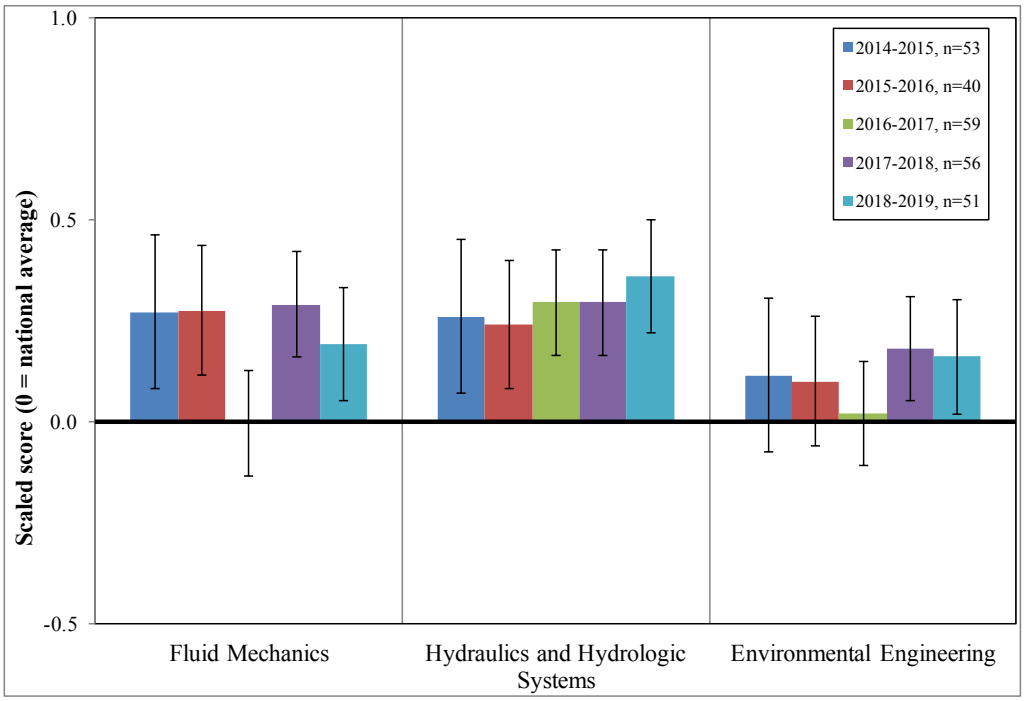



Figure 1-5: Scaled Fe Exam results (fluids, hydraulics, environmental engineering). Error bars represent uncertainty range for scaled scores.

