ORU

School of Engineering

College of Science and Engineering

2018 – 2021 | Program Review Reports

Biomedical Engineering

Program Review | 2018-2021

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I. Number of Majors | 2018 - 2021

Residential:

Fall 2018	Fall 2019	Fall 2020	Fall 2021
19	19	18	19

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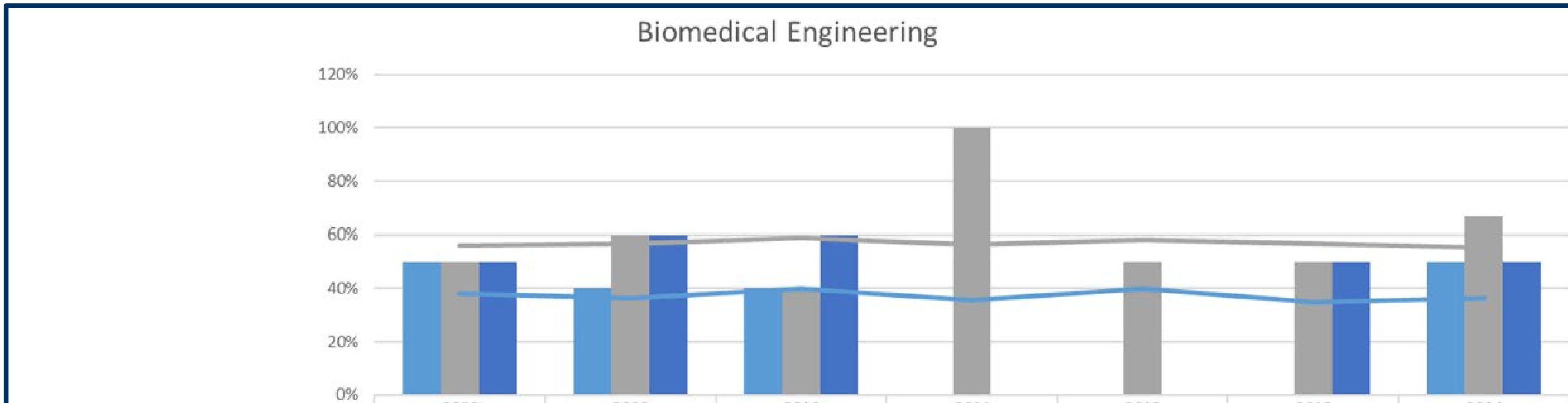
II. Graduation Rate | Cohort of 2008 - 2014



	2008	2009	2010	2011	2012	2013	2014
Program to Prog - Biomedical Engineering	50%	40%	40%	0%	0%	0%	50%
Program to Any - Biomedical Engineering	50%	60%	40%	100%	50%	50%	67%
Any to Program - Biomedical Engineering	50%	60%	60%	0%	0%	50%	50%
Program to Prog - ORU	38%	37%	40%	36%	40%	35%	36%
Program to Any - ORU	56%	57%	59%	57%	58%	57%	55%

III. Program Outcomes

#	Program Outcome
1	Students are able to apply knowledge of mathematics, science, and engineering.
2	Students are able to design and conduct experiments, as well as analyze and interpret data.
3	Students are able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health
4	Students are able to function on multi-disciplinary teams.
5	Students are able to identify, formulate, and solve engineering problems.
6	Students understand professional and ethical responsibility.
7	Students are able to communicate effectively.
8	Students have a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
9	Students recognize the need for, and are able to engage in life-long learning.
10	Students have knowledge of contemporary issues.
11	Students are able to use the techniques, skills, and modern tools necessary for engineering practice.
12	Students are able to apply Christian principles of stewardship.
13	Students are able to identify, formulate and solve biomedical engineering problems.

IV. Artifact Descriptions and Program Alignment

1. Artifact: EGR 330 Control Systems Mini Project
   Student Outcome 1.1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. Artifact: EGR 499 Senior Project Report.
   Student Outcome 1.2: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

3. Artifact: CMPE 340 Digital Systems Mini Project
   Student Outcome 1.3: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

4. Artifact: ME 381 Principles of Design Exam
   Student Outcome 1.4: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

5. Artifact: EGR 498 Design Process Paper
   Student Outcome 2.1: 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.

6. Artifact: EGR 499 Senior Project Report
   Student Outcome 2.2: 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.

7. Artifact: EGR 101 Stewardship Essay
   Student Outcome 3.1: An ability to communicate effectively with a range of audiences.

8. Artifact: EGR 461 Economics Paper
   Student Outcome 3.2: An ability to communicate effectively with a range of audiences.

9. Artifact: EGR 499 Senior Project Oral Presentation
   Student Outcome 3.3: An ability to communicate effectively with a range of audiences.

10. Artifact: EGR 499 Senior Project Report
    Student Outcome 3.4: An ability to communicate effectively with a range of audiences.

11. Artifact: EGR 101 Stewardship Essay
    Student Outcome 4.1: 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.

12. Artifact: EGR 461 Economics Paper
    Student Outcome 4.2: 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.

13. Artifact: EGR 498 Ethics Quiz
    Student Outcome 4.3: 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.

14. Artifact: EGR 499 Senior Project Report
    Student Outcome 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.

15. Artifact: EGR 252 MATLAB Programming Project
    Student Outcome 6.1: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

16. Artifact: ME 381 Principles of Design Lab
    Student Outcome 6.2: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

17. Artifact: ME 444 Experimental Methods Experiment
    Student Outcome 6.3: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

18. Artifact: EGR 499 Senior Design Project
    Student Outcome 6.4: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

19. Artifact: EGR 101 Stewardship Essay
    Student Outcome 7.1: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

20. Artifact: EGR 461 Economics Paper
    Student Outcome 7.2: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

21. Artifact: EGR 498 Senior Project Research Paper
    Student Outcome 7.3: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

22. Artifact: EGR 499 Senior Project Report
    Student Outcome 7.4: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

23. Artifact: EGR 101 Stewardship Essay
    Student Outcome 8.1: An ability to apply Christian principles of stewardship.

24. Artifact: EGR 461 Economics Paper
    Student Outcome 8.2: An ability to apply Christian principles of stewardship.

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V. Primary Evidence

A. Program Outcomes - Reported at the criterion level

Outcome	2016-17	2017-18	2018-19	2019-20	2020-2021
1.1.1	-	-	-	-	3.55
1.1.2	-	-	-	-	3.7
1.1.3	-	-	-	-	3.3
1.1.4	-	-	-	-	3.35
1.1.5	-	-	-	-	3.4
1.2	2.71	3.37	3.33	3.5	-
1.3.1	-	-	4	3.58	-
1.3.2	-	-	3.86	3.67	-
1.3.3	-	-	3.43	3.92	-
1.4.1	3.67	3.45	2.85	3.92	-
1.4.2	2.24	3.18	-	-	-
1.4.3	2.1	1.73	2.62	4	-
2.1	3.29	3.82	3.58	2.82	3.33
2.2.1	2.76	3.37	3.22	3.6	-
2.2.2	3.53	3.26	3	4	-
2.2.3	3.59	3.74	4	3.9	-
2.2.4	3.12	3.79	3.22	4	-
2.2.5	3.53	3.53	3.78	4	-
2.2.6	3.47	3.42	3.22	3.7	-
3.1.1	3.54	3.33	3.94	3.19	4
3.1.2	3	3.04	2.65	3.9	3.57
3.1.3	3.75	3.76	3.96	2.81	3.43
3.2.1	3.78	4	4	4	3.84
3.2.2	3.28	2.96	3.05	3.53	3.68
3.2.3	4	4	4	4	3.89
3.3.1	3.82	3.52	3.65	3.9	-
3.3.2	3.18	3.72	3.42	3.6	-
3.3.3	4	4	3.85	4	-
3.3.4	3.88	3.44	3.73	3.7	-
3.4.1	2.59	3.37	3.67	3.9	-
3.4.2	3.76	3.68	3.56	4	-
3.4.3	3.59	3.58	3.44	4	-
3.4.4	2.18	3.84	3	3.9	-
3.4.5	3.71	3.68	4	3.5	-
3.4.6	-	-	-	3.7	-
4.1	3.48	3.17	2.83	3.17	3.02
4.2.1	2.83	3.3	3.05	2.87	3.37
4.2.2	3.67	3.83	3.62	3.41	3.81

Outcome	2016-17	2017-18	2018-19	2019-20	2020-2021
4.3.1	3.53	3.71	3.82	3.71	3.72
4.3.2	3.82	3.04	3.53	3.9	3.61
4.3.3	3.53	3.82	3.12	3.48	2.83
5	3.88	3.84	3.44	4	-
6.1	-	-	3.64	2.2	2.88
6.2.1	-	-	3.53	4	-
6.2.2	-	-	3.27	4	-
6.2.3	-	-	3.07	4	-
6.2.4	-	-	3.27	4	-
6.3.1	-	2.5	1.9	1.4	-
6.3.2	-	2.2	1.8	1.3	-
6.3.3	-	2.3	1.8	1.3	-
6.4.1	-	-	3.13	3	-
6.4.2	-	-	3.38	3.37	-
6.4.3	-	-	3.63	3.74	-
6.4.4	-	-	3.25	3.68	-
7.1	3.46	2.74	3.35	2.52	3.27
7.2	2.72	3.39	3.24	3.19	3.21
7.3	3.57	3.59	3.1	3.8	3.17
7.4	2.59	3.37	3.33	4	-
8.1.1	3.34	3.41	3.44	3.67	3.7
8.1.2	3.39	3.3	3.25	2.48	3.2
8.2.1	3.67	4	3.95	3.97	3.89
8.2.2	3.61	4	3.52	3.94	3.58

Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

B. Artifact Outcomes

Artifact Outcomes	2018 - 2019		2019 - 2020		2020 - 2021	
	n	score	n	score	n	score
WPA EGRB 222 Exam	3	3.00	-	-	-	-
WPA EGRB Network Analysis I Exam	4	3.35	-	-	-	-
WPA-EGRB- 221 Mechanics I: Statics Final Examination	2	2.20	-	-	-	-
WPA-EGRB-Engineering Computational Methods C Programming Final Project	6	3.17	-	-	-	-
WPA-EGRB-Ethics Quiz	1	3.33	2	3.33	-	-
WPA-EGRB-Senior Project Report (EGR 499-3)	-	-	-	-	4	3.25

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

C. Criterion Outcomes

Criterion Outcomes	2018 - 2019		2019 - 2020		2020 - 2021	
	n	score	n	score	n	score
EGRB-1-A-Application of Engineering Concepts	-	-	-	-	4	2.50
EGRB-2-A-Consideration of Alternatives	-	-	-	-	4	4.00
EGRB-2-B-Depth and Breadth of Project Content	-	-	-	-	4	3.25
EGRB-2-C-Design Problem Statement	-	-	-	-	4	2.50
EGRB-2-D-Engineering Standards	-	-	-	-	4	3.00
EGRB-2-E-Realistic Constraints	-	-	-	-	4	3.00
EGRB-2-F-Response to Customer Needs	-	-	-	-	4	4.00
EGRB-3-A-Content	-	-	-	-	4	3.25
EGRB-3-C-Format	-	-	-	-	4	3.25
EGRB-3-D-Organization	-	-	-	-	4	3.00
EGRB-3-H-Spelling and Grammar	-	-	-	-	4	4.00
EGRB-3-I-Style and Vocabulary	-	-	-	-	4	3.25
EGRB-5-A-Teaming	-	-	-	-	4	4.00
EGRB-7-A-Research	-	-	-	-	4	2.50
EGRB-a-2-Formulas	4	3.50	-	-	-	-
EGRB-a-3-Problem Solving Using Energy Methods	3	2.67	-	-	-	-
EGRB-a-4-Problem Solving Using Momentum	3	3.67	-	-	-	-
EGRB-a-5-Schematic Diagrams and Waveforms	17	3.35	-	-	-	-
EGRB-a-6-Theories	13	3.08	-	-	-	-
EGRB-a-7-Theories and Assumptions	4	3.25	-	-	-	-
EGRB-a-8-Vectors	3	3.33	-	-	-	-
EGRB-b-1 Data Analysis and Interpretation	10	3.70	-	-	-	-
EGRB-b-2 Equipment Selection	10	4.00	-	-	-	-

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

EGRB-b-3 Experiment Procedures and Data Measurement	10	3.30	-	-	-	-
EGRB-b-4 Theoretical Value Calculation	10	3.80	-	-	-	-
EGRB-b-5 Theory	10	3.40	-	-	-	-
EGRB-e-1-Assumptions	2	2.50	-	-	-	-
EGRB-e-2-Diagrams	2	2.50	-	-	-	-
EGRB-e-3-Formulas	2	2.50	-	-	-	-
EGRB-e-4-Information	19	3.00	-	-	-	-
EGRB-e-5-Problem Formulation: Rigid Bodies, Translation and Rotation	3	2.33	-	-	-	-
EGRB-e-6-Solutions	19	2.68	-	-	-	-
EGRB-f-1-Disclosure	1	4.00	2	4.00	-	-
EGRB-f-2-Identification and Description of Conflict of Interest	1	4.00	2	2.50	-	-
EGRB-f-3-Responsibilies of Engineers	1	2.00	2	3.50	-	-
EGRB-g-10-Technical Content	4	4.00	-	-	4	3.25
EGRB-g-2 Format	29	3.93	23	2.65	21	3.38
EGRB-g-4 Organization	29	3.90	23	4.00	21	4.00
EGRB-g-5-Organization of Ideas	3	3.33	-	-	4	4.00
EGRB-g-6-Slide Quality	3	3.00	-	-	4	4.00
EGRB-g-7-Speaking and Audience Engagement	3	3.33	-	-	4	4.00
EGRB-g-8 Spelling and Grammar	29	2.59	23	3.30	21	3.52
EGRB-h-1 Content	29	2.66	23	3.17	21	3.05
EGRB-i-1 Research	29	3.21	23	2.74	21	3.05
EGRB-k-1 Appropriate Feature Application and Location	50	3.24	-	-	-	-
EGRB-k-10 Use of SolidWorks Features	50	3.26	-	-	-	-
EGRB-k-11 Use of Specified Features	50	3.74	-	-	-	-
EGRB-k-2 Basic Modeling Requirements	50	3.74	-	-	-	-
EGRB-k-3-Demonstration	6	3.50	-	-	-	-
EGRB-k-4 Dimensioning of Sketches	50	3.08	-	-	-	-

Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

EGRB-k-5-Efficiency	6	3.17	-	-	-	-
EGRB-k-6 Interpretation of Drawings	50	3.02	-	-	-	-
EGRB-k-7-Specifications	6	2.83	-	-	-	-
EGRB-k-8-Readability	6	3.67	-	-	-	-
EGRB-k-9-Reusability	6	2.67	-	-	-	-
EGRB-l-1 Biblical References for Stewardship	29	3.48	23	2.26	21	3.10
EGRB-l-2 Stewardship	29	3.31	23	3.96	21	3.48

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

D. University Whole Person Outcomes

ORU Whole Person Outcomes		2018 - 2019		2019 - 2020		2020 - 2021	
		n	score	n	score	n	score
1A	Biblical Literacy	14	3.417	-	-	12	4.00
1B	Spiritual Formation	4	4.000	11	3.82	28	3.76
2A	Critical Thinking, Creativity & Aesthetic Appreciation	34	3.656	18	3.05	10	3.64
2B	Global & Historical Perspectives	6	4.000	-	-	-	-
2C	Information Literacy	15	3.714	25	3.79	32	3.60
2D	Knowledge of the Physical & Natural World	1	4.000	-	-	-	-
3A	Healthy Lifestyle	4	2.500	16	2.36	12	2.67
3B	Physically Disciplined Lifestyle	12	3.500	16	3.25	19	3.45
4A	Ethical Reasoning & Behavior	30	3.929	49	3.53	35	3.38
4B	Intercultural Knowledge & Engagement	2	3.500	-	-	13	3.86
4C	Written & Oral Communication	18	3.667	17	3.55	40	3.23
4D	Leadership Capacity	19	3.665	48	3.88	26	3.83

VI. Program Assessment Process Description

The ORU School of Engineering faculty members meet regularly at the start of each semester concerning assessment to evaluate measured academic data for continuous program improvement. To streamline the assessment process, faculty members created a curriculum map to align the School of Engineering student learning outcomes with course work. Based on the curriculum map, the faculty member develop a formal assessment plan to determine which assignments would provide the most relevant assessment of student outcomes. Faculty members deleted several of the assignments previously used for assessment to streamline the process and avoid excessive data collection.

Minutes from School of Engineering Assessment Meetings provides records of faculty assessment meetings. Using the results of the assessment meetings, The School of Engineering faculty members demonstrate the revised assessment of student outcomes and provide data supporting student expression of the outcomes. Evidence from nine different engineering courses provides for the assessment of the student outcomes. Faculty members highlight average data values below 3.0 and develop action plans with implementation dates and results to address possible concerns resulting in the low student scores.

The formal assessment process used by the School of Engineering faculty members include the following steps:

1. Development of an Assessment Plan by faculty members listing the artifacts used for data collection addressing each of the student outcomes.
2. Data collection by faculty members from appropriate courses using the learning management system Desire2Learn (D2L) to facilitate data management.
3. Data evaluation by faculty members during formal School of Engineering Assessment Days at the start of every semester.
4. School of Engineering Assessment Days consists of five parts
   A. Review the impact of previous curriculum changes on assessment data results.
   B. Evaluation of collected data results for program improvement.
   C. Implementation of curriculum changes to address indicated concerns.
   D. Chronicling of the curriculum change from Assessment Days to facilitate implementation.
   E. Completion of feedback form with the results from School of Engineering Assessment days.

