Assessing ABET Student Outcomes With Enhanced Evidence During Accreditation Changes

Thomas W. DeNucci
U.S. Coast Guard Academy

Elizabeth Garcia
U.S. Coast Guard Academy

The U.S. Coast Guard Academy Naval Architecture and Marine Engineering Program is accredited by the Engineering Accreditation Commission (EAC) of ABET. For the 2019 ABET general review, the program's transition to the new ABET Criteria is described. This includes program interpretation of the updated ABET Criteria, specifically Criterion 3, Student Outcomes, and newly revised ABET language and definitions. Concurrently, evidence-based changes were applied to assessment. A performance vector was implemented to categorize the quality of student work as Excellent, Adequate, Marginal or Unsatisfactory (EAMU Vector), both increasing the fidelity of the assessment data and creating meaningful student performance data trends.

Keywords: assessment, ABET, EAMU Vector, student outcomes

INTRODUCTION

Quality assurance in engineering education is paramount (Natarjan, 2000, Phillips, et.al, 2000, Uziak, et.al., 2014). The programmatic and peer reviews required by the accreditation process ensure the quality and relevancy of each program. Engineering accreditation, most often achieved through the Engineering Accreditation Commission (EAC) of ABET, formerly the Accreditation Board for Engineering and Technology, provides a framework to assess a program against eight criteria including: students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities and institutional support.

The EAC recently approved changes to its General Criteria for Baccalaureate Programs for implementation in the 2019 – 2020 Review Cycle (Karimi, 2017). The EAC changes affect the following components and criterion of the assessment framework:

- Introduction and Definitions that apply to all parts of the criteria
- Criterion 3 – Student Outcomes
- Criterion 5 – Curriculum

All general reviews conducted in the 2019 – 2020 accreditation cycle, and beyond, will be evaluated against these new criteria.

Changes to Criterion 3, with revised accreditation definitions, will likely have the largest impact on the assessment architecture of each program. The most evident change includes the replacement of eleven legacy outcomes, identified (a) – (k), with seven new student outcomes enumerated (1) – (7). The specific mapping between the new outcomes (1) – (7) and legacy outcomes (a) – (k), as well as updated language and definitions, are provided in ABET guidance (ABET, 2019a).

Since current ABET-accredited engineering programs will have some component of the legacy Student Outcomes, most programs will require changes to their assessment process at or below the Student Outcome level. As a result of the changes, most program will be required to:

- Revise student performance criteria to explicitly support the new SOs
- Verify that evaluative student artifacts provide appropriate evidence of student performance

The magnitude of change will vary from program to program depending upon on the scope of the legacy outcomes and the specific assessment structure (Turner, et.al., 2018). These changes, plus experiences with an accreditation year 2019-2020 ABET general review, may provide insight for engineering programs transitioning to the new ABET Criteria. Academic programs seeking initial accreditation from ABET may also benefit from the process, approach and techniques described in this paper.

PROGRAM ASSESSMENT ARCHITECTURE

The Naval Architecture and Marine Engineering Program assessment architecture consists of Program Educational Objectives (PEOs), Student Outcomes (SOs), Performance Indicators (PIs) and Barometric Assessments (BAs). Although this argot may be unique to the Naval Architecture and Marine Engineering Program at the U.S. Coast Guard Academy, most engineering programs will have a similar hierarchy of levels in their assessment framework.

Student Outcomes (SOs) are the cornerstone of an ABET accredited program; programs must provide evidence that students achieve each of the seven SOs. Student outcomes are statements which describe what students are expected to know and be able to do by the time of graduation. Student outcomes are closely connected to Program Educational Objectives (PEOs) in that the achievement of SOs should indicate that students are prepared to achieve the PEOs.

The Naval Architecture and Marine Engineering Program subdivided each Student Outcome into one or more Performance Indicators (PIs). PIs are measurable interpretations of each SO that describe a competency or skill that each student is expected to attain and demonstrate. The Performance Indicators are influenced by faculty interpretation of the PI as it applies to the specific program, in this case, Naval Architecture and Marine Engineering.

Student achievement of a Performance Indicator is evaluated using a combination of specific assignments, projects and/or examination problems, rubric score or a survey response called Barometric Assessments (BA's). BA's serve as "barometers" of student performance in achieving the specific Performance Indicators. For each Performance Indicator, the Program has identified two or more BAs that were judged to be key measures of student achievement of that Performance Indicator. The demonstration of student achievement of a particular Performance Indicator is typically summative in nature, examined in one or more Program-required courses using sets of one or more BAs. The Program declares that a Student Outcome has been achieved when all Performance Indicators tied to that outcome have been achieved in at least one course.