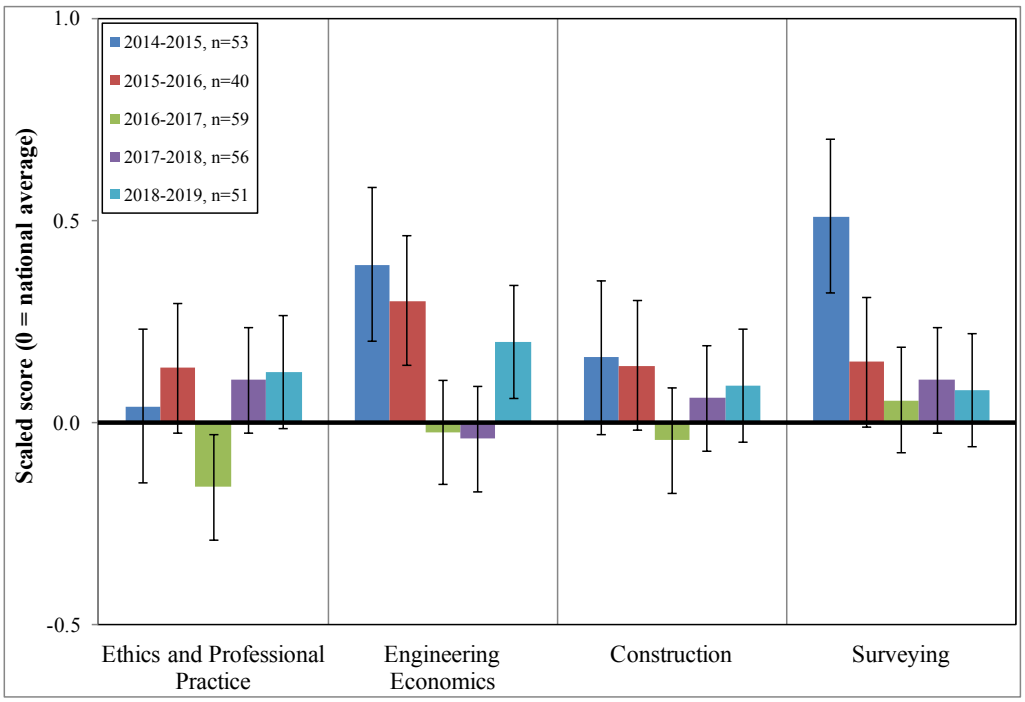



Figure 1-6: Scaled Fe Exam results (ethics and professional practice, economics, construction, surveying). Error bars represent uncertainty range for scaled scores.

***Senior Exit Interviews***

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The survey response rate was 47/62 students (76%). The performance goal is to have at least 80% of the students rating their attainment as "fully met" or "partly met", which was easily achieved with 93% of students rating Outcome 1 as "fully met" and 7% as "partly met" for a total of 100% (Figure 1-7). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

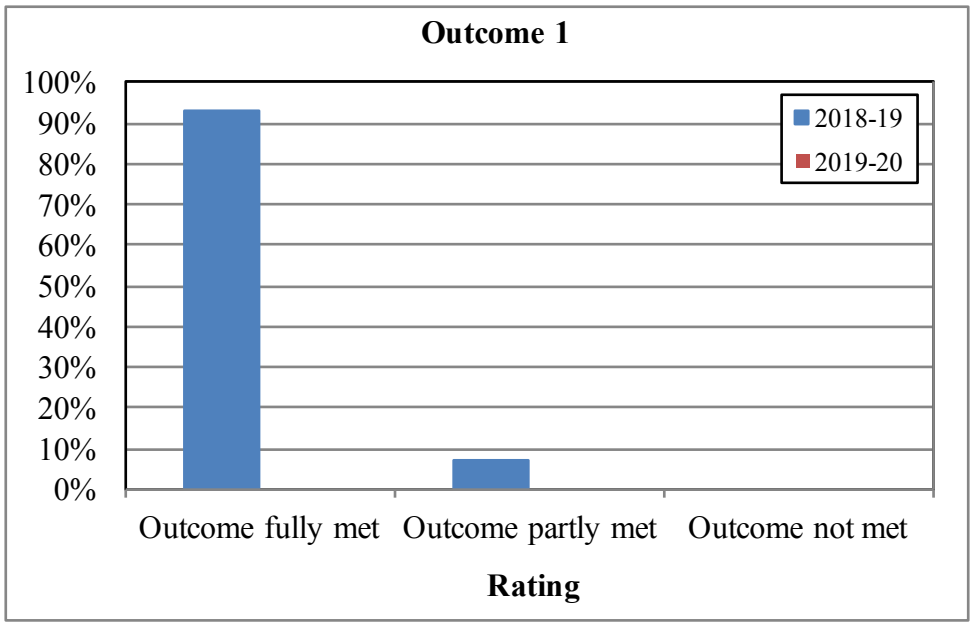



Figure 1-7: Student exit interview ratings of progress on Outcome 1

***Summary***

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcome 1 is being met. FE Exam performance on probability/statistics continues to be below average, but we anticipate those scores will increase since content was added into CEE courses starting in Fall 2018.

***Recommendations***

Evaluate Outcome 1 as planned during the 2020-2021 school year.

# Civil Engineering
# ABET Outcome Summary
# 2018-2019

**Outcome 2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors**

***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 CE 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 12 courses (see Table 2-1 on the next page), using 680 samples of student work. Goal 1 was met with 80% of student work rating a 2 and Goal 2 was met with 93% of student work rating a 1 or 2 (Figure 2-1). However, not all assessed assignments required students to consider all six factors listed in the outcome. We will continue to educate faculty members that all six factors don't have to be relevant to a particular design problem, but students still need to consider all of them and state which factors are not applicable.