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VII. Continuous Program Improvement Description

How have the results of assessment directly affected program changes for the future?

For each of the following questions:

- *Place any key documents that you reference in the folder with this document*
- *Describe who's involved.* Please make reference to faculty, instructional, and other staffmembers involved in the processes and methodologies to assess student learning
- *Describe when the activity took place*

1. Since 2016, *how have the results of assessment directly affected program changes for thefuture*?

- Provide data used to support the need for improvement. Data may come from:
  - i. ORU, program, artifact-rubric, and criterion line scores
  - ii. Professional accreditation reviews, student surveys, alumni and stakeholderfeedback, market reports, etc.
- Changes may have taken place in the following areas:
  - i. Course content, artifacts, and rubrics
  - ii. Instructional strategies, including a change in the use of technology
  - iii. Sequencing or repetition of material in an individual course or as a wholeprogram
  - iv. Updating program outcomes
  - v. Updating a curriculum map
  - vi. Updating the program's master rubric
- As available, provide data that demonstrates the impact your changes had on meetingprogram outcomes. See trends in the data tables.

Table 1 at the end of this program review includes examples with evidence and documentation of assessment data collected from sample courses. Faculty members highlight average data values below 3.00 and develop action plans to address possible concerns resulting in the low student scores. Table 1 also include assessment data for theyear following completed changes with improved average scores.

2. If you use *Senior papers/projects* they often provide rich data on student achievement. Howdo you tie the results from these artifacts back to changes for specific courses?
   Please see next section below that contains information about senior design project data on student achievement and how this is tied back to changes for EGR 498 and EGR 499.
3. As applicable, describe how you've updated the program due to professional accreditationchanges or reports, student surveys, alumni and stakeholder feedback, market trends, etc.

2017 ABET Final Statement

ORU School of Engineering received the following Program Weakness related to Criterion4 – Continuous Improvement:

"Statement of weakness: This criterion requires that the program must regularly use appropriate, documented process for assessing and evaluating the extent to which the student outcomes are being attained. The program could not demonstrate that student achievement of student outcome (b), an abilityto design and conduct experiments, as well as to analyze and interpret data, is being assessed. The program therefore does not have data to effect changes that may be needed. This criterion also requires that the results of these evaluations must be systematically utilized as input for the continuous improvement of the program and that other available information may also be used. While the program has amassed a substantial amount of data relating to the achievement of most student outcomes, including data systematically gathered from other sources, the data collected from direct assessment of student outcomes have not been used to improve the program. Strength of compliance with this criterionis lacking."

Response to ABET Final Statement: Continuous Improvement

The ORU Engineering faculty members meet regularly concerning assessment to evaluate measured academic data for continuous program improvement. Using the results of the assessment meetings, the Engineering faculty members demonstrate the revised assessment of student outcome (b) and provide data supporting student expression of the outcome. Evidence from five different Engineering courses provides for the assessment of student outcome (b). This section also includes evidence and documentation of the process used by faculty to develop action plans for continuous improvement concerning all twelve of the student outcomes along with the documents used to collect and analyze the data.

1. Identification and detail of evidence and documents used by Engineering faculty members to assess student achievement of student outcome (b), an ability to designand conduct experiments, as well as to analyze and interpret data

This section includes Examples A–E with detailed evidence and documentation of assessment data collected from five different courses for Student Outcome (b) an abilityto design and conduct experiments, as well as to analyze and interpret data. Faculty members highlight average data values below 3.0 and develop action plans to address possible concerns resulting in the low student scores.

Example	Student Outcome	Course
A	(b)	EGR 252 Engineering Computational Methods
B	(b)	EE 321L Electronics I Lab
C	(b)	EGR 499 Senior Design and Research
D	(b)	ME 444 Experimental Methods
E	(b)	ME 381 Principles of Design

A. Evidence for Student Outcome (b) in the course EGR 252 Engineering Computational Methods

In the EGR 252 Engineering Computational Methods course, faculty members teach first- and second-year Engineering students the skills needed to develop programming in the Matlab and C languages. The course includes two Matlab projects requiring students to design different experiments. Students design and conduct the experiments by writing and executing code. Students then analyze and interpret the resulting data by testing the program with different input data.

Within grading rubrics used to evaluate assignments, faculty members embed assessment rubric lines addressing student outcomes relevant to the specific assignment to provide assessment data at the point of student engagement with the specified student outcome. Faculty members included the following assessment rubric line in the Matlab project grading rubric to evaluate student experience relevant to student outcome (b). Note that information highlighted by the Matlab project focuses on assessing the “analyzing and interpreting” portion of student outcome (b).

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Assessment Rubric Line for EGR 252 Engineering Computational Methods
Matlab Programming Project

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Test Program with All Possible Inputs	Able to test the program with all cases correctly	Able to test the program with most cases correctly	Able to test the program with some cases correctly	Unable to test the program correctly	No attempt to test the program

Student Outcome (b) Assessment Results from EGR 252 Engineering Computational Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
EGR 252 Matlab Programming Project	*N*	Ave
Test Program with All Possible Inputs	33	3.64

Average assessment results from the Matlab project with a score greater than 3.00 indicates the successful acquisition of the student outcome through this assessment,which does not indicate any need for modification of the project.

B. Evidence for Student Outcome (b) in the course EE 321L Electronics I Lab

In EE 321L Electronics I Lab students design and conduct experiments to determine the input-output characteristics of a BJT AC amplifier and verify the theory learned in lectures by analyzing and interpreting the measured data. Assessment data from fall 2017 and fall 2018 indicate that students score above 3.00 on average, so faculty members determined not to modify the assignment at this time.

Assessment Rubric Lines for EE 321L Electronics I Lab Experiment Design

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Theory	Circuits are clearly understood, and all required formulas are listed correctly.	Circuits are clearly understood with minor errors in the formulas.	Understand the circuits with part of missing or redundant formulas.	Circuits are misunderstood with irrelevant formulas	No attempt to describe or explain the circuit theory
Equipment selection	All equipment is correctly identified and selected with the correct rating.	All equipment is correctly identified and selected with some misunderstanding in rating and settings.	Most of the equipment is correctly identified and selected with some misunderstanding in rating.	Most of the selected equipment is irrelevant or with the wrong rating.	No attempt to select any equipment
Theoretical value calculation	All theoretical values required are calculated correctly following the required format.	All theoretical values required are calculated following the required format with minor miscalculations.	All theoretical values required are calculated without following the required format and with minor miscalculations.	Irrelevant formulas are used, and most of the theoretical values are wrong.	No attempt to do any calculation
Design of experimental procedures	All experiment procedures are clearly and correctly listed. The circuit is neatly and correctly connected. All required data are correctly measured.	All experiment procedures are clearly and correctly listed. The circuit is neatly and correctly connected with minor error in measuring the required data.	Most of the experiment procedures are correctly listed. The circuit is correctly connected with part of component mistaken and wrong measured data.	Most of the experimental procedures are not correct. The circuit is incorrectly connected. Most of the measured data are wrong.	No attempt to connect the circuit and to do any measurement
Data analysis and interpretation	Precise and correct conclusions are reached from both the theoretical and measured data. Any discrepancy is correctly discovered and interpreted with convincing reasoning.	Correct conclusions are reached from both the theoretical and measured data. Any discrepancy is discovered and interpreted with minor error in reasoning.	Correct conclusions are reached both the theoretical and measured.	Conclusions are wrong or irrelevant, with no explanation for the discrepancy between the theoretical and measured data.	No attempt to reach any conclusion and to discover a discrepancy between the theoretical and measured data

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Student Outcome (b) Assessment Results from EE 321L Electronics I Lab

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	2018-19			2017-18	
EE 321 Experiment Design	*N*	Ave		*N*	Ave
Theory	27	3.56		9	3.44
Equipment Selection	22	4.00		9	3.89
Theoretical Value Calculation	23	3.74		9	3.50
Design of Experimental Procedures	24	3.38		9	3.22
Data Analysis and Interpretation	24	3.46		9	3.11

C. Evidence for Student Outcome (b) in EGR 499 Senior Design and Research II

In the validation section of the EGR 499 Senior Design and Research II Final Report, students provide a description of the experimental test procedures that verifies the project meets the definition of completeness. In the results section of the report, students present the results of these tests and compare the results with theory and specifications. Students verify the inclusion of the design and completion of the experimental test procedures on a report checklist turned in with the report. Faculty members assess the student design and performance of testing for the satisfaction of student outcome (b) Current average assessment scores for the paper result in values above 3.00, so faculty members will not make any changes to the assignment at this time.

Assessment Rubric Lines for EGR 499 Senior Design and Research II
Experimental Test Procedures

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Clear Research Question	The research question is clear and testable	The research question is clear, but not testable	The research question is mostly clear	The research question is not clear	Not attempted
Design of Experiment	Experimental design is clearly described and addresses research question	Experimental design is clearly described and is relevant to research question	Experimental design partially addresses research question	Experimental design does not address research question	Not attempted
Conduct Experiment	The experiment was conducted and produced reliable data	The experiment was conducted and produced somewhat inconsistent data	The experiment was conducted but did not produce useful data	The experiment was attempted but did not produce data	Not attempted
Analyze Data	Data was correctly analyzed leading to valid conclusions	Data was correctly analyzed and justified the conclusions somewhat	Data was correctly analyzed but did not justify the conclusions	Data was incorrectly analyzed	Not attempted

Student Outcome (b) Assessment Results from EGR 499 Senior Design and Research II

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
EGR 499 Experimental Test Procedures	*N*	Ave
Clear Research Question	8	3.13
Design of Experiment	8	3.38
Conduct Experiment	8	3.63
Analyze Data	8	3.25

D. Evidence for Student Outcome (b) in the course ME 444 Experimental Methods

In ME 444, students conduct experiments, analyze and interpret data, and record the process, results, and conclusions in a lab report. Also, ME 444 students design additional experiments for in-class and homework assignments as demonstrated by the following:

i. Application of single experimental measurements (e.g., temperature) toreal industrial processes (e.g., glass furnace).
ii. Application of multiple measurements to Biblical miracles (Faculty members presented on the assignment “Experimental Methods Applied toBiblical Miracles” during the 2013 Christian Engineering Conference in Atlanta).
iii. Design an experiment to test a new engine made out of “Halsmerium” forthe final exam.

Current average assessment results indicate values below 3.00. Faculty members developed a plan of action to improve student performance in ME 444.

Assessment Rubric Lines for ME 444 Experimental Methods Design of Experiment

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Experiment Objectives	Selects all appropriate variables & their ranges that should be measured.	One incorrect or missing variable or range that should be measured.	Two incorrect or missing variables or their ranges that should be measured.	More than two incorrect or missing variables or their ranges that should be measured.	No attempt to select appropriate variables & their ranges
Instrument Selection	Selects all appropriate instruments to measure needed variables.	All instruments selected would work but better choices available.	Improperly selected one instrument.	Multiple instruments improperly selected.	No attempt to select appropriate instruments
Experimental Design	Measurement frequency & location for all devices properly specified.	Only one measurement frequency or location improperly specified.	Total of two measurement frequencies or locations improperly specified.	More than two measurement frequencies or locations improperly specified.	Measurement frequencies and locations not specified

Student Outcome (b) Assessment Results from ME 444 Experimental Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**			**2017-18**	
ME 444 Design of Experiment	*N*	Ave		*N*	Ave
Experimental Objectives	21	1.90		20	2.50
Instrument Selection	21	1.80		20	2.20
Experimental Design	21	1.80		20	2.30

E. Evidence for Student Outcome b) in ME 381 Principles of Design

During a lecture on load and stress analyses with a focus on press and shrink fits and the corresponding contact stresses, a faculty member compared these ideas to the popular toy construction system known as Lego or Duplo bricks as the toys employ a high-quality press fit. Students responded favorably to the illustration with an immediate increase in attention and interest. Based on the student reaction, the facultymembers developed a student assignment to design and conduct an experiment that allows students to explore the various dimensions of the toy application. Providing students with the larger two-by-two Duplo bricks, the faculty members required students to complete the following tasks:

1. Evaluate the necessary measurements to predict the “pull-apart” force.
2. Determine the required peg and hole dimensions to produce a pull-apart forceof 1 pound.
3. Design and conduct an experiment to determine the actual pull-apart force.

The open-ended lab enabled students to use whatever methods, materials and reporting procedures they deemed appropriate. The faculty members assess the Lego Lab Report using the same grading rubric as used in EGR 499 Senior Design and Research II. Current average assessment scores for the report result in values above 3.00, so faculty members will not make any changes to the assignment at this time.

Assessment Rubric Lines for ME 381 Principles of Design Lego Lab

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Clear Research Question	The research question is clear and testable	The research question is clear, but not testable	The research question is mostly clear	The research question is not clear	Not attempted
Design of Experiment	Experimental design is clearly described and addresses research question	Experimental design is clearly described and is relevant to research question	Experimental design partially addresses research question	Experimental design does not address research question	Not attempted
Conduct Experiment	The experiment was conducted and produced reliable data	The experiment was conducted and produced somewhat inconsistent data	The experiment was conducted but did not produce useful data	The experiment was attempted but did not produce data	Not attempted
Analyze Data	Data was correctly analyzed leading to valid conclusions	Data was correctly analyzed and justified the conclusions somewhat	Data was correctly analyzed but did not justify the conclusions	Data was incorrectly analyzed	Not attempted

Student Outcome (b) Assessment Results from ME 381 Principles of Design

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
ME 381 Principles of Design Lego Lab	*N*	Ave
Clear Research Question	15	3.53
Design of Experiment	15	3.27
Conduct Experiment	15	3.07
Analyze Data	15	3.27

2. Evidence and documentation of the process used to collect data from the directassessment of student outcomes to develop action plans for the continuous improvement of the Engineering program

The following examples provide detailed evidence and documentation of assessment datacollected for different student outcomes to develop action plans for continuous improvement. Average assessment scores below 3.00 indicate a need for action plan development.

Example	Student Outcome	Course
A	(a)	EGR 222 Mechanics II: Dynamics
B	(a)	EGR 499 Senior Design and Research II
C	(b)	ME 444 Experimental Methods
D	(c)	EGR 499 Senior Design and Research II
E	(e)	EGR 221 Mechanics I: Statics
F	(e)	EGR 222 Mechanics II: Dynamics
G	(e)	EE 311 Network Analysis II
H	(e)	ME 381 Principles of Design
I	(g)	EGR 461 Engineering Management and Economy
J	(i)	EGR 101 Introduction to Engineering
K	(k)	EGR 140 Engineering Graphics
L	(k)	EGR 252 Engineering Computational Methods

A. Evidence of using assessment data for improving EGR 222 Mechanics II Dynamics

Student Outcome (a) Students are able to apply knowledge of mathematics, science andengineering

Data: Average assessment scores indicate a persistent concern for students' low ability to solve problems in energy methods and the use of vectors

a) Students are able to apply knowledge of mathematics, science and engineering	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 222 Dynamics Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Problem Solving Using Energy Methods	16	2.94		25	2.68		19	2.84		21	2.95		16	2.94
Problem Solving Using Momentum	16	3.50		25	3.44		19	2.68		21	3.19		16	3.00
Vectors	16	2.56		25	2.96		19	2.79		21	2.62		16	2.00

Action: To increase student capacity for effective problem-solving, faculty members will require the following action items.

1. Require the format listed below for submitted homework assignments requiringproblem-solving.

    a. Definition of the problem.

        i. List all quantities required for a solution.

        ii. List all unknown quantities of interest.

        iii. List the data provided within the problem (can be a written copy of a diagram withdimensions, mass, velocities, etc.).

    b. Draw diagrams suitable for the problem, such as free body diagrams.

    c. Develop equations required to solve the problem.

    d. Finalize the equations into a solution.

2. Provide an in-class test on vectors in all PHY 111 sections to emphasize the importance of vectors and free body diagrams.

Implementation Date: Spring 2018

Results: Final exam average scores increased from 66.8 in 2017 to 79.0 in 2018 to 81.3 in 2019. Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Include an energy-based analysis in the Dynamics design project.

Implementation Date: Spring 2018

Result: Implementation produced a slight increase in the students' ability to use energy methods. Faculty members will consider additional improvement strategies for teaching energy methods.

Action: Increase the number of homework problems in basic vector cross products, decomposition, and representation of dynamic quantities. To some extent, this represents repetitive drills that should make students comfortable and fluent working with vectors.

Implementation Date: Spring 2018

Result: Students perform well in decomposing force vectors into components but struggle with analyzing rigid body motion using vector cross products. Faculty members will consider additional improvement strategies for teaching vectors.

Action: Faculty members altered the order of content presentation to engage students in active learning problem sessions distributed throughout the course.

Implementation Date: Spring 2018

Result: Final exam average scores increased from 66.8 in 2017 to 79.0 in 2018 to 81.3 in 2019.

Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Faculty members required students to submit high quality, written free body diagrams with all forces calculated except tension and reaction forces, and decomposed into appropriate directions. Also, faculty members required students to identify when a problem can be solved using the conservation of energy or using the work-energy equation.

Implementation Date: Spring 2019

Result: Students in EGR 222 Mechanics II: Dynamics improved in their ability to produce appropriate free body diagrams with only a slight improvement in the use of energy methods. Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Faculty members will assign vector cross product problems related to rigid body motion after discussing the material in a lecture earlier than in previous semesters.