TRANSITION TO NEW ABET CRITERION 3 – STUDENT OUTCOMES

To comply with this criterion, the mapping of Student Outcomes, Performance Indicators and Barometric Assessments to Program-specific courses were completely revised in the 2017 – 2018 academic year. A faculty subcommittee met monthly to perform this mapping. The subcommittee included faculty with the greatest knowledge and breadth of the program, including the Program assessment coordinator and a faculty member who serves as an ABET Program Evaluator. Faculty were guided by ABET

documentation (ABET, 2019a) that summarized the migration from the legacy Student Outcomes (a) – (k) to the new Student Outcomes (1) – (7).

The Naval Architecture and Marine Engineering Program has 10 Student Outcomes. The first seven outcomes are taken directly from the ABET Criterion 3, (1) – (7). It is expected that programs adopt these outcomes, in a wholesale fashion, to demonstrate compliance with Criterion 3. The remaining three Student Outcomes are developed from the ABET program-specific criteria for Naval Architecture and Marine Engineering programs (ABET, 2019b). Although program-specific criteria are not explicitly required to appear as additional Student Outcomes, harmonizing these criteria as outcomes in the assessment architecture is both efficient and effective for the program.

The biggest challenge with the mapping of legacy outcomes to new outcomes, was that some legacy Student Outcomes are combined into a new (singular) outcome; some are natural, while have important caveats. For example, legacy outcomes (a) "an ability to apply knowledge of mathematics, science and engineering" and (e) "…identify, formulate and solve engineering problems" are similar and combining them into a single Student Outcome (1) improves the efficiency of the assessment process. However, combining legacy outcomes (f), (h) and (j) into a single outcome (4) or that legacy outcome (k) is implied in Student Outcomes (1), (2) and (6) can be fraught with problems. The danger for a program is that they might assess one aspect of the outcome and miss the other which could result in a shortcoming that might otherwise be avoided by keeping these outcomes separate. This requires that programs take great care in implementing changes, especially below the SO level, to ensure all elements of each outcome are achieved.

ASSESSMENT FRAMEWORK BELOW THE STUDENT OUTCOME LEVEL

Fundamental changes to the language and definitions pertaining to all Criteria heavily influenced the development of Performance Indicators and their subsequent Barometric Assessments. The most challenging aspects of these alterations are described below.

The first is the definition, and rather inclusive aspects, of Engineering Design. The legacy student outcome (c) required that engineering design, "meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability". The use of the term "such as" as a determiner indicates that only a subset of need and constraints is required. The new Student Outcome states, "engineering design solutions must meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors." Relative to the legacy student outcome, it would appear that all of these aspects should be included. Therefore, EAC Criterion 3, Student Outcome 2 requires multiple Performance Indicators to encompass all these characteristics.

The second challenge is the design of experiments. The legacy student outcome (b) required that "students design and conduct experiments." This was a challenge because Naval Architecture and Marine Engineering students do not often design experiments. To achieve this outcome, experimentation was often artificially introduced in the curriculum. The new EAC Criterion 3, Student Outcome 6 more reasonably requires that "students develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions." This is more realistic and indicative of program specifics and may not require students to actually design experiments; only analyze and interpret the data. This should result in programs having greater flexibility in demonstrating student achievement of this outcome.

Next, oral communication skills have been expanded to include speaking to a range of audiences. The legacy student outcome (g) required students to communicate effectively while the new outcome (3) adds that students should effectively communicate across a range of audiences. As a result, students must now demonstrate the ability to a range of audiences, e.g., peers, faculty, industry representatives, people outside of their academic specialty, etc. Programs must now ensure students speak to a range of audiences.

Last, the role of the team has also changed significantly. Legacy student outcome (d) required that students "function on multidisciplinary teams." The new Student Outcome 5 also requires team members to "provide leadership and create a collaborative and inclusive environment." It is much more challenging

to provide evidence of leadership and a collaborative and inclusive environment in a program than to merely function on a team.

As a process, the Program proceeded cautiously to ensure that PIs included all aspects of each student outcome and that each barometric assessment (or equivalent) was developed in a manner to meet the new language and definitions of the EAC Criteria. In September 2018, a final review of the Student Outcomes, Performance Indicators and associated Barometric Assessments was completed and presented to the entire Program faculty for approval and ratification.