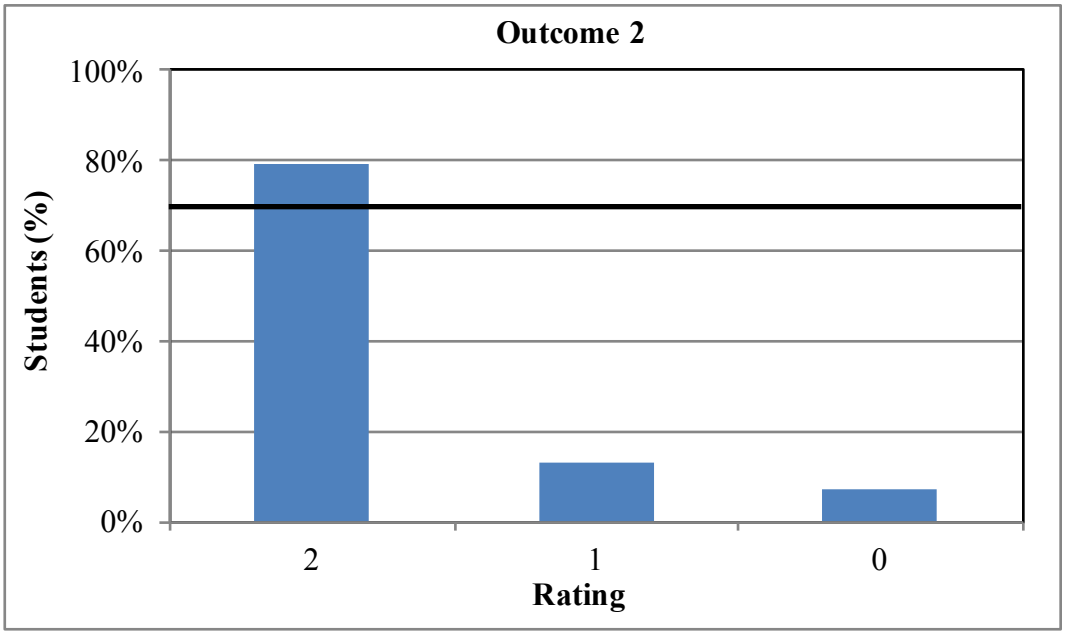



Figure 2-1: Summary of ratings of student work on Outcome 2

Table 2-1: List of student work assessed for Outcome 2

| Class | | Name | Instructor | Term | Enrol. | Method | Description | Assessment score 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CEE | 3210 | Intro to Transportation | Mekker | Sp 2019 | 69 | design projec | open-ended design on various student-chosen transp topics | 53% | 34% | 13% |
| CEE | 3430 | Engineering Hydrology | Neilson | Sp 2019 | 73 | HW | detention basin design using HEC-HMS - consider all 6 fact | 82% | 11% | 7% |
| CEE | 3500 | Fluid Mechanics | Urroz | F 2018 | 80 | HW | design freeboard for channel considering flood (safety) | 93% | 1% | 6% |
| CEE | 3510 | Hydraulics | Crookston | Sp 2019 | 75 | team design p | design various hydraulics topics | 100% | 0% | 0% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | mini-design | mini-design of water treatment processes #1 - technical cont | 86% | 11% | 3% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | mini-design | mini-design of water treatment processes #1 - consider all 6 | 69% | 17% | 14% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | mini-design | mini-design of water treatment processes #2 - technical cont | 80% | 14% | 6% |
| CEE | 3880 | CEE Design I | Ball | Sp 2019 | 71 | team design p | design proposal - consider all 6 factors | 82% | 18% | 0% |
| CEE | 4200 | Engineering Economics | Stevens | F 2018 | 86 | exam | design economic analysis for equipment depreciation and M | 59% | 20% | 21% |
| CEE | 4870 | CEE Design II | Ball | F 2018 | 74 | capstone des | concept report - consider all 6 factors | 85% | 12% | 3% |
| CEE | 5070 | Steel Design | Maguire | F 2018 | 30 | project | design beams and columns in steel structure | 97% | 0% | 3% |
| CEE | 5190 | GIS for CEE | Horsburgh | Sp 2019 | 18 | exam | determine parcels that meet criteria for development - consid | 72% | 22% | 6% |

***FE Exam Results***

Not applicable to this outcome.