Implementation Date: Spring 2020

Result: To be determined.

B. Evidence of using assessment data for improving EGR 499 Senior Design and Research II

Student Outcome (a) Students are able to apply knowledge of mathematics, science andengineering.

Data: Average assessment scores on the application of engineering concepts improved following faculty members' implementation of providing timely feedback on required weekly progress reports.

Student Outcome (a) Students are able to apply knowledge of mathematics, science and engineering	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 499 Senior Project Report	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Application of Engineering Concepts	9	3.33		19	3.37		17	2.71		12	2.75		7	2.71

Action: The EGR 498 and EGR 499 courses require students to include theory, engineering analysis, simulation results, and experimental data in weekly progress reports. Faculty members provide timely feedback and encourage students to include needed improvements.

Implementation Date: Fall 2017

Results: Weekly progress reports now include significant amounts of technical information. The average assessment results for the Application of Engineering Concepts in the Senior Project Reports demonstrate a distinct improvement resulting in scores above 3.00.

C. Evidence of using assessment data for improving ME 444 Experimental Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data.

Data: Average assessment scores indicate a persistent concern for students' low ability to identify experimental objectives, select appropriate instruments, and design experiments.

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	2018-19			2017-18	
ME 444 Experimental Methods	*N*	Ave		*N*	Ave
Experimental Objectives	21	1.9		20	2.5
Instrument Selection	21	1.8		20	2.2
Experimental Design	21	1.8		20	2.3

Action: To address the three issues, faculty members implemented the following changes in ME 444 Experimental Methods.

1. Experimental Objectives

   a. Require students to specify experimental objectives within homework assignments5, 10, and 13.

   b. Require students to include experimental objectives within the application projects.

2. Instrument Selection

   Require students to present the process of selecting an instrument during lectures given by the student.

3. Experimental Design

   Require students to discuss an experimental design exercise during application project presentations.

Implementation Date: Spring 2019

Results: Implementation of the new requirements resulted in lower average assessment scores for all three categories.

Action: Based on assessment results from spring 2019, faculty members revised the teaching strategy and implemented the following actions for the spring 2020 semester.

1. Experimental Objectives:

   a. Provide students with a mock example of a design problem and discuss how toidentify appropriate experimental objectives and required experimental variables.

   b. Assign at least one exercise where students have to identify the appropriateexperimental objectives and required experimental variables.

2. Instrument Selection:

    a. Provide students with a mock example of a design problem and discuss theprocess of selecting an appropriate instrument.

    b. Include an experimental design homework exercise that requires students toselect an appropriate instrument for an experiment.

3. Experimental Design:

    a. Provide students with a mock example of a design problem and discuss theprocess of design.

    b. Include an experimental design exercise during the Process Heater Simulatorlaboratory.

    c. Require students to provide a detailed discussion of the design process duringthe experimental design exercise.

Implementation Date: Spring 2020

Result: To be determined.

D. Evidence of using assessment data for improving EGR 499 Senior Design and Research II

Student Outcome (c) Students are able 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.

Data: Average assessment scores for Depth and Breadth of Project Content improved following faculty members' implementation of providing timely feedback on required weekly progress reports.

Student Outcome (c) Students are able 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.	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 499 Senior Project Report	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Depth and Breadth of Project Content	9	3.22	19	3.37	17	2.76	12	3.83	7	2.71

Action: To improve students' depth and breadth of project content, faculty members require students to submit weekly reports in EGR 498 and EGR 499 and require specific technical content and documentation of theory, engineering analysis, simulation, and experimental data. Faculty members provide timely formative feedback rather than waiting until the end of the semester. Students also submit checklists with the EGR 498 Semester progress report and EGR 498 Final Report requiring students to note in the report that "Engineering analysis (calculations), theory (equations), computer simulations, and experimental results are included." Also, the final report contains a separate section entitled "Engineering Analysis." Appendices 4-5 and 4-8 include the instructions and grading scheme for the weekly reports, the instructions, a rubric for the Final Report, and the two checklists. Discussion included in Criterion 5: Curriculum addresses the concern in more detail.

Implementation Date: Fall 2017

Result: Due to the continuous feedback from faculty members, students' submitted weekly reports include a marked increase in engineering content. Current average assessment scores greater than 3.00 demonstrate that timely faculty feedback enables students to improve the depth and breadth of project content.

E. Evidence of using assessment data for improvement of EGR 221 Statics Exam

Student Outcome (e) Students are able to identify, formulate and solve engineering problems

Data: Average assessments scores in EGR 221 demonstrate the results of effective intervention strategies introduced by faculty members concerning Diagrams and Formulas, new concerns concerning Information and Assumptions, and indentify a persistent concern for students' low ability to develop effective Solutions to engineering problems.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	2018-19			2017-18			2016-17			2015-16			2014-15	
EGR 221 Statics Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Information	15	2.80		30	3.57		19	3.74		24	3.25		26	3.77
Assumptions	15	2.80		30	3.47		19	3.21		24	3.21		26	3.27
Diagrams	15	3.47		30	3.00		19	3.42		24	2.46		26	2.92
Formulas	15	3.40		30	3.43		19	3.21		24	3.00		26	2.92
Solution	15	2.53		30	2.60		19	2.89		24	2.63		26	2.35

Action: At the end of the 2015-2016 academic year, average assessment scores related to Diagrams indicated a persistent concern. Faculty members noted that the Statics Exam Rubric calls for students to draw pertinent diagrams correctly to assist in the solution procedure. Students continued to struggle with the "free-body diagram," which shows all of the forces acting on an object isolated from its surroundings.

Faculty members agreed to spend an extra 30 minutes of lecture focusing on the proper drawing of free-body diagrams and distribute a worksheet of practice problems involving free-body diagrams. Faculty members provided students time during class to work through all the problems and the opportunity to discuss the solution after each problem.

Implementation Date: Fall 2016

Result: Based on the significant improvement in the average assessment score for Diagrams, faculty members agreed to continue the focus on teaching and practicing free-body diagrams.

Action: To address the persistent concern for students' low ability to develop effective solutions to engineering problems, faculty members developed a worksheet to inform students of the following best practices for solving statics problems.

1. Carry units throughout calculations, and use the proper units as part of the solution.
2. Recognize that some problems involve transcendental equations that have no closedform solution, and students must solve these problems using trial and error.
3. Recognize the given quantities and which are unknown in the general solution ofsimultaneous equations (no numbers involved).
4. Understand that problems often require algebraic and trigonometric manipulations todevelop solutions.
5. Identify common pitfalls that distract from developing appropriate solutions.

Implementation Date: Fall 2018

Results: Average assessment results following the introduction of the best practices for solutions worksheet decreased in the areas of Assumptions, Information, and Solution.

Action: Faculty members responded to the lower average assessment results by developing an additional information worksheet concerning Information and Assumptions.

1. Faculty members will introduce an additional reminder sheet concerning Informationand Assumptions for statics students
2. Faculty members will continue to provide the Solutions worksheet.
3. Faculty members will continue to provide the Free-Body Diagram Worksheet.

Implementation Date: Fall 2019

Results: To be determined.

F. Evidence of using assessment data for improving EGR 222 Mechanics II: Dynamics

Student Outcome (e) Students are able to identify, formulate and solve engineering problems
Data: Average assessment scores indicate a persistent concern for students' low ability to solve problems with rigid bodies.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 222 Dynamics Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Problem Formulation: Rigid Bodies, Translation and Rotation	16	2.19		25	2.84		19	2.68		21	3.24		16	1.75

Action: Faculty members will include at least one problem on one midterm exam that consists solely of drawing free body diagrams for rigid body problems. Faculty members will announce the existence of the rigid body problem before the exam to reinforce the importance of learning how to use free body diagrams to solve rigid body problems. Faculty members will implement the same type of exam question in EGR 221 Mechanics I Statics to underline the importance of free body diagrams in solving problems.

Implementation Date: Spring 2018

Result: While the inclusion of the exam question in spring 2018 did not improve the average assessment score, faculty members anticipate that improvements in the ability to use vectors should help. Faculty members also intend to assign frequent written free body diagram homework problems along with vector cross product problems related to rigid body motion following the introduction of the material in lecture.

G. Evidence of using assessment data for improving EE 311 Network Analysis II

Student Outcome (e) Students are able to identify, formulate and solve engineering problems.

Data: Average assessment scores seem to indicate a variable concern for students' low ability to solve Network Analysis problems requiring the use of Laplace and Fourier Transforms.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems.	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EE 311 Network Analysis II Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Information	12	3.00		6	3.33		7	3.43		5	3.40		4	3.75
Solutions	12	2.67		6	3.33		7	2.57		5	3.40		4	3.50

Action: Faculty members identified that students scored low for solutions on the EE 311 Exam in fall 2016 due to insufficient calculus skills. In this exam, the students use Laplace Transforms and Fourier Transforms as mathematical tools to solve circuit problems. During the fall 2017 course, faculty members informed the students at the beginning of the course concerning the specific mathematical concepts needed during the course and encouraged the students to review the topics. Additionally, faculty members offered specific one-on-one math tutoring as needed and provided information concerning the free mathematics tutoring services available on campus. As an additional help, faculty members provided students with written feedback while grading student assignments.

Implementation Date: Fall 2017

Results: While the math review, tutoring prompts, and timely feedback helped students succeed, the average assessment score fell below 3.00 again during fall 2018. Faculty members offered the course in an online format during fall 2018.

Action: Faculty members reconsidered the course format and will teach the course as a residential course during fall 2019.

Implementation Date: Fall 2019

Results: To be determined.

H. Evidence of using assessment data for improving ME 381 Principles of Design

Student Outcome (e) Students are able to identify, formulate and solve engineering problems

Data: Average assessments scores in ME 381 Principles of Design indicate a persistent concern for students' low ability to form problems in the Gear Force Analysis and a new concern for problem formation in the Ball Bearing Analysis.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	2018-19		2017-18		2016-17		2015-16		2014-15	
ME 381 Principles of Design Exam	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Problem Formulation: Ball Bearing Analysis	13	2.85	11	3.45	21	3.67	17	3.47	14	3.86
Problem Formulation: Journal Bearing Analysis			11	3.18	21	2.24	17	3.59	14	3.64
Problem Formulation: Gear Force Analysis	13	2.62	11	1.73	21	2.10	17	2.18	14	3.43

Action: Faculty members identified that students struggle with identifying the proper units in the gear force analysis. Faculty members will provide detailed explanation and clarification of the units involved and the purpose of using the units in the gear force analysis. Faculty members will provide more example problems of gear force analysis and demonstrate detailed solutions.

Implementation Date: Spring 2019

Result: While the faculty members' intervention concerning units appeared to increase the average Gear Force Analysis assessment score, additional improvement may require additional assistance. Emphasis on the Gear Force Analysis may have affected the effort focused on the Ball Bearing Analysis. Faculty members will develop tools to assist student understanding.

Action:

1. Faculty members will spend more time discussing issues of concern in the Ball Bearings and Gear Force Analysis.

2. Faculty members will develop worksheets for students that specify the expectations ofthe analyses.

Implementation Date: Spring 2020

Result: To be determined.

I. Evidence of using assessment data for improving EGR 461 Engineering Management and Economy

Student Outcome (g) Students are able to communicate effectively

Data: Average assessment scores indicate that students struggle with spelling and grammar.

Student Outcome (g) Students are able to communicate effectively	2018-19		2017-18		2016-17		2015-16		2014-15	
EGR 461 Economics Paper	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Organization	21	4.00	23	4.00	18	3.78	21	3.95	13	2.62
Spelling and Grammar	21	3.05	23	2.96	18	3.28	21	2.95	13	3.08
Format	21	4.00	23	4.00	18	4.00	21	3.95	13	3.92

Action: The University provides all students with access to Grammarly free-of-charge for student and faculty assessment of spelling and grammar in academic papers and reports Faculty members will require students to include a statement concerning the use of Grammarly (or any other spelling and grammar review) on the first page of the Economics Paper. Faculty members will not accept student papers submitted without the statement.

Implementation Date: Fall 2018

Result: The average assessment score in spelling and grammar increased slightly and now exceeds 3.00.

J. Evidence of using assessment data for improving EGR 101 Introduction to Engineering

Student Outcome (i) Students recognize the need for, and are able to engage in life-longlearning.

Data: Average assessment scores for Research vary widely from year-to-year and may indicate an inconsistent student understanding regarding the quality of research required in the Stewardship Essay.

Student Outcome (i) Students recognize the need for, and are able to engage in life-long learning	2018-19		2017-18		2016-17		2015-16		2014-15	
EGR 101 Stewardship Essay	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Research	48	3.35	23	2.74	56	3.46	38	3.13	49	2.94

Action: Faculty members will provide more information to the students concerning expectations of the quality of research required to complete the Stewardship Essay successfully.

Implementation Date: Spring 2018

Result: The average assessment score on Research increased after faculty members provided students with clear expectation guidelines.

K. Evidence of using assessment data for improving EGR 140 Engineering Graphics

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice.

Data: Average assessment scores indicate that students struggle with Interpretation of Drawings.

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice	2018-19		2017-18		2016-17		2015-16		2014-15	
EGR 140 Graphics Exam	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Basic Modeling Requirements	50	3.74	33	3.36	45	3.73	40	3.58	49	3.24
Use of SolidWorks Features	50	3.26	33	3.24	45	3.33	40	3.18	49	3.27
Dimensions on Sketches	50	3.08	33	3.00	45	3.47	40	2.90	49	2.88
Use of specified Features	50	3.74	33	3.48	45	3.96	40	3.83	49	3.80
Interpretation of Drawings	50	3.02	33	2.91	45	3.36	40	2.80	49	2.86
Appropriate Feature Application and Location.	50	3.24	33	3.27	45	3.64	40	3.30	49	3.35

Action: Faculty members noted that either the students do not set the dimensions of the drawing correctly or the students do not use Smart Dimension correctly.

1. Faculty members will emphasize the need for students to use Smart Dimension to setdrawing dimensions correctly.

2. Faculty members will require students to use Smart Dimension during Exams 1 and 3.

Implementation Date: Spring 2019

Result: The average assessment score on setting dimensions on sketches correctly improved and now exceeds the 3.00 standard.

L. Evidence of using assessment data for improving EGR 252 Engineering Computational Methods

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice. Data: The average assessment score for Specifications in EGR 252 indicated a concern regarding the Matlab Programming Project:

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 252 Matlab Programming Project	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Specifications	33	3.24	41	2.56	18	3.33	41	3.34	20	3.30
Readability	33	3.45	41	3.71	18	3.61	41	3.46	20	3.55
Reusability	33	3.52	41	3.07	18	3.72	41	3.54	20	2.75
Efficiency	33	3.09	41	3.24	18	3.44	41	3.02	20	3.60
On time delivery/Demonstration	33	3.42	41	3.41	18	4.00	41	3.73	20	3.90

Action: While the average assessment scores did not indicate a persistent concern, faculty members will emphasize the importance of error checking.

1. Faculty members will provide students with a simple quiz before assigning the MatlabProgramming Project to highlight the importance of code reusability by creating appropriate functions and emphasizing error checking.

2. Faculty members will remind students at the beginning of the project to include errorcheck code for each input.

3. Faculty members will include a grading score for error checking in the project description and explain to students how to use the error checking before the start of theproject.

Implementation Date: Fall 2018

Result: Average assessment scores for Specifications and Reusability increased following faculty members' increased emphasis on error checking.

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3. Document the Engineering program's formal process of facilitating the effective andefficient evaluation of data for continuous improvement

To improve the assessment of student outcome (b) an ability to design and conduct experiments, as well as to analyze and interpret data, faculty members completed the following tasks.

- Added the following new assignments to assess student outcome

  (b).o ME 381 Principles of Design Lego Lab

  Students design and conduct an experiment to determine the pull-apart force for Duplo bricks.

  o ME 444 Experimental Methods Laboratory Report

  Students design and execute an experiment based on provided specifications

- Modified the following assignments to assess student outcome (b) more effectively.

  o EE 325 Electronics I Lab

  Students design and conduct an experiment based on provided specifications.

  o EGR 252 Computational Methods Matlab Programming Project

  Students design a test procedure for a Matlab program and test the program with all possible inputs.

  o EGR 499 Senior Design Final Report

  Students include in the final report of a project the description of test design used during the project and specifics concerning how the test meets the design specifications.

Faculty members added additional assessments of EGR 225 Circuits and Electronics Exam to address outcomes (a) and (e) for the students in the Mechanical Concentration who do not take EGR 210 Network Analysis I. Faculty members assess the EGR 225 Circuits and Electronics exam using the same rubric used for the EGR 210 Network Analysis I Exam.

Faculty members observed that a large number of artifacts assessed outcome (g) and eliminated some of the artifacts to streamline the assessment process. In the EGR 101 Introduction to Engineering course, faculty removed the artifacts for Initial Resume, Robot Report, and Robot Project Oral Presentation.

For the EGR 498 Senior Design and Research I course, faculty removed the artifacts for the Resume.

Faculty members also removed the assessment of two presentation reflection papers (EGR 101 Intro Project Oral Presentation Reflection and EGR 499 Senior Project Oral Presentation Reflection) as the assessment of the papers did not provide useful information for the assessment of outcome (i) Lifelong Learning.