At the same time as the new ABET Criterion 3 Student Outcomes were incorporated into the program, a new institutional core curriculum was being implemented. Therefore, this overhaul allowed the faculty subcommittee to also examine if any changes to the curriculum also affected the transition to the new assessment process. If this had this not happened simultaneously, it would have been necessary to incorporate a separate review of the assessment process to ensure that all Student Outcomes were being assessed in the most appropriate courses, either due to the discontinued older courses or the introduction of new courses. Since the program largely relies on courses taught by faculty in the program, there was a minimal impact on the assessment process because of the new core curriculum.

EVIDENCE OF STUDENT PERFORMANCE

Once the student performance criteria was revised to explicitly support the new SOs, the program had to verify that the selected barometric assessments could provide appropriate evidence of performance, relative to each student outcome. Prior to 2018, Student Outcomes were considered achieved if at least 75% of the program students attained at least a 70% score on the Barometric Assessment associated with each Performance Indicator. Although this approach served the Program well for a number of years, a number of shortcomings restricted its efficacy.

First, there was no good dashboard for rapidly assessing year-over-year trends for each Performance Indicator. Although the historical assessment data was available, it required substantial time to collect, collate and analyze the information. After much discussion and a review of best practices, the faculty agreed that a three-year performance trend for each Performance Indicator would provide the most insightful and useful information for Program assessment and continuous improvement activities.

Second, and perhaps more importantly, the approach used prior to 2018 lacked the fidelity to identify meaningful student performance trends; it only reported whether the Barometric Assessments demonstrated achievement of the Performance Indicator. Unfortunately, this information was reported as a single percentage, which masked both the distribution and variability of the underlying performance data. For example, an Outcome Score that is reported as 100% may have had all of the students achieving a 70% on the Barometric Assessment (prior threshold), and the following year, this could drop to 0% of the students achieving 70% only because every student scored a 69% on the Barometric Assessment. Therefore, the evaluation approach concealed the fact that these two sets of student performance data were, in fact, statistically the same.

INCREASED FIDELITY IN THE ASSESSMENT OF STUDENT ARTIFACTS

To remedy these limitations, and in keeping with assessment best practices, the Program updated the assessment framework to include an EAMU vector to increase the fidelity of the assessment process. The approach was described as a rubric to assess student performance, using the categories of “Exemplary”, “Proficient”, “Apprentice”, and “Novice” (Miller, et.al., 1999). This concept has since evolved into a widely accepted rubric designation of (E)xcellent, (A)dequate, (M)arginal or (U)nsatisfactory, and the vector representation of student performance in each band.

The EAMU Vector is most visibly used as the assessment instrument for EvalTools® (Evaltools). The EAMU Vector measures the degree to which students achieve a Student Outcome Performance Indicator by categorizing student work as (E)xcellent, (A)dequate, (M)arginal or (U)nsatisfactory. Table 1 shows the scores the Naval Architecture and Marine Engineering Program used to band the EAMU vector.

TABLE 1
EAMU SCORING BANDS

(E)xcellent	90-100%
(A)dequate	80-89.99%
(M)arginal	70-79.99%
(U)nsatisfactory	<70%

The range of each scoring band follows common delineators in higher education with the exception of the (U)nsatisfactory range. Program faculty elected to include a grade of "D" (60-70%) within the (U)nsatisfactory rather than in the (M)arginal category because earning a "D" on an assignment negatively impacts the 2.0 GPA graduate requirement for students in the Program.

Since most Naval Architecture and Marine Engineering student cohort sizes are not large enough to report overall percentages with statistical significance, raw scores in each category are used to better reflect the underlying distribution of performance. Therefore, to calculate the EAMU Vector, the raw number of Naval Architecture and Marine Engineering students earning a grade in each scoring band are tallied, not the overall percentage of students earning a grade in each scoring band.

The Naval Architecture and Marine Engineering Program EAMU Average is computed on a 3.0 scale using equation (1):

$$\text{EAMU Average} = (3*\text{Count(E)}+2*\text{Count(A)}+\text{Count(M)})/(\text{Count All}) \quad (1)$$

This composite score provides an additional avenue in which to consider the data; student achievement is now assessed on multiple parameters including the EAMU Vector, the EAMU Average, and the 3-year Average Trend, which shows a trend line (slope) for the data. The vector, its average, and 3-year trend enable assessment of student performance in three distinct areas:

1. Percentage of students obtaining an "Unsatisfactory" score
2. Overall EAMU Average
3. 3-year trend

The 3-year trend is an assessment tool unique to the Naval Architecture and Marine Engineering Program. Since assessment data is collected for all Barometric Assessments each year, the 3-year trend to become a simple but useful metric to describe improvements (or declines) in student performance and/or changes in the grading fidelity of instructors. After the EAMU vector is calculated for a particular Barometric Assessment, student performance is assessed using a collection of EAMU Matrix Flags shown in Table 2.