***Senior Exit Interviews***

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The survey response rate was 47/62 students (76%). The performance goal is to have at least 80% of the students rating their attainment as "fully met" or "partly met", which was achieved in 2018-2019 with 87% of students rating Outcome 2 as "fully met" and 13% as "partly met" for a total of 100% (Figure 2-2). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

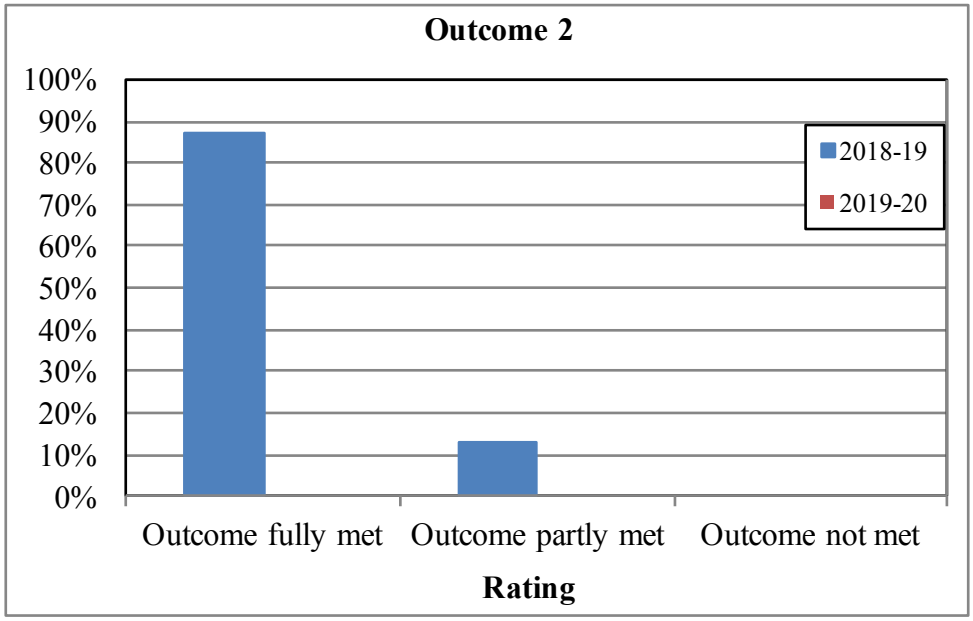



Figure 2-2: Student exit interview ratings of progress on Outcome 2

***Summary***

The evaluation of student work and exit interviews indicates that goals related to Outcome 2 are being met.

***Recommendations***

Evaluate Outcome 2 during the 2020-2021 school year as planned. Course assessment will require students to specifically consider all six factors (public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors).

# Civil Engineering
# ABET Outcome Summary
# 2018-19

## Outcome 3: an ability to communicate effectively with a range of audiences

***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 CE 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 ten upper-level classes using 462 samples of student work (see Table 3-1 on the next page). Students had to communicate both orally and in written form to a range of audiences (lay-person, a client such as a municipality, and technical audiences such as student colleagues, faculty, or an engineering supervisor). Both goals were met, with 92% of students rating a '2' and 99% of students rating a 1 or 2 (Figure 3-1).