During fall 2019, the School of Engineering transitioned from the previous ABET student outcomes to the revised ABET student outcomes.[1]

New Student Outcomes for Criterion 3	Old Student Outcomes for Criterion 3
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	(a) Students are able to apply knowledge of mathematics, science and engineering
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	(b) Students are able to design and conduct experiments, as well as analyze and interpret data
3. An ability to communicate effectively with a range of audiences	(c) Students are able 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.
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	(d) Students are able to function on multi-disciplinary teams
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	(e) Students are able to identify, formulate and solve engineering problems
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	(f) Students understand professional and ethical responsibility
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	(g) Students are able to communicate effectively
8. An ability to apply Christian principles of stewardship	(h) Students have a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
	(i) Students recognize the need for, and are able to engage in life-long learning
	(j) Students have knowledge of contemporary issues
	(k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice
	(l) Students are able to apply Christian principles of stewardship

Comparison of the previous to the revised student outcomes allows for the following relations between them[2-3]. Faculty members have revised assessment data collection based on the revised student outcomes.

Engineering Student Outcome Map

New Student Outcomes	Old Student Outcome a)	Old Student Outcome b)	Old Student Outcome c)	Old Student Outcome d)	Old Student Outcome e)	Old Student Outcome f)	Old Student Outcome g)	Old Student Outcome h)	Old Student Outcome i)	Old Student Outcome j)	Old Student Outcome k)	Old Student Outcome l)
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.									✓			
8. An ability to apply Christian principles of stewardship												✓

References

1. ABET, "Criteria for Accrediting Engineering Programs: Effective for Reviews During the 2019-2020 Accreditation Cycle ", Baltimore, MD, November 2, 2018.

2. McCullough, C. L., "A Plan to Assess All the New ABET Outcomes Using Only Three Courses,"2018 ASEE Southeastern Section Conference.

3. Haddad R. J, Kalaani, Y., and El Shabat, A.," An Optimal Mapping Framework for ABET Criteria 3 (a-k) Student Outcomes into the Newly Proposed (1-7) Student Outcomes, Proceedings of the 2016 IAJC-ISAM Joint International Conference, ISBN 978-1-60643-379-9.

2017 ABET Final Statement

ORU School of Engineering received the following Program Weakness related to Criterion5 – Curriculum:

Statement of weakness: This criterion requires that students must be prepared for engineering practice through a curriculum culminating in a major design experience based on a knowledge of skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. The major design experience is realized through two courses: EGR498 Senior Design and Research I, and EGR499, Senior Design and Research II. Many of the projects do not build on the foundation of mathematics, science, and engineering sciences. Design reports do not consistently include the mathematical foundations and supporting data on which the project design was based, nor do they incorporate realistic constraints and engineering standards. Based on these design projects, students maynot be sufficiently prepared for engineering practice. Thus, strength of compliance with this criterion is lacking.

Response to ABET Draft Statement: Curriculum

Faculty members implemented the following changes to prepare students sufficiently for engineering practice through a curriculum culminating in a major design experience based on mathematical foundations, including supporting data based on knowledge acquired in earlier course work and incorporating appropriate engineering standards with multiple realistic constraints.

1. Project Selection

Instructors recommend most senior design experiences based on the needs of an external customer or stakeholder. In general, these experiences have a significant amount of mathematical foundation and engineering content using student knowledge from prior coursework. Students propose some experiences, which faculty members then evaluate for appropriateness. Beginning in fall 2018, faculty members will only accept senior design experiences based on the student's major field coursework. Students will either work an experience recommended by a faculty member or submit an abstract describing how the experience will utilize the major field coursework from the student's program.

2. Mathematical Foundations and Engineering Analysis in Senior Design Experience Reports

Students will address the intentional incorporation of mathematical foundations and engineering analysis in senior design experiences to provide technical content in the weekly progress reports in both EGR 498 and EGR 499. Previously, the weekly progress reports only contained reporting and plans for the following week. The technical content now includes the following required sections.

A. Design alternatives considered by the student.

B. Theory, engineering analysis, and simulation or experimental results.

C. Pictures or diagrams of the current state of the design.

Faculty members will grade weekly reports based on containing theory, engineering analysis, and simulation or experimental results. Although students will not generally add new theory every week, students must include any additional theory applied during the specified week. Faculty project advisors grade the weekly reports rather than the course coordinator as the advisors are in a better position to evaluate specialized technical content. Students will use material from these weekly reports to write fall semester progress reports in EGR 498 and spring final reports in EGR 499.

Requiring the technical material in the weekly reports gives students feedback concerning compliance with required technical material and an opportunity to make changes, which would not be possible with the semester progress report in EGR 498 or the final report in EGR 499. Weekly reporting also requires ongoing documentation of engineering content as the design experience develops. Faculty members implemented the change in EGR 498 in fall 2017 and continued the change in EGR 499 in spring 2018. After receiving feedback on the first two weekly reports, most design groups significantly increased the amount of theory and engineering analysis included in the weekly reports.

In fall 2018 (EGR 498) and spring 2019 (EGR 499), faculty members directed students to include technical material only rather than planning/management data to increase the focus on theory and engineering analysis. Faculty members modified the collection of the reports to a biweekly format in response to student feedback. Implementation of the reporting process resulted in significant improvements in the mathematical and engineering content of the design process in the final reports.

To improve compliance and identify expectations, faculty members require students to submit checklists along with the EGR 498 Semester Progress Reports and EGR 499 Final Report indicating the inclusion of theory, engineering analysis, simulations, and experimental results. The instructions for the EGR 499 Final Report require a separate section entitled Engineering Analysis.

Starting in fall 2018, project advisors began grading the EGR 498 Semester Progress Reports. Starting in spring 2019, project advisors also graded the EGR 499 Final Reports. Before 2018, the course coordinator graded the reports, and the project advisors graded the overall progress. Changing the grading process will facilitate a more thorough evaluation of the specialized technical content of the reports.

3. Engineering Standards

Faculty members require students to identify relevant engineering standards in senior project proposals but have not evaluated students based on including standards in the design reporting. To encourage students to include standards in the design reports, the Engineering department purchased 27 engineering standards and will continue to purchase relevant standards as needed. Faculty members require students enrolled in EGR 498 to identify engineering standards selected for the proposed project and require students to reference the standards in weekly reports, including quoted material from the standards that will guide the project. Faculty members also dedicate a portion of the course to discuss the use of engineering standards.

Faculty members require students to include a subsection within the introduction to the EGR 498 semester progress report entitled “Applicable Standards” and identify the sections of the applicable standard relevant to the students’ design experience. Students also submit a checklist identifying the applicable standards, citing relevant sections, and describing the impact of the standards on the project design.

For the EGR 499 final report, faculty members again require students to identify and cite the relevant engineering standards, including an impact discussion. Students also include an additional subsection in the results section entitled "Standards and Design Constraints" to indicate clearly if the design satisfies the selected engineering standards. As with the progress report, students also submit a checklist indicating the identified and cited applicable standards along with the impact of the standards on the project design.

4. Realistic Design Constraints

Faculty members require students to include a special section in the EGR 498 Semester Project Report and EGR 499 Final Report to document identified and realistic design constraints relevant to the specified project. To increase awareness of design constraints, students must also turn in a checklist identifying the intentional inclusion of design constraints with the Semester Project Report and an additional checklist with the Final Report. Faculty members address the use of design constraints in EGR 498 and require students to identify design constraints (such as weight) in specific weekly reports. In the following week report, faculty members require students to identify appropriate project thresholds for the design constraint (such as 220 lb).

5. Student Time Management

In response to comments provided by the ABET site visit team, faculty members agreed to reduce the number of assignments in EGR 498 Senior Design to allow students additional time to focus on the design experience. Faculty members removed the following assignments from the course requirements:

- Resume writing assignment: Faculty members will discuss resume writing and interviewing butwill not grade any relevant assignments.
- Research writing assignments: In place of three research papers, faculty members will assignone design proposal and one research paper.
- Oral presentations:In place of three oral presentations based on research reporting, facultymembers will require students to present two oral reports on research and design.

While the assignment changes do not reduce or alter the material provided, the changes will provide additional time for students to focus on the overall design experience. Faculty members understand the importance of assessing the Life-Long Learning student-learning outcome, so faculty will assess student engagement with the research and design process in EGR 498 to evaluate research and independent learning skills.

Comments from the site visit team also indicated that students would benefit by committing to design experiences earlier in the course. To facilitate student commitment to design experiences, faculty members contacted potential industrial customers to develop ideas for student experiences. Industrial customers who engage students in design experiences through the Engineering program include Alfa Laval, Apergy Artificial Lift Technologies, Baker Hughes, Muncie Power Products, National Steak and Poultry, and the Oklahoma Aquarium, a not-for profit institution. Students visit potential project customers.

To assist students through the design project, the Engineering lab manager trains students in fabrication and meets with the senior project groups to discuss project status to stress the importance of intuitive design and knowledge of standard parts.

4. Describe any data-driven decisions that faculty members made to *open this program* since2016. Please provide evidence of data informing the decision to open the program.

   N/A (this is not a new program that opened after 2016)

5. Describe your stakeholder participation from alumni, community members, businesses, otherorganizations, etc.
   - Who are they?
   - What feedback have you received?
   - How have you used the feedback for continuous improvement?

     The program constituencies are the following:

     1. Currently enrolled students

        These are students who are enrolled at ORU and who have started taking classes in preparation for entering the engineering program or have been accepted into theengineering program. Successful realization of the educational objectives will equip students in the engineering program with the skills needed to enter the profession of engineering.

     2. Full-time active faculty, adjunct faculty, and retired and past faculty members

        The educational objectives give all levels of faculty guidelines for designing their courses to meet the educational needs of the students in the program. They also provide guidance for mentoring students and advising them regarding academic questions.

     3. Other constituencies who are not directly included in the on-campus program

        a. Alumni of the Engineering Program.

        b. Faculty members from other institutions who collaborate with the Engineeringdepartment.

        c. Graduate programs that have currently enrolled graduates of the program.

        d. Industrial partners/companies who currently employ graduates of the program.

e. Industry representatives who have given talks to the Engineering department.

f. Industry representatives who have sponsored design projects.

g. Organizations that currently employ alumni.

h. Prospective students who have made inquiry to the Engineering department.

All of the above constituencies need to know the type of engineering program that ORU offers and the level of preparation that graduates of the program are expected to attain. This is important for recruitment and involvement of outside groups with the Engineering department.

The Engineering department is in dialogue with the constituencies through advisory board meetings, student interviews and alumni and student surveys. As needs are expressed there are monthly meetings of the faculty where the chair canpropose changes to better serve all constituencies.

6. Describe any open questions that faculty members have concerning the program that they are *waiting on future data* to evaluate for decision-making.

   We are continuously evaluating assessment data at the beginning of each semester andmaking data driven decisions.

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4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

Artifact Outcome	Criterion Outcome	Supporting Data Source	Year	Low Data (< 3)	Action Plans	Year	Improved Data	Evidence
WPA-EGR-Senior Project Report	EGR-1-A-Application of Engineering Concepts	Program Outcome Report	2016-2017	2.71 (N = 17)	Require students to include theory, engineering analysis, simulation results and experimental data in weekly progress reports	2017-2018	3.37 (N=19)	Minutes, August 14, 2018
WPA-EGR-Senior Project Report	EGR-2-B-Depth and Breadth of Project Content	Program Outcome Report	2016-2017	2.76 (N = 17)	Require weekly reports in EGR 498 and EGR 499 with required technical content. Students submit checklists with their EGR 498 Semester progress report and EGR 499 Final Report. Final report is required to have a section with engineering analysis.	2017-2018	3.37 (N=19)	Minutes, August 14, 2018
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-7-A-Research	Program Outcome Report	2017-2018	2.74 (N = 23)	Dr. Halsmer gave the students more information on what was expected for the research.	2018-2019	3.35 (N = 48)	Minutes, January 7, 2019
WPA-EGR- C Programming Project	EGR-k-7-Specifications	Program Outcome Report	2017-2018	2.56 N = 41)	1. Before assigning the project, we give students a simple quiz to highlight a) importance of code reusability by creating appropriate functions and b) error checking. 2. At beginning of the project, we tell students that error checking of code is required for each input and that they may need to take more time to complete this 3. Include a score for error checking in the project description and explain to the students how to assess this when introducing the project	2018-2019	3.24 (N = 33)	Minutes, January 7, 2019
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-H-Spelling and Grammar	Program Outcome Report	2018-2019	2.65 (N = 48)	Dr. Halsmer gave students feedback with more detailed written comments on their papers regarding improving their grammar and writing skills. He also recommended software that might help in this regard.	2019-2020	3.9 (N = 52)	Minutes, January 6, 2020
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-A-Content	Program Outcome Report	2018-2019	2.83 (N = 48)	Dr. Halsmer said that he got an extra class with them and during that class he discussed this essay in detail. The essay was also moved to the end of the semester, rather than at the beginning. Also, Dr. Halsmer's new book, *Hacking the Cosmos*, was used in this class for the first time.	2019-2020	3.17 (N = 52)	Minutes, January 6, 2020
WPA-EGR-Mechanics I: Statics Final Examination (EGR 221)	EGR-1-E-Information	Program Outcome Report	2018-2019	2.8 (N=15)	Dr. Halsmer developed a worksheet that he handed out to students in Fall of 2019 to give them instruction, insight and practice in this area.	2019-2020	3.88	Minutes, January 6, 2020
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-C-Format	Program Outcome Report	2019-2020	2.81 (N = 52)	Dr. Halsmer had added a checklist to the assignment sheet and he believes that is what helped increase the scores.	2020-2021	3.43 (N = 44)	Minutes, January 20, 2021

Table 1. Examples with evidence and documented action plans for assessment data collected from courses

Results of Primary Evidence: B.S.E. Engineering

A. Program Outcome Report:

		2016 – 2017		2017 – 2018		2018 – 2019		2019 - 2020		2020 - 2021	
		Residential		Residential		Residential		Residential		Residential	
		n	score	n	score	n	score	n	score	n	score
EGR 101	Stewardship Essay: Content	56	3.48	46	3.17	48	2.83	52	3.17	44	3.02
EGR 101	Stewardship Essay: Format	56	3.75	46	3.76	48	3.96	52	2.81	44	3.43
EGR 101	Stewardship Essay: Research	56	3.46	23	2.74	48	3.35	52	2.52	44	3.27
EGR 101	Stewardship Essay: Spelling and Grammar	56	3	46	3.04	48	2.65	52	3.9	44	3.57
EGR 222	Statics Exam: Information	19	3.74	30	3.57	15	2.8	---	3.88		
EGR 252	C Programming Project: Specifications	18	3.33	41	2.56	33	3.24				
EGR 499	Senior Project Report: Application of Engineering Concepts	17	2.71	19	3.37	9	3.33	8	3.5	8	3.2
EGR 499	Senior Project Report: Depth and Breadth of Project Content	17	2.76	19	3.37	9	3.22	8	3.6	8	3.5

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Engineering

Program Review | 2018-2021

Department Chair: Dr. John Matsson
Assessment Coordinator: Dr. Bob Leland

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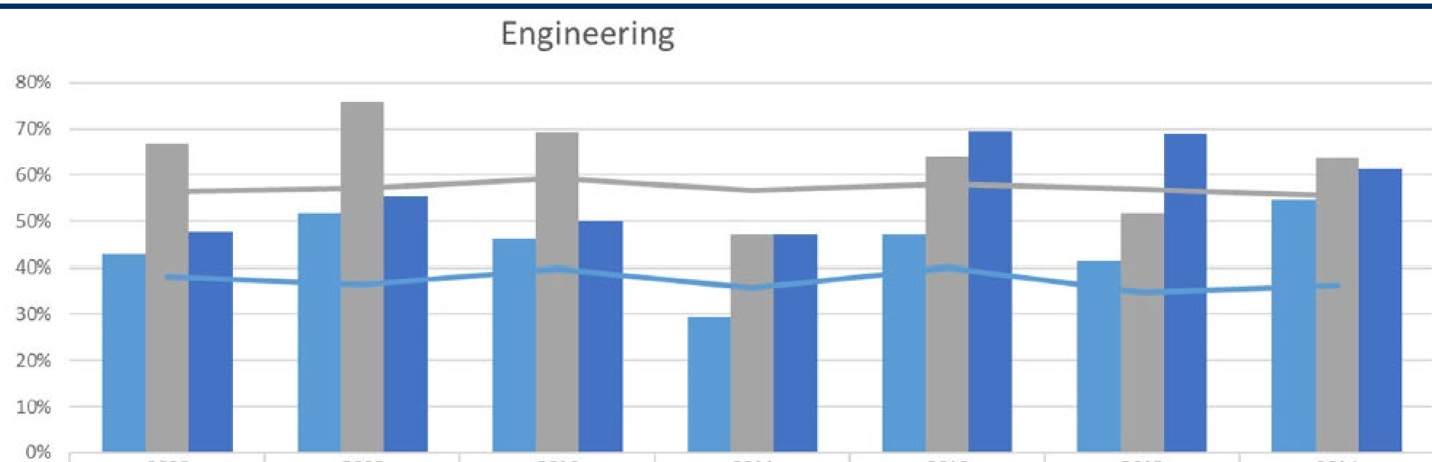
I. Number of Majors | 2018 - 2021

Residential:

	Fall 2018	Fall 2019	Fall 2020	Fall 2021
Physics	4	4	2	3
Electrical	26	24	15	16
Computer	28	34	30	29
Mechanical	89	82	90	86
Total	**147**	**144**	**137**	**134**

II. Graduation Rate | Cohort of 2008 - 2014



	2008	2009	2010	2011	2012	2013	2014
Program to Prog - Engineering	43%	52%	46%	29%	47%	41%	55%
Program to Any - Engineering	67%	76%	69%	47%	64%	52%	64%
Any to Program - Engineering	48%	55%	50%	47%	69%	69%	61%
Program to Prog - ORU	38%	37%	40%	36%	40%	35%	36%
Program to Any - ORU	56%	57%	59%	57%	58%	57%	55%

III. Program Outcomes

#	Program Outcome
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.
8	An ability to apply Christian principles of stewardship

IV. Artifact Descriptions and Program Alignment

1. Artifact: EGR 330 Control Systems Mini Project
   Students design a control system using theory and computer tools, develop a test plan, then build and test their design.
   Student Outcome 1.1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. Artifact: EGR 499 Senior Project Report.
   Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design.
   Student Outcome 1.2: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

3. Artifact: CMPE 340 Digital Systems Mini Project
   This mini project is to design and implement a vending machine mechanism using a digital circuit with integrated logic chips. The project is a perfect combination of mathematical theory and hands on implementation.
   Student Outcome 1.3: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

4. Artifact: ME 381 Principles of Design Exam
   Students must solve complex problems involving the analysis and design of machine components based on the stresses and strains induced by static, dynamic and thermal loads, while also avoiding failure due to impact, fatigue, wear, and surface damage.
   Student Outcome 1.4: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

5. Artifact: EGR 498 Design Process Paper
   Students must describe the design process, and identify key issues in a variety of scenarios.
   Student Outcome 2.1: 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.