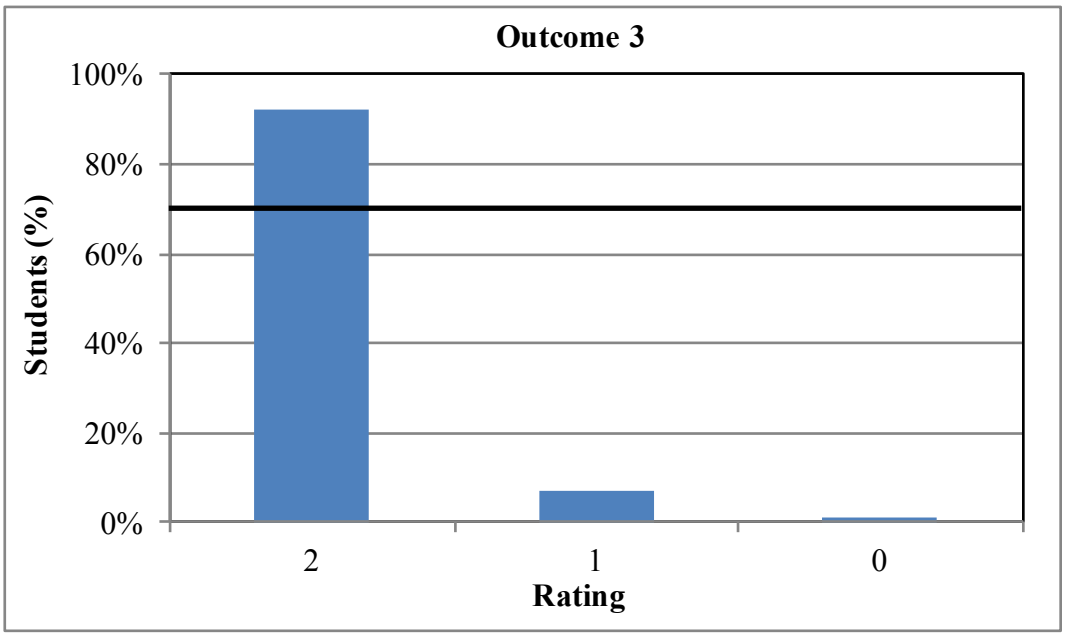



Figure 3-1: Summary of ratings of student work on Outcome 3

Table 3-1: List of student work assessed for Outcome 3

| Class | | Name | Instructor | Term | Enrol. | Method | Description | Assessment score 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CEE | 3165 | CE Materials Lab | Sorensen | F 2018 | 65 | lab exercise | written lab report for technical audience | 98% | 2% | 0% |
| CEE | 3610 | Environmental Management | McNeill | F 2018 | 83 | HW | written summary of an EIS for a lay-person | 86% | 12% | 2% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | HW | written essay on Flint MI - technical audience | 80% | 11% | 9% |
| CEE | 3650 | Wastewater Engineering | Dupont | Sp 2019 | 18 | team project | WWTP design for effluent discharge to meet use - written | 78% | 22% | 0% |
| CEE | 3650 | Wastewater Engineering | Dupont | Sp 2019 | 18 | team project | WWTP design for effluent discharge to meet use - oral | 100% | 0% | 0% |
| CEE | 3780 | Solid and Haz Waste Mgmt | Dupont | F 2018 | 41 | report | written report for team project | 100% | 0% | 0% |
| CEE | 3780 | Solid and Haz Waste Mgmt | Dupont | F 2018 | 41 | poster | oral presentation using poster for team project | 100% | 0% | 0% |
| CEE | 3880 | CEE Design I | Ball | Sp 2019 | 71 | team design | written design proposal - audience is the client | 82% | 18% | 0% |
| CEE | 4880 | CEE Design III | Ball | Sp 2019 | 74 | team design | poster presentation for general and technical audiences | 100% | 0% | 0% |
| CEE | 5860 | Air Quality Management | Martin | F 2018 | 14 | group design | oral presentation for technical audience | 100% | 0% | 0% |

***FE Exam Results***

Not applicable to this outcome.

***Senior Exit Interviews***

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The survey response rate was 47/62 students (76%). The performance goal is to have at least 80% of the students rating their attainment as "fully met" or "partly met", which was achieved in 2018-2019 with 80% of students rating Outcome 3 as "fully met" and 17% as "partly met" for a total of 97% (Figure 3-2). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

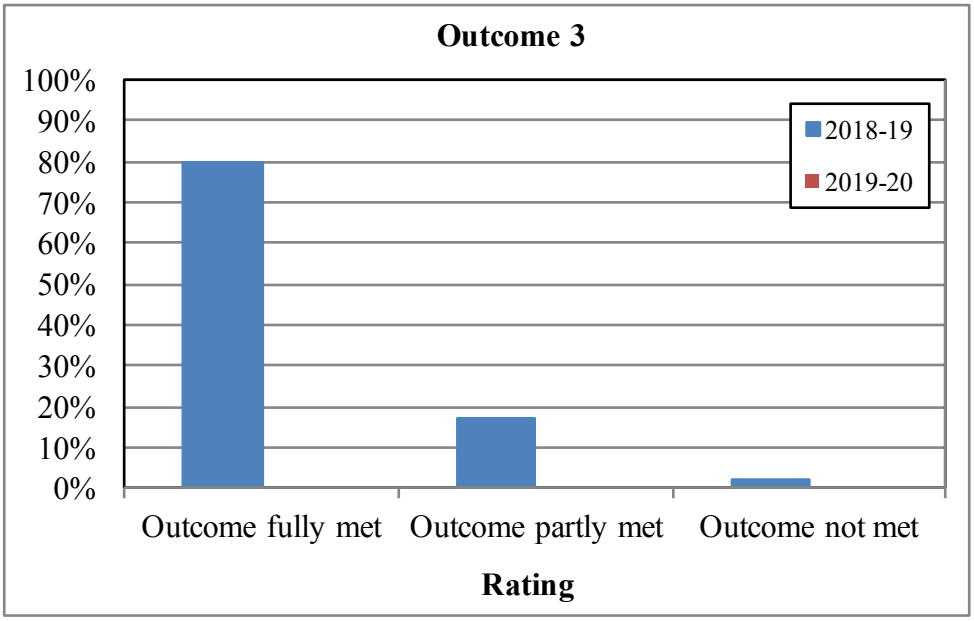



Figure 3-2: Student exit interview ratings of progress on Outcome 3

***Summary***

The evaluation of student work and exit interviews indicates that goals related to Outcome 3 are being met.

***Recommendations***

Evaluate Outcome 3 during the 2020-2021 school year as planned. Continue emphasizing communication to a range of audiences.

# Civil Engineering
# ABET Outcome Summary
# 2018-2019

**Outcome 4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

***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 CE 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.

Outcome 4 was assessed six upper-division classes (178 samples; see Table 4-1 on the next page). Although both Goal 1 and Goal 2 were met (Figure 4-1), we continue to refine our assessment of this outcome. The ASCE Code of Ethics was only assessed in one class and it is a Selective Elective so not all CE students take the class. Instructors also need to have students consider the impacts of engineering solutions in all four contexts listed in the outcome. This year, most assignments only looked at some, but not all, of the four contexts.