6. Artifact: EGR 499 Senior Project Report
   Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design.

Student Outcome 2.2: 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.

7. Artifact: EGR 101 Stewardship Essay
   Students express your understanding of Christian stewardship and its relationship to the field of engineering. This includes a discussion of personal stewardship in addition to corporate stewardship over global resources, for example. They also relate why they chose engineering as their major, and how stewardship and engineering relate to evangelism, missions, and scientifically informed apologetics.
   Student Outcome 3.1: An ability to communicate effectively with a range of audiences.

8. Artifact: EGR 461 Economics Paper
   Students research topics involving an economic impact and write a formal paper.
   Student Outcome 3.2: An ability to communicate effectively with a range of audiences.

9. Artifact: EGR 499 Senior Project Oral Presentation
   Students present their senior projects to the department in the Engineering Seminar, which involves all students and faculty in the school. They are assessed on the quality of their presentation.
   Student Outcome 3.3: An ability to communicate effectively with a range of audiences.

10. Artifact: EGR 499 Senior Project Report
    Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design. Student Outcome 3.4: An ability to communicate effectively with a range of audiences.

11. Artifact: EGR 101 Stewardship Essay
    Student Outcome 4.1: 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.

12. Artifact: EGR 461 Economics Paper
    Students research topics involving an economic impact and write a formal paper.
    Student Outcome 4.2: 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.

13. Artifact: EGR 498 Ethics Quiz
    Students study the NSPE code of ethics, identify key parts of the code, and discuss how they would handle a variety of scenarios, and how the NSPE code would advise their actions.
    Student Outcome 4.3: 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.

14. Artifact: EGR 499 Senior Project Report
    Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design.
    Student Outcome 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.

15. Artifact: EGR 252 MATLAB Programming Project
    The Scheduling for Library Help Desk project is to develop the modular program using MATLAB computer language to schedule student workers duty for reference help desk at ORU library. Students develop experience in specifying and designing a solution to an engineering problem during the course EGR 252—Engineering Computational Methods using the software tool Matlab.
    Student Outcome 6.1: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

16. Artifact: ME 381 Principles of Design Lab
    Students must formulate, design and conduct experiments to explore and quantify the parameters associated with a high-quality interference fit between mechanical components.
    Student Outcome 6.2: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

17. Artifact: ME 444 Experimental Methods Experiment
    There are eight labs over the course that incorporate all of the elements as described in student outcome 6.3 and where each requires a complete lab report.
    Student Outcome 6.3: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

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18. Artifact: EGR 499 Senior Design Project Report
    Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design.
    Student Outcome 6.4: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

19. Artifact: EGR 101 Stewardship Essay
    Students express your understanding of Christian stewardship and its relationship to the field of engineering. This includes a discussion of personal stewardship in addition to corporate stewardship over global resources, for example. They also relate why they chose engineering as their major, and how stewardship and engineering relate to evangelism, missions, and scientifically informed apologetics.
    Student Outcome 7.1: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

20. Artifact: EGR 461 Economics Paper
    Students research topics involving an economic impact and write a formal paper.
    Student Outcome 7.2: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

21. Artifact: EGR 498 Senior Project Research Paper
    A paper written by each design team that includes the background research for their project. Students must include at least one patent.
    Student Outcome 7.3: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

22. Artifact: EGR 499 Senior Project Report
    Final report on senior projects. Students must address engineering standards, realistic design constraints, teaming, testing and project management in addition to reporting on their design.
    Student Outcome 7.4: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

23. Artifact: EGR 101 Stewardship Essay
    Students express your understanding of Christian stewardship and its relationship to the field of engineering. This includes a discussion of personal stewardship in addition to corporate stewardship over global resources, for example. They also relate why they chose engineering as their major, and how stewardship and engineering relate to evangelism, missions, and scientifically informed apologetics.
    Student Outcome 8.1: An ability to apply Christian principles of stewardship.

24. Artifact: EGR 461 Economics Paper
    Students research topics involving an economic impact and write a formal paper.
    Student Outcome 8.2: An ability to apply Christian principles of stewardship.

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V. Primary Evidence

A. Program Outcomes – by criterion levels

Outcome	2018-19	2019-20	2020-2021
1.1.1	-	-	3.55
1.1.2	-	-	3.70
1.1.3	-	-	3.30
1.1.4	-	-	3.35
1.1.5	-	-	3.40
1.2	3.33	3.5	-
1.3.1	4.00	3.58	-
1.3.2	3.86	3.67	-
1.3.3	3.43	3.92	-
1.4.1	2.85	3.92	-
1.4.2	-	-	-
1.4.3	2.62	4.00	-
2.1	3.58	2.82	3.33
2.2.1	3.22	3.60	-
2.2.2	3.00	4.00	-
2.2.3	4.00	3.90	-
2.2.4	3.22	4.00	-
2.2.5	3.78	4.00	-
2.2.6	3.22	3.70	-
3.1.1	3.94	3.19	4.00
3.1.2	2.65	3.90	3.57
3.1.3	3.96	2.81	3.43
3.2.1	4.00	4.00	3.84
3.2.2	3.05	3.53	3.68
3.2.3	4.00	4.00	3.89
3.3.1	3.65	3.90	-
3.3.2	3.42	3.60	-
3.3.3	3.85	4.00	-
3.3.4	3.73	3.70	-
3.4.1	3.67	3.90	-
3.4.2	3.56	4.00	-
3.4.3	3.44	4.00	-
3.4.4	3.00	3.90	-
3.4.5	4.00	3.50	-
3.4.6	-	3.70	-
4.1	2.83	3.17	3.02
4.2.1	3.05	2.87	3.37
4.2.2	3.62	3.41	3.81

Outcome	2018-19	2019-20	2020-2021
4.3.1	3.82	3.71	3.72
4.3.2	3.53	3.90	3.61
4.3.3	3.12	3.48	2.83
5	3.44	4.00	-
6.1	3.64	2.20	2.88
6.2.1	3.53	4.00	-
6.2.2	3.27	4.00	-
6.2.3	3.07	4.00	-
6.2.4	3.27	4.00	-
6.3.1	1.90	1.40	-
6.3.2	1.80	1.30	-
6.3.3	1.80	1.30	-
6.4.1	3.13	3.00	-
6.4.2	3.38	3.37	-
6.4.3	3.63	3.74	-
6.4.4	3.25	3.68	-
7.1	3.35	2.52	3.27
7.2	3.24	3.19	3.21
7.3	3.10	3.80	3.17
7.4	3.33	4.00	-
8.1.1	3.44	3.67	3.7
8.1.2	3.25	2.48	3.2
8.2.1	3.95	3.97	3.89
8.2.2	3.52	3.94	3.58

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

B. Artifact Outcomes

Artifact Outcomes	2018 - 2019		2019 - 2020		2020 - 2021	
	n	score	n	score	n	score
WPA-EGR-101 Introduction to Engineering Stewardship Essay	18	3.40	25	2.99	20	3.56
WPA-EGR-222 Exam	13	2.71	-	-	-	-
WPA-EGR-340 Digital Systems Mini Project	-	-	-	-	-	-
WPA-EGR-Control Systems Exam	19	3.62	21	3.57	-	-
WPA-EGR-Design Process Paper	3	3.67	7	3.00	-	-
WPA-EGR-Economics Paper	12	3.31	14	3.54	2	3.69
WPA-EGR-EE 311 Network Analysis II Exam	13	2.73	-	-	-	-
WPA-EGR-EE 321 Electronics I Lab Experiment Design	11	3.64	9	3.49	-	-
WPA-EGR-Engineering Computational Methods C Programming Final Project	33	3.32	13	2.77	-	-
WPA-EGR-Engineering Management & Economy	13	3.62	18	3.64	-	-
WPA-EGR-Ethics Quiz	15	3.51	19	3.74	-	-
WPA-EGR-Finite Element Analysis Using ANSYS	15	3.07	19	2.95	-	-
WPA-EGR-Master Rubric	-	-	-	-	6	3.78
WPA-EGR-MEC 225 Circuits and Electronics Exam	10	3.60	-	-	-	-
WPA-EGR-Mechanics I: Statics Final Examination (EGR 221)	12	3.08	12	3.08	-	-
WPA-EGR-Network Analysis I Exam	13	3.72	-	-	-	-
WPA-EGR-Research Paper	5	2.40	9	3.78	-	-
WPA-EGR-Senior Design and Research	7	3.86	13	2.85	-	-
WPA-EGR-Senior Project Oral Presentation	6	3.38	-	-	11	3.82
WPA-EGR-Senior Project Report	3	3.36	-	-	11	3.62

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

C. Criterion Outcomes

Criterion Outcomes	2018 - 2019		2019 - 2020		2020 - 2021	
	n	score	n	score	n	score
EGR-1-A-Application of Engineering Concepts	8	3.38	-	-	36	3.36
EGR-1-B-Application of Finite State Machine and Implication Chart Method	7	3.71	-	-	6	3.67
EGR-1-B-Assumptions	-	-	17	3.82	-	-
EGR-1-C-Application of Karnaugh Map	7	3.86	-	-	6	3.83
EGR-1-C-Diagrams and Curves	-	-	17	3.53	-	-
EGR-1-D-Assumptions	31	3.35	4	3.25	6	4.00
EGR-1-D-Formulas	-	-	17	3.65	-	-
EGR-1-E-Diagrams and Curves	31	3.45	4	3.50	6	4.00
EGR-1-E-Information	-	-	17	3.59	-	-
EGR-1-F-Formulas	33	3.64	4	3.50	6	4.00
EGR-1-G-Information	39	3.41	7	3.29	6	4.00
EGR-1-H-Problem Formation	46	2.96	-	-	6	4.00
EGR-1-I-Schematic Diagrams and Waveforms	36	3.44	-	-	6	4.00
EGR-1-I-Solutions	-	-	17	3.65	-	-
EGR-1-J-Solutions	45	3.16	2	3.50	6	4.00
EGR-1-J-Theories	-	-	17	3.47	-	-
EGR-1-K-Theories	32	3.28	2	3.00	6	4.00
EGR-1-L-Solutions	-	-	2	3.50	-	-
EGR-1-L-Theories and Assumptions	23	3.78	-	-	6	4.00
EGR-1-M-Assumptions	-	-	9	3.44	6	4.00
EGR-1-M-Theories	-	-	2	3.50	-	-
EGR-1-N-Diagrams	-	-	9	2.67	6	4.00

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

EGR-1-O-Formulas	21	3.62	9	3.33	6	4.00
EGR-1-P-Assumptions	-	-	3	3.67	-	-
EGR-1-P-Information	28	3.50	6	3.67	6	4.00
EGR-1-Q-Diagrams	-	-	3	2.00	-	-
EGR-1-Q-Problem Formulation: Ball Bearing Analysis	-	-	14	4.00	-	-
EGR-1-Q-Solutions	22	3.00	3	2.67	6	4.00
EGR-1-R-Formulas	-	-	3	3.00	-	-
EGR-1-R-Problem Formulation: Gear Force Analysis	-	-	14	2.86	-	-
EGR-1-S-Information	-	-	3	3.67	-	-
EGR-1-S-Problem Formulation: Journal Bearing Analysis	-	-	14	3.79	-	-
EGR-1-U-Solutions	-	-	9	2.56	-	-
EGR-2-A-Consideration of Alternatives	8	3.13	-	-	36	3.81
EGR-2-B-Depth and Breadth of Project Content	8	3.25	-	-	36	3.56
EGR-2-C-Design Problem Statement	8	3.13	-	-	36	3.75
EGR-2-D-Engineering Standards	8	3.25	-	-	36	2.97
EGR-2-E-Realistic Constraints	8	4.00	-	-	36	3.67
EGR-2-F-Response to Customer Needs	8	4.00	-	-	36	3.97
EGR-2-G-Description of Design Process	10	3.80	20	2.90	6	4.00
EGR-3-A-Content	51	3.12	57	2.98	58	3.40
EGR-3-C-Format	51	4.00	57	3.47	58	3.43
EGR-3-D-Organization	51	3.92	57	3.91	58	3.50
EGR-3-E-Organization of Ideas	22	3.91	-	-	35	3.97
EGR-3-F-Slide Quality	22	3.45	-	-	35	3.63
EGR-3-G-Speaking and Audience Engagement	22	3.73	-	-	35	3.89
EGR-3-H-Spelling and Grammar	51	2.94	57	3.28	59	3.78
EGR-3-I-Style and Vocabulary	8	3.63	-	-	36	3.86
EGR-3-J-Technical Content	22	3.68	-	-	35	3.91
EGR-4-A-Disclosure	15	3.40	19	3.89	6	3.67

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

EGR-4-B-Identification and Description of Conflict of Interest	15	3.87	19	3.84	6	3.67
EGR-4-C-Responsibilities of Engineers	15	3.27	19	3.47	8	3.88
EGR-4-D-Broader Impact	25	3.44	32	3.41	8	3.88
EGR-4-E-Content	-	-	-	-	6	3.67
EGR-5-A-Teaming	8	3.38	-	-	36	3.69
EGR-6-A-Data Analysis and Interpretation	11	3.18	9	3.33	6	3.83
EGR-6-B-Equipment Selection	11	4.00	9	3.89	6	3.33
EGR-6-C-Experiment Procedures and Data Measurement	11	3.45	9	3.56	6	3.33
EGR-6-D-Test Program with All Possible Inputs	-	-	4	2.25	-	-
EGR-6-D-Theoretical Value Calculation	11	3.82	9	3.44	6	3.83
EGR-6-E-Clear Research Question	-	-	6	4.00	-	-
EGR-6-E-Theory	11	3.73	9	3.22	6	3.67
EGR-6-F-Design of Experiment	-	-	6	4.00	-	-
EGR-6-F-Test Program with All Possible Inputs	-	-	9	3.00	6	3.67
EGR-6-G-Clear Research Question	-	-	-	-	6	3.83
EGR-6-G-Conduct Experiment	-	-	6	4.00	-	-
EGR-6-H-Analyze Data	-	-	6	4.00	-	-
EGR-6-H-Design of Experiment	-	-	-	-	6	3.33
EGR-6-I-Conduct Experiment	-	-	-	-	6	3.33
EGR-6-J-Analyze Data	-	-	-	-	6	3.67
EGR-7-A-Research	51	3.27	57	2.77	58	3.36
EGR-7-B-Use of Online and Print media and Published Patents	5	2.40	9	3.78	6	3.50
EGR-8-A-Biblical References for Stewardship	43	3.30	57	3.35	28	3.32
EGR-8-B-Stewardship	43	3.77	57	3.74	28	3.71
EGR-a-12-Vectors	10	2.20	-	-	-	-
EGR-a-15-Vectors	3	3.00	-	-	-	-
EGR-j-1-Contemporary Issues	25	3.32	32	3.44	-	-
EGR-k-10-Software Use	15	3.07	19	2.95	-	-

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

EGR-k-3-Demonstration	33	3.45	-	-	-	-
EGR-k-5-Efficiency	15	3.27	-	-	-	-
EGR-k-7-Specifications	33	3.21	-	-	-	-
EGR-k-8-Readability	15	3.67	-	-	-	-
EGR-k-9-Reusability	33	3.36	-	-	-	-

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Scale			
4.00	90%+	3.00	60%
3.66	80%	2.00	35%
3.33	70%	1.00	15%

D. University Whole Person Outcomes

ORU Whole Person Outcomes		2018 - 2019		2019 - 2020		2020 - 2021	
		n	score	n	score	n	score
1A	Biblical Literacy	116	3.84	8	3.92	58	3.91
1B	Spiritual Formation	41	3.96	43	3.81	137	3.69
2A	Critical Thinking, Creativity & Aesthetic Appreciation	216	3.13	108	3.02	81	3.44
2B	Global & Historical Perspectives	78	3.63	2	4.00	1	3.00
2C	Information Literacy	109	3.23	171	3.13	172	3.35
2D	Knowledge of the Physical & Natural World	N/A	N/A	N/A	N/A	N/A	N/A
3A	Healthy Lifestyle	36	2.44	90	2.36	70	2.47
3B	Physically Disciplined Lifestyle	105	3.61	172	3.54	164	3.47
4A	Ethical Reasoning & Behavior	266	3.63	183	3.48	191	3.64
4B	Intercultural Knowledge & Engagement	20	3.15	15	3.48	26	3.71
4C	Written & Oral Communication	212	3.38	214	3.29	216	3.25
4D	Leadership Capacity	136	3.57	228	3.72	196	3.64

VI. Program Assessment Process Description

The ORU School of Engineering faculty members meet regularly at the start of each semester concerning assessment to evaluate measured academic data for continuous program improvement. To streamline the assessment process, faculty members created a curriculum map to align the School of Engineering student learning outcomes with course work. Based on the curriculum map, the faculty member develop a formal assessment plan to determine which assignments would provide the most relevant assessment of student outcomes. Faculty members deleted several of the assignments previously used for assessment to streamline the process and avoid excessive data collection.