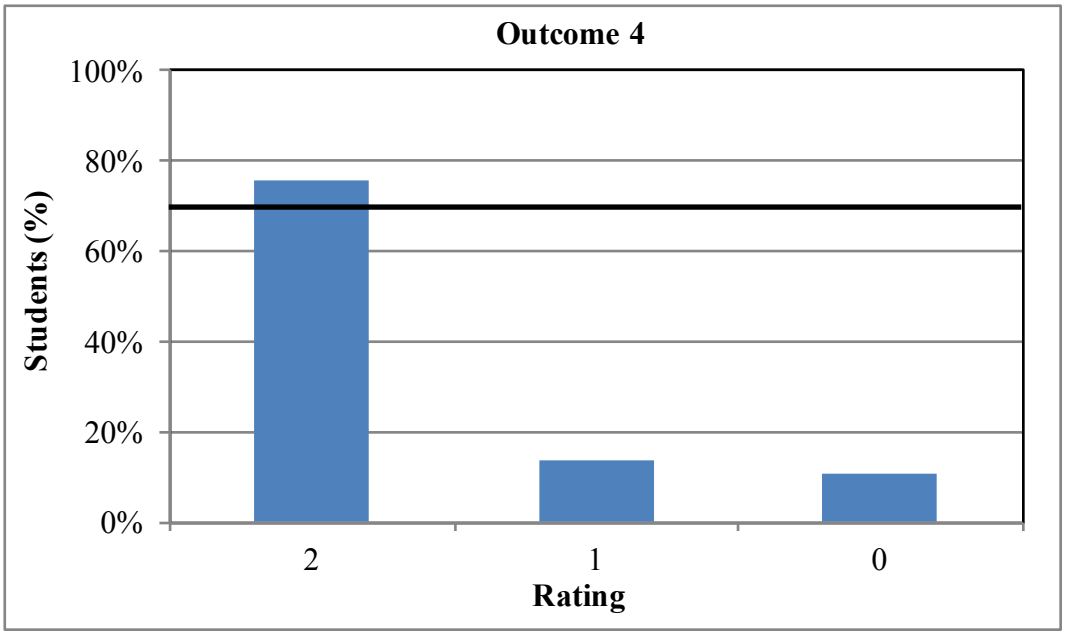



Figure 4-1: Summary of ratings of student work on Outcome 4

Table 4-1: List of student work assessed for Outcome 4

| Class | | Name | Instructor | Term | Enrol. | Method | Description | Assessment score 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| CEE | 3080 | Reinforced Concrete Design | Barr | Sp 2019 | 63 | HW | design columns with consideration of impacts | 73% | 18% | 10% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | HW | written essay on Flint MI - ASCE Code of Ethics | 83% | 11% | 6% |
| CEE | 3640 | Drinking Water Engineering | McNeill | Sp 2019 | 35 | HW | written essay on Flint MI - consider all impacts | 49% | 20% | 31% |
| CEE | 5220 | Traffic Engineering | Song | F 2018 | 12 | lab | analyze signal perf using actual traffic data, evaluate impact | 100% | 0% | 0% |
| CEE | 5350 | Foundation Analysis/Design | Caliendo | F 2018 | 20 | HW | solve anchor force, depth, and moment considering cost | 100% | 0% | 0% |
| CEE | 5860 | Air Quality Management | Martin | F 2018 | 14 | HW | written reflection on "God and Smog" symposium speakers | 86% | 14% | 0% |

### *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 4-2 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 CE pass rate for graduating students has been between 90% and 100%.

**Table 4-2: CE Graduates Passing FE Exam vs. National Annual Pass Rate**

| | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|---|
| Total CE degrees | 56 | 59 | 53 | 68 | 72 | 57 |
| Graduates passing FE (%) | 93% | 100% | 98% | 100% | 100% | 100% |
| National CE pass rate | 72% | 70% | 69% | 68% | 70% | 67% |

FE Exam performance by first-time test takers on the ethics and professional practice section is summarized in Figure 4-2. CE students performed at or above the national average, considering the uncertainty range (error bars), in four of the past five years. Overall, the fact that nearly all CE students continue to pass the FE exam is a strong independent external indicator for meeting Student Outcome 4. It is also a strong indication of a good foundation for life-long (independent) learning skills.