Minutes from School of Engineering Assessment Meetings provides records of faculty assessment meetings. Using the results of the assessment meetings, The School of Engineering faculty members demonstrate the revised assessment of student outcomes and provide data supporting student expression of the outcomes. Evidence from nine different engineering courses provides for the assessment of the student outcomes. Faculty members highlight average data values below 3.0 and develop action plans with implementation dates and results to address possible concerns resulting in the low student scores.

The formal assessment process used by the School of Engineering faculty members include the following steps:

1. Development of an Assessment Plan by faculty members listing the artifacts used for data collection addressing each of the student outcomes.
2. Data collection by faculty members from appropriate courses using the learning management system Desire2Learn (D2L) to facilitate data management.
3. Data evaluation by faculty members during formal School of Engineering Assessment Days at the start of every semester.
4. School of Engineering Assessment Days consists of five parts
    A. Review the impact of previous curriculum changes on assessment data results.
    B. Evaluation of collected data results for program improvement.
    C. Implementation of curriculum changes to address indicated concerns.
    D. Chronicling of the curriculum change from Assessment Days to facilitate implementation.
    E. Completion of feedback form with the results from School of Engineering Assessment days.

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VII. Continuous Program Improvement Description

How have the results of assessment directly affected program changes for the future?

For each of the following questions:

- *Place any key documents that you reference in the folder with this document*
- *Describe who's involved.* Please make reference to faculty, instructional, and other staffmembers involved in the processes and methodologies to assess student learning
- *Describe when the activity took place*

1. Since 2016, *how have the results of assessment directly affected program changes for thefuture*?

- Provide data used to support the need for improvement. Data may come from:
    i. ORU, program, artifact-rubric, and criterion line scores
    ii. Professional accreditation reviews, student surveys, alumni and stakeholderfeedback, market reports, etc.
- Changes may have taken place in the following areas:
    i. Course content, artifacts, and rubrics
    ii. Instructional strategies, including a change in the use of technology
    iii. Sequencing or repetition of material in an individual course or as a wholeprogram
    iv. Updating program outcomes
    v. Updating a curriculum map
    vi. Updating the program's master rubric
- As available, provide data that demonstrates the impact your changes had on meetingprogram outcomes. See trends in the data tables.

Table 1 at the end of this program review includes examples with evidence and documentation of assessment data collected from sample courses. Faculty members highlight average data values below 3.00 and develop action plans to address possible concerns resulting in the low student scores. Table 1 also include assessment data for theyear following completed changes with improved average scores.

2. If you use *Senior papers/projects* they often provide rich data on student achievement. Howdo you tie the results from these artifacts back to changes for specific courses?
   Please see next section below that contains information about senior design project data on student achievement and how this is tied back to changes for EGR 498 and EGR 499.

3. As applicable, describe how you've updated the program due to professional accreditationchanges or reports, student surveys, alumni and stakeholder feedback, market trends, etc.

2017 ABET Final Statement

ORU School of Engineering received the following Program Weakness related to Criterion4 – Continuous Improvement:

"Statement of weakness: This criterion requires that the program must regularly use appropriate, documented process for assessing and evaluating the extent to which the student outcomes are being attained. The program could not demonstrate that student achievement of student outcome (b), an abilityto design and conduct experiments, as well as to analyze and interpret data, is being assessed. The program therefore does not have data to effect changes that may be needed. This criterion also requires that the results of these evaluations must be systematically utilized as input for the continuous improvement of the program and that other available information may also be used. While the program has amassed a substantial amount of data relating to the achievement of most student outcomes, including data systematically gathered from other sources, the data collected from direct assessment of student outcomes have not been used to improve the program. Strength of compliance with this criterionis lacking."

Response to ABET Final Statement: Continuous Improvement

The ORU Engineering faculty members meet regularly concerning assessment to evaluate measured academic data for continuous program improvement. Using the results of the assessment meetings, the Engineering faculty members demonstrate the revised assessment of student outcome (b) and provide data supporting student expression of the outcome. Evidence from five different Engineering courses provides for the assessment of student outcome (b). This section also includes evidence and documentation of the process used by faculty to develop action plans for continuous improvement concerning all twelve of the student outcomes along with the documents used to collect and analyze the data.

1. Identification and detail of evidence and documents used by Engineering faculty members to assess student achievement of student outcome (b), an ability to designand conduct experiments, as well as to analyze and interpret data

This section includes Examples A–E with detailed evidence and documentation of assessment data collected from five different courses for Student Outcome (b) an abilityto design and conduct experiments, as well as to analyze and interpret data. Faculty members highlight average data values below 3.0 and develop action plans to address possible concerns resulting in the low student scores.

Example	Student Outcome	Course
A	(b)	EGR 252 Engineering Computational Methods
B	(b)	EE 321L Electronics I Lab
C	(b)	EGR 499 Senior Design and Research
D	(b)	ME 444 Experimental Methods
E	(b)	ME 381 Principles of Design

A. *Evidence for Student Outcome (b) in the course EGR 252 Engineering Computational Methods*

In the EGR 252 Engineering Computational Methods course, faculty members teach first- and second-year Engineering students the skills needed to develop programming in the Matlab and C languages. The course includes two Matlab projects requiring students to design different experiments. Students design and conduct the experiments by writing and executing code. Students then analyze and interpret the resulting data by testing the program with different input data.

Within grading rubrics used to evaluate assignments, faculty members embed assessment rubric lines addressing student outcomes relevant to the specific assignment to provide assessment data at the point of student engagement with the specified student outcome. Faculty members included the following assessment rubric line in the Matlab project grading rubric to evaluate student experience relevant to student outcome (b). Note that information highlighted by the Matlab project focuses on assessing the “analyzing and interpreting” portion of student outcome (b).

Assessment Rubric Line for EGR 252 Engineering Computational Methods Matlab Programming Project

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Test Program with All Possible Inputs	Able to test the program with all cases correctly	Able to test the program with most cases correctly	Able to test the program with some cases correctly	Unable to test the program correctly	No attempt to test the program

Student Outcome (b) Assessment Results from EGR 252 Engineering Computational Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
EGR 252 Matlab Programming Project	*N*	Ave
Test Program with All Possible Inputs	33	3.64

Average assessment results from the Matlab project with a score greater than 3.00 indicates the successful acquisition of the student outcome through this assessment,which does not indicate any need for modification of the project.

B. Evidence for Student Outcome (b) in the course EE 321L Electronics I Lab

In EE 321L Electronics I Lab students design and conduct experiments to determine the input-output characteristics of a BJT AC amplifier and verify the theory learned in lectures by analyzing and interpreting the measured data. Assessment data from fall 2017 and fall 2018 indicate that students score above 3.00 on average, so faculty members determined not to modify the assignment at this time.

Assessment Rubric Lines for EE 321L Electronics I Lab Experiment Design

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Theory	Circuits are clearly understood, and all required formulas are listed correctly.	Circuits are clearly understood with minor errors in the formulas.	Understand the circuits with part of missing or redundant formulas.	Circuits are misunderstood with irrelevant formulas	No attempt to describe or explain the circuit theory
Equipment selection	All equipment is correctly identified and selected with the correct rating.	All equipment is correctly identified and selected with some misunderstanding in rating and settings.	Most of the equipment is correctly identified and selected with some misunderstanding in rating.	Most of the selected equipment is irrelevant or with the wrong rating.	No attempt to select any equipment
Theoretical value calculation	All theoretical values required are calculated correctly following the required format.	All theoretical values required are calculated following the required format with minor miscalculations.	All theoretical values required are calculated without following the required format and with minor miscalculations.	Irrelevant formulas are used, and most of the theoretical values are wrong.	No attempt to do any calculation
Design of experimental procedures	All experiment procedures are clearly and correctly listed. The circuit is neatly and correctly connected. All required data are correctly measured.	All experiment procedures are clearly and correctly listed. The circuit is neatly and correctly connected with minor error in measuring the required data.	Most of the experiment procedures are correctly listed. The circuit is correctly connected with part of component mistaken and wrong measured data.	Most of the experimental procedures are not correct. The circuit is incorrectly connected. Most of the measured data are wrong.	No attempt to connect the circuit and to do any measurement
Data analysis and interpretation	Precise and correct conclusions are reached from both the theoretical and measured data. Any discrepancy is correctly discovered and interpreted with convincing reasoning.	Correct conclusions are reached from both the theoretical and measured data. Any discrepancy is discovered and interpreted with minor error in reasoning.	Correct conclusions are reached both the theoretical and measured.	Conclusions are wrong or irrelevant, with no explanation for the discrepancy between the theoretical and measured data.	No attempt to reach any conclusion and to discover a discrepancy between the theoretical and measured data

Student Outcome (b) Assessment Results from EE 321L Electronics I Lab

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**			**2017-18**	
EE 321 Experiment Design	*N*	Ave		*N*	Ave
Theory	27	3.56		9	3.44
Equipment Selection	22	4.00		9	3.89
Theoretical Value Calculation	23	3.74		9	3.50
Design of Experimental Procedures	24	3.38		9	3.22
Data Analysis and Interpretation	24	3.46		9	3.11

C. Evidence for Student Outcome (b) in EGR 499 Senior Design and Research II

In the validation section of the EGR 499 Senior Design and Research II Final Report, students provide a description of the experimental test procedures that verifies the project meets the definition of completeness. In the results section of the report, students present the results of these tests and compare the results with theory and specifications. Students verify the inclusion of the design and completion of the experimental test procedures on a report checklist turned in with the report. Faculty members assess the student design and performance of testing for the satisfaction of student outcome (b) Current average assessment scores for the paper result in values above 3.00, so faculty members will not make any changes to the assignment at this time.

Assessment Rubric Lines for EGR 499 Senior Design and Research II
Experimental Test Procedures

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Clear Research Question	The research question is clear and testable	The research question is clear, but not testable	The research question is mostly clear	The research question is not clear	Not attempted
Design of Experiment	Experimental design is clearly described and addresses research question	Experimental design is clearly described and is relevant to research question	Experimental design partially addresses research question	Experimental design does not address research question	Not attempted
Conduct Experiment	The experiment was conducted and produced reliable data	The experiment was conducted and produced somewhat inconsistent data	The experiment was conducted but did not produce useful data	The experiment was attempted but did not produce data	Not attempted
Analyze Data	Data was correctly analyzed leading to valid conclusions	Data was correctly analyzed and justified the conclusions somewhat	Data was correctly analyzed but did not justify the conclusions	Data was incorrectly analyzed	Not attempted

Student Outcome (b) Assessment Results from EGR 499 Senior Design and Research II

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
EGR 499 Experimental Test Procedures	*N*	Ave
Clear Research Question	8	3.13
Design of Experiment	8	3.38
Conduct Experiment	8	3.63
Analyze Data	8	3.25

D. Evidence for Student Outcome (b) in the course ME 444 Experimental Methods

In ME 444, students conduct experiments, analyze and interpret data, and record the process, results, and conclusions in a lab report. Also, ME 444 students design additional experiments for in-class and homework assignments as demonstrated by the following:

i. Application of single experimental measurements (e.g., temperature) toreal industrial processes (e.g., glass furnace).
ii. Application of multiple measurements to Biblical miracles (Faculty members presented on the assignment "Experimental Methods Applied toBiblical Miracles" during the 2013 Christian Engineering Conference in Atlanta).
iii. Design an experiment to test a new engine made out of "Halsmerium" forthe final exam.

Current average assessment results indicate values below 3.00. Faculty members developed a plan of action to improve student performance in ME 444.

Assessment Rubric Lines for ME 444 Experimental Methods Design of Experiment

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Experiment Objectives	Selects all appropriate variables & their ranges that should be measured.	One incorrect or missing variable or range that should be measured.	Two incorrect or missing variables or their ranges that should be measured.	More than two incorrect or missing variables or their ranges that should be measured.	No attempt to select appropriate variables & their ranges
Instrument Selection	Selects all appropriate instruments to measure needed variables.	All instruments selected would work but better choices available.	Improperly selected one instrument.	Multiple instruments improperly selected.	No attempt to select appropriate instruments
Experimental Design	Measurement frequency & location for all devices properly specified.	Only one measurement frequency or location improperly specified.	Total of two measurement frequencies or locations improperly specified.	More than two measurement frequencies or locations improperly specified.	Measurement frequencies and locations not specified

Student Outcome (b) Assessment Results from ME 444 Experimental Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**			**2017-18**	
ME 444 Design of Experiment	*N*	Ave		*N*	Ave
Experimental Objectives	21	1.90		20	2.50
Instrument Selection	21	1.80		20	2.20
Experimental Design	21	1.80		20	2.30

E. *Evidence for Student Outcome b) in ME 381 Principles of Design*

During a lecture on load and stress analyses with a focus on press and shrink fits and the corresponding contact stresses, a faculty member compared these ideas to the popular toy construction system known as Lego or Duplo bricks as the toys employ a high-quality press fit. Students responded favorably to the illustration with an immediate increase in attention and interest. Based on the student reaction, the facultymembers developed a student assignment to design and conduct an experiment that allows students to explore the various dimensions of the toy application. Providing students with the larger two-by-two Duplo bricks, the faculty members required students to complete the following tasks:

1. Evaluate the necessary measurements to predict the “pull-apart” force.
2. Determine the required peg and hole dimensions to produce a pull-apart forceof 1 pound.
3. Design and conduct an experiment to determine the actual pull-apart force.

The open-ended lab enabled students to use whatever methods, materials and reporting procedures they deemed appropriate. The faculty members assess the Lego Lab Report using the same grading rubric as used in EGR 499 Senior Design and Research II. Current average assessment scores for the report result in values above 3.00, so faculty members will not make any changes to the assignment at this time.

Assessment Rubric Lines for ME 381 Principles of Design Lego Lab

Category	Exemplary (4 points)	Competent (3 points)	Acceptable (2 points)	Unacceptable (1 point)	Unattempted (0 points)
Clear Research Question	The research question is clear and testable	The research question is clear, but not testable	The research question is mostly clear	The research question is not clear	Not attempted
Design of Experiment	Experimental design is clearly described and addresses research question	Experimental design is clearly described and is relevant to research question	Experimental design partially addresses research question	Experimental design does not address research question	Not attempted
Conduct Experiment	The experiment was conducted and produced reliable data	The experiment was conducted and produced somewhat inconsistent data	The experiment was conducted but did not produce useful data	The experiment was attempted but did not produce data	Not attempted
Analyze Data	Data was correctly analyzed leading to valid conclusions	Data was correctly analyzed and justified the conclusions somewhat	Data was correctly analyzed but did not justify the conclusions	Data was incorrectly analyzed	Not attempted

Student Outcome (b) Assessment Results from ME 381 Principles of Design

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**	
ME 381 Principles of Design Lego Lab	*N*	Ave
Clear Research Question	15	3.53
Design of Experiment	15	3.27
Conduct Experiment	15	3.07
Analyze Data	15	3.27

2. Evidence and documentation of the process used to collect data from the directassessment of student outcomes to develop action plans for the continuous improvement of the Engineering program

The following examples provide detailed evidence and documentation of assessment datacollected for different student outcomes to develop action plans for continuous improvement. Average assessment scores below 3.00 indicate a need for action plan development.

Example	Student Outcome	Course
A	(a)	EGR 222 Mechanics II: Dynamics
B	(a)	EGR 499 Senior Design and Research II
C	(b)	ME 444 Experimental Methods
D	(c)	EGR 499 Senior Design and Research II
E	(e)	EGR 221 Mechanics I: Statics
F	(e)	EGR 222 Mechanics II: Dynamics
G	(e)	EE 311 Network Analysis II
H	(e)	ME 381 Principles of Design
I	(g)	EGR 461 Engineering Management and Economy
J	(i)	EGR 101 Introduction to Engineering
K	(k)	EGR 140 Engineering Graphics
L	(k)	EGR 252 Engineering Computational Methods

A. Evidence of using assessment data for improving EGR 222 Mechanics II Dynamics

Student Outcome (a) Students are able to apply knowledge of mathematics, science andengineering

Data: Average assessment scores indicate a persistent concern for students' low ability to solve problems in energy methods and the use of vectors

a) Students are able to apply knowledge of mathematics, science and engineering	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 222 Dynamics Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Problem Solving Using Energy Methods	16	2.94		25	2.68		19	2.84		21	2.95		16	2.94
Problem Solving Using Momentum	16	3.50		25	3.44		19	2.68		21	3.19		16	3.00
Vectors	16	2.56		25	2.96		19	2.79		21	2.62		16	2.00

Action: To increase student capacity for effective problem-solving, faculty members will require the following action items.

1. Require the format listed below for submitted homework assignments requiringproblem-solving.

   a. Definition of the problem.

      i. List all quantities required for a solution.

      ii. List all unknown quantities of interest.

      iii. List the data provided within the problem (can be a written copy of a diagram withdimensions, mass, velocities, etc.).

   b. Draw diagrams suitable for the problem, such as free body diagrams.

   c. Develop equations required to solve the problem.

   d. Finalize the equations into a solution.

2. Provide an in-class test on vectors in all PHY 111 sections to emphasize the importance of vectors and free body diagrams.

Implementation Date: Spring 2018

Results: Final exam average scores increased from 66.8 in 2017 to 79.0 in 2018 to 81.3 in 2019. Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Include an energy-based analysis in the Dynamics design project.

Implementation Date: Spring 2018

Result: Implementation produced a slight increase in the students' ability to use energy methods. Faculty members will consider additional improvement strategies for teaching energy methods.

Action: Increase the number of homework problems in basic vector cross products, decomposition, and representation of dynamic quantities. To some extent, this represents repetitive drills that should make students comfortable and fluent working with vectors.

Implementation Date: Spring 2018

Result: Students perform well in decomposing force vectors into components but struggle with analyzing rigid body motion using vector cross products. Faculty members will consider additional improvement strategies for teaching vectors.

Action: Faculty members altered the order of content presentation to engage students in active learning problem sessions distributed throughout the course.

Implementation Date: Spring 2018

Result: Final exam average scores increased from 66.8 in 2017 to 79.0 in 2018 to 81.3 in 2019.

Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Faculty members required students to submit high quality, written free body diagrams with all forces calculated except tension and reaction forces, and decomposed into appropriate directions. Also, faculty members required students to identify when a problem can be solved using the conservation of energy or using the work-energy equation.

Implementation Date: Spring 2019

Result: Students in EGR 222 Mechanics II: Dynamics improved in their ability to produce appropriate free body diagrams with only a slight improvement in the use of energy methods. Faculty members will consider additional improvement strategies for teaching general problem-solving skills.

Action: Faculty members will assign vector cross product problems related to rigid body motion after discussing the material in a lecture earlier than in previous semesters.

Implementation Date: Spring 2020

Result: To be determined.

B. Evidence of using assessment data for improving EGR 499 Senior Design and Research II

Student Outcome (a) Students are able to apply knowledge of mathematics, science andengineering.

Data: Average assessment scores on the application of engineering concepts improved following faculty members' implementation of providing timely feedback on required weekly progress reports.

Student Outcome (a) Students are able to apply knowledge of mathematics, science and engineering	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 499 Senior Project Report	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Application of Engineering Concepts	9	3.33		19	3.37		17	2.71		12	2.75		7	2.71

Action: The EGR 498 and EGR 499 courses require students to include theory, engineering analysis, simulation results, and experimental data in weekly progress reports. Faculty members provide timely feedback and encourage students to include needed improvements.

Implementation Date: Fall 2017

Results: Weekly progress reports now include significant amounts of technical information. The average assessment results for the Application of Engineering Concepts in the Senior Project Reports demonstrate a distinct improvement resulting in scores above 3.00.

C. Evidence of using assessment data for improving ME 444 Experimental Methods

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data.

Data: Average assessment scores indicate a persistent concern for students' low ability to identify experimental objectives, select appropriate instruments, and design experiments.

Student Outcome (b) Students are able to design and conduct experiments, as well as analyze and interpret data	**2018-19**			**2017-18**	
ME 444 Experimental Methods	*N*	Ave		*N*	Ave
Experimental Objectives	21	1.9		20	2.5
Instrument Selection	21	1.8		20	2.2
Experimental Design	21	1.8		20	2.3

Action: To address the three issues, faculty members implemented the following changes in ME 444 Experimental Methods.

1. Experimental Objectives

   a. Require students to specify experimental objectives within homework assignments5, 10, and 13.

   b. Require students to include experimental objectives within the application projects.

2. Instrument Selection

   Require students to present the process of selecting an instrument during lectures given by the student.

3. Experimental Design

   Require students to discuss an experimental design exercise during application project presentations.

Implementation Date: Spring 2019

Results: Implementation of the new requirements resulted in lower average assessment scores for all three categories.

Action: Based on assessment results from spring 2019, faculty members revised the teaching strategy and implemented the following actions for the spring 2020 semester.

1. Experimental Objectives:

   a. Provide students with a mock example of a design problem and discuss how toidentify appropriate experimental objectives and required experimental variables.

   b. Assign at least one exercise where students have to identify the appropriateexperimental objectives and required experimental variables.

2. Instrument Selection:

    a. Provide students with a mock example of a design problem and discuss theprocess of selecting an appropriate instrument.

    b. Include an experimental design homework exercise that requires students toselect an appropriate instrument for an experiment.

3. Experimental Design:

    a. Provide students with a mock example of a design problem and discuss theprocess of design.

    b. Include an experimental design exercise during the Process Heater Simulatorlaboratory.

    c. Require students to provide a detailed discussion of the design process duringthe experimental design exercise.

Implementation Date: Spring 2020

Result: To be determined.

D. Evidence of using assessment data for improving EGR 499 Senior Design and Research II

Student Outcome (c) Students are able 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.

Data: Average assessment scores for Depth and Breadth of Project Content improved following faculty members' implementation of providing timely feedback on required weekly progress reports.

Student Outcome (c) Students are able 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.	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 499 Senior Project Report	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Depth and Breadth of Project Content	9	3.22		19	3.37		17	2.76		12	3.83		7	2.71

Action: To improve students' depth and breadth of project content, faculty members require students to submit weekly reports in EGR 498 and EGR 499 and require specific technical content and documentation of theory, engineering analysis, simulation, and experimental data. Faculty members provide timely formative feedback rather than waiting until the end of the semester. Students also submit checklists with the EGR 498 Semester progress report and EGR 498 Final Report requiring students to note in the report that "Engineering analysis (calculations), theory (equations), computer simulations, and experimental results are included." Also, the final report contains a separate section entitled "Engineering Analysis." Appendices 4-5 and 4-8 include the instructions and grading scheme for the weekly reports, the instructions, a rubric for the Final Report, and the two checklists. Discussion included in Criterion 5: Curriculum addresses the concern in more detail.

Implementation Date: Fall 2017

Result: Due to the continuous feedback from faculty members, students' submitted weekly reports include a marked increase in engineering content. Current average assessment scores greater than 3.00 demonstrate that timely faculty feedback enables students to improve the depth and breadth of project content.

E. Evidence of using assessment data for improvement of EGR 221 Statics Exam

Student Outcome (e) Students are able to identify, formulate and solve engineering problems

Data: Average assessments scores in EGR 221 demonstrate the results of effective intervention strategies introduced by faculty members concerning Diagrams and Formulas, new concerns concerning Information and Assumptions, and indentify a persistent concern for students' low ability to develop effective Solutions to engineering problems.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 221 Statics Exam	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Information	15	2.80	30	3.57	19	3.74	24	3.25	26	3.77
Assumptions	15	2.80	30	3.47	19	3.21	24	3.21	26	3.27
Diagrams	15	3.47	30	3.00	19	3.42	24	2.46	26	2.92
Formulas	15	3.40	30	3.43	19	3.21	24	3.00	26	2.92
Solution	15	2.53	30	2.60	19	2.89	24	2.63	26	2.35

Action: At the end of the 2015-2016 academic year, average assessment scores related to Diagrams indicated a persistent concern. Faculty members noted that the Statics Exam Rubric calls for students to draw pertinent diagrams correctly to assist in the solution procedure. Students continued to struggle with the "free-body diagram," which shows all of the forces acting on an object isolated from its surroundings.

Faculty members agreed to spend an extra 30 minutes of lecture focusing on the proper drawing of free-body diagrams and distribute a worksheet of practice problems involving free-body diagrams. Faculty members provided students time during class to work through all the problems and the opportunity to discuss the solution after each problem.

Implementation Date: Fall 2016

Result: Based on the significant improvement in the average assessment score for Diagrams, faculty members agreed to continue the focus on teaching and practicing free-body diagrams.

Action: To address the persistent concern for students' low ability to develop effective solutions to engineering problems, faculty members developed a worksheet to inform students of the following best practices for solving statics problems.

1. Carry units throughout calculations, and use the proper units as part of the solution.

2. Recognize that some problems involve transcendental equations that have no closedform solution, and students must solve these problems using trial and error.

3. Recognize the given quantities and which are unknown in the general solution ofsimultaneous equations (no numbers involved).

4. Understand that problems often require algebraic and trigonometric manipulations todevelop solutions.

5. Identify common pitfalls that distract from developing appropriate solutions.

Implementation Date: Fall 2018

Results: Average assessment results following the introduction of the best practices for solutions worksheet decreased in the areas of Assumptions, Information, and Solution.

Action: Faculty members responded to the lower average assessment results by developing an additional information worksheet concerning Information and Assumptions.

1. Faculty members will introduce an additional reminder sheet concerning Informationand Assumptions for statics students

2. Faculty members will continue to provide the Solutions worksheet.

3. Faculty members will continue to provide the Free-Body Diagram Worksheet.

Implementation Date: Fall 2019

Results: To be determined.

F. Evidence of using assessment data for improving EGR 222 Mechanics II: Dynamics

Student Outcome (e) Students are able to identify, formulate and solve engineering problems
Data: Average assessment scores indicate a persistent concern for students' low ability to solve problems with rigid bodies.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EGR 222 Dynamics Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Problem Formulation: Rigid Bodies, Translation and Rotation	16	2.19		25	2.84		19	2.68		21	3.24		16	1.75

Action: Faculty members will include at least one problem on one midterm exam that consists solely of drawing free body diagrams for rigid body problems. Faculty members will announce the existence of the rigid body problem before the exam to reinforce the importance of learning how to use free body diagrams to solve rigid body problems. Faculty members will implement the same type of exam question in EGR 221 Mechanics I Statics to underline the importance of free body diagrams in solving problems.

Implementation Date: Spring 2018

Result: While the inclusion of the exam question in spring 2018 did not improve the average assessment score, faculty members anticipate that improvements in the ability to use vectors should help. Faculty members also intend to assign frequent written free body diagram homework problems along with vector cross product problems related to rigid body motion following the introduction of the material in lecture.

G. Evidence of using assessment data for improving EE 311 Network Analysis II

Student Outcome (e) Students are able to identify, formulate and solve engineering problems.

Data: Average assessment scores seem to indicate a variable concern for students' low ability to solve Network Analysis problems requiring the use of Laplace and Fourier Transforms.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems.	**2018-19**			**2017-18**			**2016-17**			**2015-16**			**2014-15**	
EE 311 Network Analysis II Exam	*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave		*N*	Ave
Information	12	3.00		6	3.33		7	3.43		5	3.40		4	3.75
Solutions	12	2.67		6	3.33		7	2.57		5	3.40		4	3.50

Action: Faculty members identified that students scored low for solutions on the EE 311 Exam in fall 2016 due to insufficient calculus skills. In this exam, the students use Laplace Transforms and Fourier Transforms as mathematical tools to solve circuit problems. During the fall 2017 course, faculty members informed the students at the beginning of the course concerning the specific mathematical concepts needed during the course and encouraged the students to review the topics. Additionally, faculty members offered specific one-on-one math tutoring as needed and provided information concerning the free mathematics tutoring services available on campus. As an additional help, faculty members provided students with written feedback while grading student assignments.

Implementation Date: Fall 2017

Results: While the math review, tutoring prompts, and timely feedback helped students succeed, the average assessment score fell below 3.00 again during fall 2018. Faculty members offered the course in an online format during fall 2018.

Action: Faculty members reconsidered the course format and will teach the course as a residential course during fall 2019.

Implementation Date: Fall 2019

Results: To be determined.

H. Evidence of using assessment data for improving ME 381 Principles of Design

Student Outcome (e) Students are able to identify, formulate and solve engineering problems

Data: Average assessments scores in ME 381 Principles of Design indicate a persistent concern for students' low ability to form problems in the Gear Force Analysis and a new concern for problem formation in the Ball Bearing Analysis.

Student Outcome (e) Students are able to identify, formulate and solve engineering problems	2018-19		2017-18		2016-17		2015-16		2014-15	
ME 381 Principles of Design Exam	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Problem Formulation: Ball Bearing Analysis	13	2.85	11	3.45	21	3.67	17	3.47	14	3.86
Problem Formulation: Journal Bearing Analysis			11	3.18	21	2.24	17	3.59	14	3.64
Problem Formulation: Gear Force Analysis	13	2.62	11	1.73	21	2.10	17	2.18	14	3.43

Action: Faculty members identified that students struggle with identifying the proper units in the gear force analysis. Faculty members will provide detailed explanation and clarification of the units involved and the purpose of using the units in the gear force analysis. Faculty members will provide more example problems of gear force analysis and demonstrate detailed solutions.

Implementation Date: Spring 2019

Result: While the faculty members' intervention concerning units appeared to increase the average Gear Force Analysis assessment score, additional improvement may require additional assistance. Emphasis on the Gear Force Analysis may have affected the effort focused on the Ball Bearing Analysis. Faculty members will develop tools to assist student understanding.

Action:

1. Faculty members will spend more time discussing issues of concern in the Ball Bearings and Gear Force Analysis.

2. Faculty members will develop worksheets for students that specify the expectations ofthe analyses.

Implementation Date: Spring 2020

Result: To be determined.

I. Evidence of using assessment data for improving EGR 461 Engineering Management and Economy

Student Outcome (g) Students are able to communicate effectively

Data: Average assessment scores indicate that students struggle with spelling and grammar.

Student Outcome (g) Students are able to communicate effectively	2018-19		2017-18		2016-17		2015-16		2014-15	
EGR 461 Economics Paper	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Organization	21	4.00	23	4.00	18	3.78	21	3.95	13	2.62
Spelling and Grammar	21	3.05	23	2.96	18	3.28	21	2.95	13	3.08
Format	21	4.00	23	4.00	18	4.00	21	3.95	13	3.92

Action: The University provides all students with access to Grammarly free-of-charge for student and faculty assessment of spelling and grammar in academic papers and reports Faculty members will require students to include a statement concerning the use of Grammarly (or any other spelling and grammar review) on the first page of the Economics Paper. Faculty members will not accept student papers submitted without the statement.

Implementation Date: Fall 2018

Result: The average assessment score in spelling and grammar increased slightly and now exceeds 3.00.

J. Evidence of using assessment data for improving EGR 101 Introduction to Engineering

Student Outcome (i) Students recognize the need for, and are able to engage in life-longlearning.

Data: Average assessment scores for Research vary widely from year-to-year and may indicate an inconsistent student understanding regarding the quality of research required in the Stewardship Essay.

Student Outcome (i) Students recognize the need for, and are able to engage in life-long learning	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 101 Stewardship Essay	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Research	48	3.35	23	2.74	56	3.46	38	3.13	49	2.94

Action: Faculty members will provide more information to the students concerning expectations of the quality of research required to complete the Stewardship Essay successfully.

Implementation Date: Spring 2018

Result: The average assessment score on Research increased after faculty members provided students with clear expectation guidelines.

K. Evidence of using assessment data for improving EGR 140 Engineering Graphics

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice.

Data: Average assessment scores indicate that students struggle with Interpretation of Drawings.

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 140 Graphics Exam	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Basic Modeling Requirements	50	3.74	33	3.36	45	3.73	40	3.58	49	3.24
Use of SolidWorks Features	50	3.26	33	3.24	45	3.33	40	3.18	49	3.27
Dimensions on Sketches	50	3.08	33	3.00	45	3.47	40	2.90	49	2.88
Use of specified Features	50	3.74	33	3.48	45	3.96	40	3.83	49	3.80
Interpretation of Drawings	50	3.02	33	2.91	45	3.36	40	2.80	49	2.86
Appropriate Feature Application and Location.	50	3.24	33	3.27	45	3.64	40	3.30	49	3.35

Action: Faculty members noted that either the students do not set the dimensions of the drawing correctly or the students do not use Smart Dimension correctly.

1. Faculty members will emphasize the need for students to use Smart Dimension to setdrawing dimensions correctly.

2. Faculty members will require students to use Smart Dimension during Exams 1 and 3.

Implementation Date: Spring 2019

Result: The average assessment score on setting dimensions on sketches correctly improved and now exceeds the 3.00 standard.

L. Evidence of using assessment data for improving EGR 252 Engineering Computational Methods

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice. Data: The average assessment score for Specifications in EGR 252 indicated a concern regarding the Matlab Programming Project:

Student Outcome (k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice	**2018-19**		**2017-18**		**2016-17**		**2015-16**		**2014-15**	
EGR 252 Matlab Programming Project	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave	*N*	Ave
Specifications	33	3.24	41	2.56	18	3.33	41	3.34	20	3.30
Readability	33	3.45	41	3.71	18	3.61	41	3.46	20	3.55
Reusability	33	3.52	41	3.07	18	3.72	41	3.54	20	2.75
Efficiency	33	3.09	41	3.24	18	3.44	41	3.02	20	3.60
On time delivery/Demonstration	33	3.42	41	3.41	18	4.00	41	3.73	20	3.90

Action: While the average assessment scores did not indicate a persistent concern, faculty members will emphasize the importance of error checking.