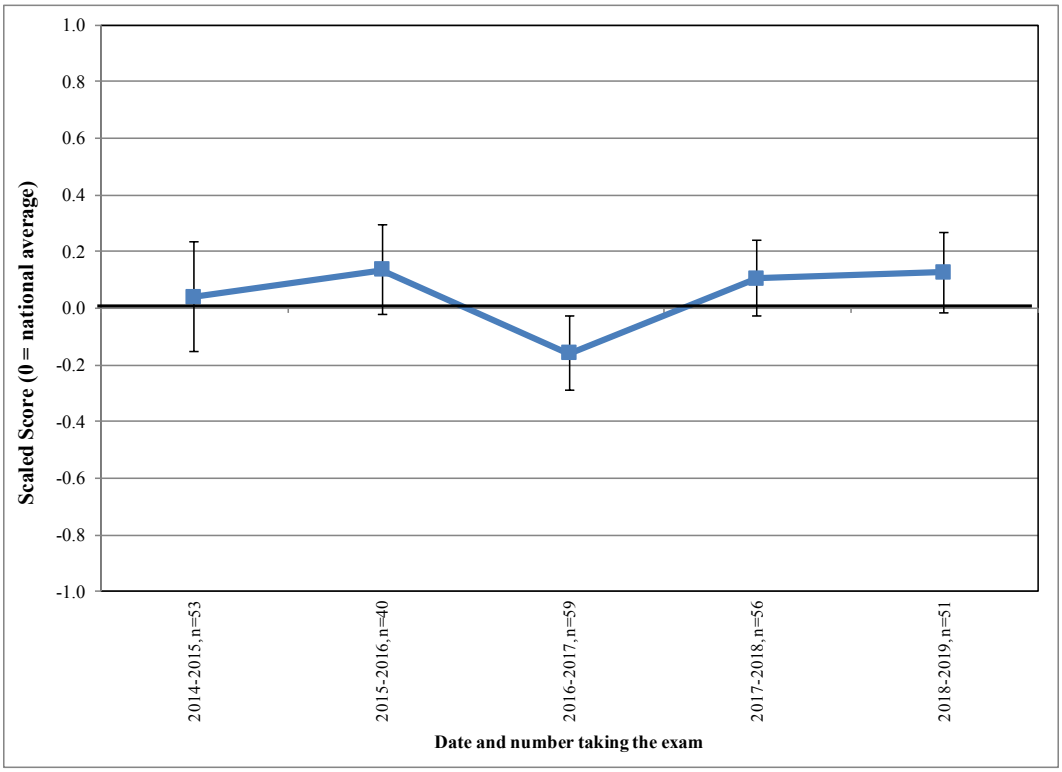



Figure 4-2: Scaled Fe Exam results for the ethics and professional practice section. Error bars represent uncertainty range for scaled scores.

***Senior Exit Interviews***

Graduating seniors complete an anonymous online exit interview to provide feedback about the CE program and rate their perceived progress in meeting each of the outcomes. The survey response rate was 47/62 students (76%). The performance goal is to have at least 80% of the students rating their attainment as "fully met" or "partly met", which was achieved in 2018-2019 with 83% of students rating Outcome 4 as "fully met" and 17% as "partly met" for a total of 100% (Figure 4-3). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

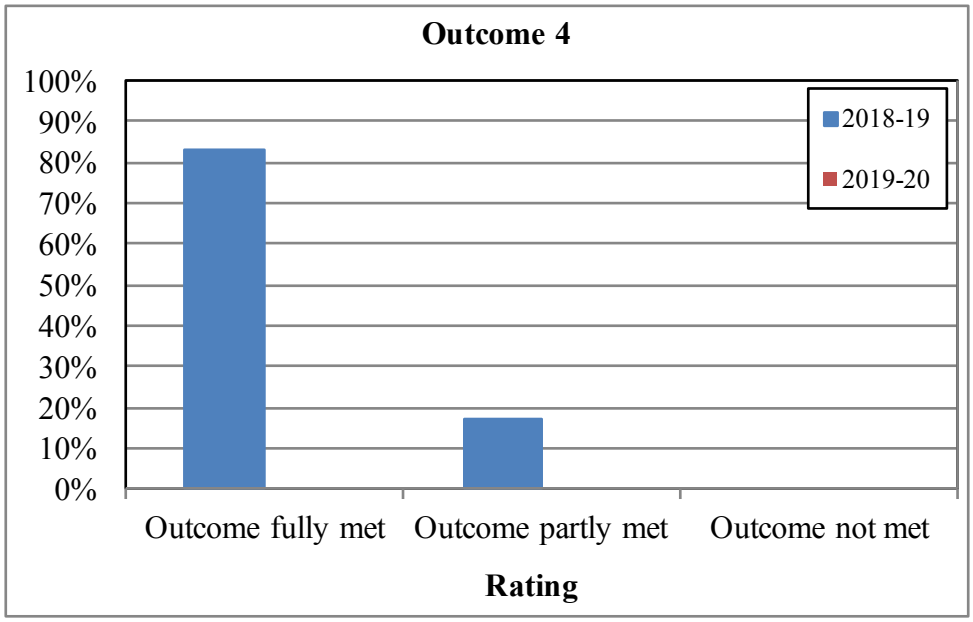



Figure 4-3: Student exit interview ratings of progress on Outcome 4

***Summary***

The evaluation of student work, FE results, and senior exit interviews indicates that Outcome 4 is being met. However, we need to expand assessment of this outcome into additional courses and be sure students are considering all four listed contexts (global, economic, environmental, and societal).

***Recommendations***

Evaluate Outcome 4 as planned during the 2020-21 school year. Ensure that additional courses specifically assess the ASCE Code of Ethics and evaluate the impacts of engineering solutions in the four listed contexts.