1. Faculty members will provide students with a simple quiz before assigning the MatlabProgramming Project to highlight the importance of code reusability by creating appropriate functions and emphasizing error checking.

2. Faculty members will remind students at the beginning of the project to include errorcheck code for each input.

3. Faculty members will include a grading score for error checking in the project description and explain to students how to use the error checking before the start of theproject.

Implementation Date: Fall 2018

Result: Average assessment scores for Specifications and Reusability increased following faculty members' increased emphasis on error checking.

3. Document the Engineering program's formal process of facilitating the effective andefficient evaluation of data for continuous improvement

To improve the assessment of student outcome (b) an ability to design and conduct experiments, as well as to analyze and interpret data, faculty members completed the following tasks.

- Added the following new assignments to assess student outcome

  (b).o ME 381 Principles of Design Lego Lab

  Students design and conduct an experiment to determine the pull-apart force for Duplo bricks.

  o ME 444 Experimental Methods Laboratory Report

  Students design and execute an experiment based on provided specifications

- Modified the following assignments to assess student outcome (b) more effectively.

  o EE 325 Electronics I Lab

  Students design and conduct an experiment based on provided specifications.

  o EGR 252 Computational Methods Matlab Programming Project

  Students design a test procedure for a Matlab program and test the program with all possible inputs.

  o EGR 499 Senior Design Final Report

  Students include in the final report of a project the description of test design used during the project and specifics concerning how the test meets the design specifications.

Faculty members added additional assessments of EGR 225 Circuits and Electronics Exam to address outcomes (a) and (e) for the students in the Mechanical Concentration who do not take EGR 210 Network Analysis I. Faculty members assess the EGR 225 Circuits and Electronics exam using the same rubric used for the EGR 210 Network Analysis I Exam.

Faculty members observed that a large number of artifacts assessed outcome (g) and eliminated some of the artifacts to streamline the assessment process. In the EGR 101 Introduction to Engineering course, faculty removed the artifacts for Initial Resume, Robot Report, and Robot Project Oral Presentation.

For the EGR 498 Senior Design and Research I course, faculty removed the artifacts for the Resume.

Faculty members also removed the assessment of two presentation reflection papers (EGR 101 Intro Project Oral Presentation Reflection and EGR 499 Senior Project Oral Presentation Reflection) as the assessment of the papers did not provide useful information for the assessment of outcome (i) Lifelong Learning.

During fall 2019, the School of Engineering transitioned from the previous ABET student outcomes to the revised ABET student outcomes.[1]

New Student Outcomes for Criterion 3	Old Student Outcomes for Criterion 3
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	(a) Students are able to apply knowledge of mathematics, science and engineering
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	(b) Students are able to design and conduct experiments, as well as analyze and interpret data
3. An ability to communicate effectively with a range of audiences	(c) Students are able 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.
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	(d) Students are able to function on multi-disciplinary teams
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	(e) Students are able to identify, formulate and solve engineering problems
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	(f) Students understand professional and ethical responsibility
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	(g) Students are able to communicate effectively
8. An ability to apply Christian principles of stewardship	(h) Students have a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
	(i) Students recognize the need for, and are able to engage in life-long learning
	(j) Students have knowledge of contemporary issues
	(k) Students are able to use the techniques, skills, and modern tools necessary for engineering practice
	(l) Students are able to apply Christian principles of stewardship

Comparison of the previous to the revised student outcomes allows for the following relations between them[2-3]. Faculty members have revised assessment data collection based on the revised student outcomes.

Engineering Student Outcome Map

New Student Outcomes	Old Student Outcome a)	Old Student Outcome b)	Old Student Outcome c)	Old Student Outcome d)	Old Student Outcome e)	Old Student Outcome f)	Old Student Outcome g)	Old Student Outcome h)	Old Student Outcome i)	Old Student Outcome j)	Old Student Outcome k)	Old Student Outcome l)
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.									✓			
8. An ability to apply Christian principles of stewardship												✓

References

1. ABET, "Criteria for Accrediting Engineering Programs: Effective for Reviews During the 2019-2020 Accreditation Cycle ", Baltimore, MD, November 2, 2018.

2. McCullough, C. L., "A Plan to Assess All the New ABET Outcomes Using Only Three Courses,"2018 ASEE Southeastern Section Conference.

3. Haddad R. J, Kalaani, Y., and El Shabat, A.," An Optimal Mapping Framework for ABET Criteria 3 (a-k) Student Outcomes into the Newly Proposed (1-7) Student Outcomes, Proceedings of the 2016 IAJC-ISAM Joint International Conference, ISBN 978-1-60643-379-9.

2017 ABET Final Statement

ORU School of Engineering received the following Program Weakness related to Criterion5 – Curriculum:

Statement of weakness: This criterion requires that students must be prepared for engineering practice through a curriculum culminating in a major design experience based on a knowledge of skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints. The major design experience is realized through two courses: EGR498 Senior Design and Research I, and EGR499, Senior Design and Research II. Many of the projects do not build on the foundation of mathematics, science, and engineering sciences. Design reports do not consistently include the mathematical foundations and supporting data on which the project design was based, nor do they incorporate realistic constraints and engineering standards. Based on these design projects, students maynot be sufficiently prepared for engineering practice. Thus, strength of compliance with this criterion is lacking.

Response to ABET Draft Statement: Curriculum

Faculty members implemented the following changes to prepare students sufficiently for engineering practice through a curriculum culminating in a major design experience based on mathematical foundations, including supporting data based on knowledge acquired in earlier course work and incorporating appropriate engineering standards with multiple realistic constraints.

1. Project Selection

Instructors recommend most senior design experiences based on the needs of an external customer or stakeholder. In general, these experiences have a significant amount of mathematical foundation and engineering content using student knowledge from prior coursework. Students propose some experiences, which faculty members then evaluate for appropriateness. Beginning in fall 2018, faculty members will only accept senior design experiences based on the student's major field coursework. Students will either work an experience recommended by a faculty member or submit an abstract describing how the experience will utilize the major field coursework from the student's program.

2. Mathematical Foundations and Engineering Analysis in Senior Design Experience Reports

Students will address the intentional incorporation of mathematical foundations and engineering analysis in senior design experiences to provide technical content in the weekly progress reports in both EGR 498 and EGR 499. Previously, the weekly progress reports only contained reporting and plans for the following week. The technical content now includes the following required sections.

A. Design alternatives considered by the student.

B. Theory, engineering analysis, and simulation or experimental results.

C. Pictures or diagrams of the current state of the design.

Faculty members will grade weekly reports based on containing theory, engineering analysis, and simulation or experimental results. Although students will not generally add new theory every week, students must include any additional theory applied during the specified week. Faculty project advisors grade the weekly reports rather than the course coordinator as the advisors are in a better position to evaluate specialized technical content. Students will use material from these weekly reports to write fall semester progress reports in EGR 498 and spring final reports in EGR 499.

Requiring the technical material in the weekly reports gives students feedback concerning compliance with required technical material and an opportunity to make changes, which would not be possible with the semester progress report in EGR 498 or the final report in EGR 499. Weekly reporting also requires ongoing documentation of engineering content as the design experience develops. Faculty members implemented the change in EGR 498 in fall 2017 and continued the change in EGR 499 in spring 2018. After receiving feedback on the first two weekly reports, most design groups significantly increased the amount of theory and engineering analysis included in the weekly reports.

In fall 2018 (EGR 498) and spring 2019 (EGR 499), faculty members directed students to include technical material only rather than planning/management data to increase the focus on theory and engineering analysis. Faculty members modified the collection of the reports to a biweekly format in response to student feedback. Implementation of the reporting process resulted in significant improvements in the mathematical and engineering content of the design process in the final reports.

To improve compliance and identify expectations, faculty members require students to submit checklists along with the EGR 498 Semester Progress Reports and EGR 499 Final Report indicating the inclusion of theory, engineering analysis, simulations, and experimental results. The instructions for the EGR 499 Final Report require a separate section entitled Engineering Analysis.

Starting in fall 2018, project advisors began grading the EGR 498 Semester Progress Reports. Starting in spring 2019, project advisors also graded the EGR 499 Final Reports. Before 2018, the course coordinator graded the reports, and the project advisors graded the overall progress. Changing the grading process will facilitate a more thorough evaluation of the specialized technical content of the reports.

3. Engineering Standards

Faculty members require students to identify relevant engineering standards in senior project proposals but have not evaluated students based on including standards in the design reporting. To encourage students to include standards in the design reports, the Engineering department purchased 27 engineering standards and will continue to purchase relevant standards as needed. Faculty members require students enrolled in EGR 498 to identify engineering standards selected for the proposed project and require students to reference the standards in weekly reports, including quoted material from the standards that will guide the project. Faculty members also dedicate a portion of the course to discuss the use of engineering standards.

Faculty members require students to include a subsection within the introduction to the EGR 498 semester progress report entitled "Applicable Standards" and identify the sections of the applicable standard relevant to the students' design experience. Students also submit a checklist identifying the applicable standards, citing relevant sections, and describing the impact of the standards on the project design.

For the EGR 499 final report, faculty members again require students to identify and cite the relevant engineering standards, including an impact discussion. Students also include an additional subsection in the results section entitled "Standards and Design Constraints" to indicate clearly if the design satisfies the selected engineering standards. As with the progress report, students also submit a checklist indicating the identified and cited applicable standards along with the impact of the standards on the project design.

4. Realistic Design Constraints

Faculty members require students to include a special section in the EGR 498 Semester Project Report and EGR 499 Final Report to document identified and realistic design constraints relevant to the specified project. To increase awareness of design constraints, students must also turn in a checklist identifying the intentional inclusion of design constraints with the Semester Project Report and an additional checklist with the Final Report. Faculty members address the use of design constraints in EGR 498 and require students to identify design constraints (such as weight) in specific weekly reports. In the following week report, faculty members require students to identify appropriate project thresholds for the design constraint (such as 220 lb).

5. Student Time Management

In response to comments provided by the ABET site visit team, faculty members agreed to reduce the number of assignments in EGR 498 Senior Design to allow students additional time to focus on the design experience. Faculty members removed the following assignments from the course requirements:

- Resume writing assignment: Faculty members will discuss resume writing and interviewing butwill not grade any relevant assignments.
- Research writing assignments: In place of three research papers, faculty members will assignone design proposal and one research paper.
- Oral presentations:In place of three oral presentations based on research reporting, facultymembers will require students to present two oral reports on research and design.

While the assignment changes do not reduce or alter the material provided, the changes will provide additional time for students to focus on the overall design experience. Faculty members understand the importance of assessing the Life-Long Learning student-learning outcome, so faculty will assess student engagement with the research and design process in EGR 498 to evaluate research and independent learning skills.

Comments from the site visit team also indicated that students would benefit by committing to design experiences earlier in the course. To facilitate student commitment to design experiences, faculty members contacted potential industrial customers to develop ideas for student experiences. Industrial customers who engage students in design experiences through the Engineering program include Alfa Laval, Apergy Artificial Lift Technologies, Baker Hughes, Muncie Power Products, National Steak and Poultry, and the Oklahoma Aquarium, a not-for profit institution. Students visit potential project customers.

To assist students through the design project, the Engineering lab manager trains students in fabrication and meets with the senior project groups to discuss project status to stress the importance of intuitive design and knowledge of standard parts.

4. Describe any data-driven decisions that faculty members made to *open this program* since2016. Please provide evidence of data informing the decision to open the program.

   N/A (this is not a new program that opened after 2016)

5. Describe your stakeholder participation from alumni, community members, businesses, otherorganizations, etc.
   - Who are they?
   - What feedback have you received?
   - How have you used the feedback for continuous improvement?

   The program constituencies are the following:

   1. Currently enrolled students

      These are students who are enrolled at ORU and who have started taking classes in preparation for entering the engineering program or have been accepted into theengineering program. Successful realization of the educational objectives will equip students in the engineering program with the skills needed to enter the profession of engineering.

   2. Full-time active faculty, adjunct faculty, and retired and past faculty members

      The educational objectives give all levels of faculty guidelines for designing their courses to meet the educational needs of the students in the program. They also provide guidance for mentoring students and advising them regarding academic questions.

   3. Other constituencies who are not directly included in the on-campus program

      a. Alumni of the Engineering Program.

      b. Faculty members from other institutions who collaborate with the Engineeringdepartment.

      c. Graduate programs that have currently enrolled graduates of the program.

      d. Industrial partners/companies who currently employ graduates of the program.

e. Industry representatives who have given talks to the Engineering department.

f. Industry representatives who have sponsored design projects.

g. Organizations that currently employ alumni.

h. Prospective students who have made inquiry to the Engineering department.

All of the above constituencies need to know the type of engineering program that ORU offers and the level of preparation that graduates of the program are expected to attain. This is important for recruitment and involvement of outside groups with the Engineering department.

The Engineering department is in dialogue with the constituencies through advisory board meetings, student interviews and alumni and student surveys. As needs are expressed there are monthly meetings of the faculty where the chair canpropose changes to better serve all constituencies.

6. Describe any open questions that faculty members have concerning the program that they are *waiting on future data* to evaluate for decision-making.

We are continuously evaluating assessment data at the beginning of each semester andmaking data driven decisions.

Artifact Outcome	Criterion Outcome	Supporting Data Source	Year	Low Data (< 3)	Action Plans	Year	Improved Data	Evidence
WPA-EGR-Senior Project Report	EGR-1-A-Application of Engineering Concepts	Program Outcome Report	2016-2017	2.71 (N = 17)	Require students to include theory, engineering analysis, simulation results and experimental data in weekly progress reports	2017-2018	3.37 (N=19)	Minutes, August 14, 2018
WPA-EGR-Senior Project Report	EGR-2-B-Depth and Breadth of Project Content	Program Outcome Report	2016-2017	2.76 (N = 17)	Require weekly reports in EGR 498 and EGR 499 with required technical content. Students submit checklists with their EGR 498 Semester progress report and EGR 499 Final Report. Final report is required to have a section with engineering analysis.	2017-2018	3.37 (N=19)	Minutes, August 14, 2018
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-7-A-Research	Program Outcome Report	2017-2018	2.74 (N = 23)	Dr. Halsmer gave the students more information on what was expected for the research.	2018-2019	3.35 (N = 48)	Minutes, January 7, 2019
WPA-EGR- C Programming Project	EGR-k-7-Specifications	Program Outcome Report	2017-2018	2.56 N = 41)	1. Before assigning the project, we give students a simple quiz to highlight a) importance of code reusability by creating appropriate functions and b) error checking. 2. At beginning of the project, we tell students that error checking of code is required for each input and that they may need to take more time to complete this 3. Include a score for error checking in the project description and explain to the students how to assess this when introducing the project	2018-2019	3.24 (N = 33)	Minutes, January 7, 2019
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-H-Spelling and Grammar	Program Outcome Report	2018-2019	2.65 (N = 48)	Dr. Halsmer gave students feedback with more detailed written comments on their papers regarding improving their grammar and writing skills. He also recommended software that might help in this regard.	2019-2020	3.9 (N = 52)	Minutes, January 6, 2020
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-A-Content	Program Outcome Report	2018-2019	2.83 (N = 48)	Dr. Halsmer said that he got an extra class with them and during that class he discussed this essay in detail. The essay was also moved to the end of the semester, rather than at the beginning. Also, Dr. Halsmer's new book, *Hacking the Cosmos*, was used in this class for the first time.	2019-2020	3.17 (N = 52)	Minutes, January 6, 2020
WPA-EGR-Mechanics I: Statics Final Examination (EGR 221)	EGR-1-E-Information	Program Outcome Report	2018-2019	2.8 (N=15)	Dr. Halsmer developed a worksheet that he handed out to students in Fall of 2019 to give them instruction, insight and practice in this area.	2019-2020	3.88	Minutes, January 6, 2020
WPA-EGR-101 Introduction to Engineering Stewardship Essay	EGR-3-C-Format	Program Outcome Report	2019-2020	2.81 (N = 52)	Dr. Halsmer had added a checklist to the assignment sheet and he believes that is what helped increase the scores.	2020-2021	3.43 (N = 44)	Minutes, January 20, 2021

Table 1. Examples with evidence and documented action plans for assessment data collected from courses

Results of Primary Evidence: B.S.E. Engineering

A. Program Outcome Report:

		2016 – 2017		2017 – 2018		2018 – 2019		2019 - 2020		2020 - 2021	
		Residential		Residential		Residential		Residential		Residential	
		n	score	n	score	n	score	n	score	n	score
EGR 101	Stewardship Essay: Content	56	3.48	46	3.17	48	2.83	52	3.17	44	3.02
EGR 101	Stewardship Essay: Format	56	3.75	46	3.76	48	3.96	52	2.81	44	3.43
EGR 101	Stewardship Essay: Research	56	3.46	23	2.74	48	3.35	52	2.52	44	3.27
EGR 101	Stewardship Essay: Spelling and Grammar	56	3	46	3.04	48	2.65	52	3.9	44	3.57
EGR 222	Statics Exam: Information	19	3.74	30	3.57	15	2.8	---	3.88		
EGR 252	C Programming Project: Specifications	18	3.33	41	2.56	33	3.24				
EGR 499	Senior Project Report: Application of Engineering Concepts	17	2.71	19	3.37	9	3.33	8	3.5	8	3.2
EGR 499	Senior Project Report: Depth and Breadth of Project Content	17	2.76	19	3.37	9	3.22	8	3.6	8	3.5