TABLE 2
ASSESSMENT MATRIX FLAGS

	EAMU		**3-year Trend**
Category	Criteria Description	Category	Criteria Description
Red Flag	Any average below 2.0 AND 10% EAMU vector in U	Red Flag	Less than -0.2 (Trending downward rapidly)
Yellow Flag	Any average below 2.0 OR 10% EAMU vector in U	Yellow Flag	Between -0.1 to -0.2 (Trending downward gradually)
Green Flag	Any average above 2.75 AND 0 EAMU vector in U	Green Flag	Above 0.2 (Trending upward rapidly)
No flag	Any vector that does not fall into one of the above categories	No flag	Trend does not fall into one of the above categories

The flags described in Table 2 act as a catalyst for continuous improvement discussions during assessment activities. Any Barometric Assessment which is flagged must have a documented discussion associated with it, regardless of whether it includes any recommended course improvements or not. In order to reduce the chance of process oversaturation, Table 2 shows two levels of flags for low performance and only one for high performance. Green flags are good indicators for excessively high grades and their implications. EAMU averages between 2.0 and 2.75 compute to an average grade of 85 which is not considered excessively high, particularly since the institution is considered highly selective. Flags are critical because they trigger mandatory discussions, ensuring that ABET assessment is directly tied to curricular continuous improvement. Flags are also considered biennial Program Reviews where Student Outcomes are measured collectively rather than individually.

FIGURE 1
STUDENT OUTCOME ASSESSMENT PROCESS WITHIN PROGRAM REVIEW PROCESS

DESCRIPTION OF ASSESSMENT PROCESS

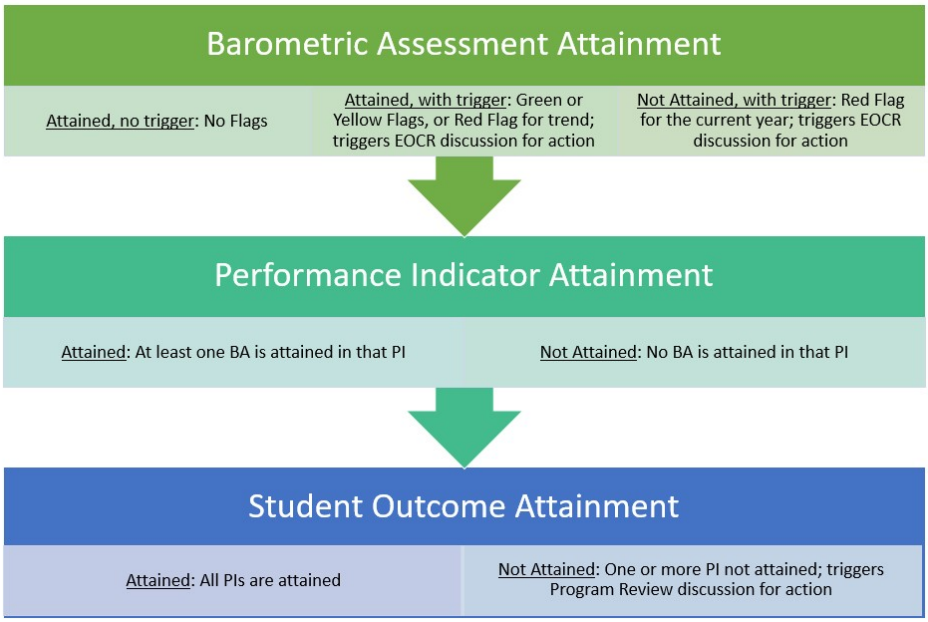
Outcome assessment occurs on an annual basis. Most courses used in assessment are taught only one semester each year. For those courses taught in both the fall and spring semesters, the semester with the largest Naval Architecture and Marine Engineering cohort is selected, e.g., 6201 Ships and Maritime Systems is assessed in the Fall. Figure 1 describes the assessment process using the EAMU vector.

The first step of the assessment process occurs at the end of each semester when the assessment coordinator requests the grades or rubric scores for each barometric assessment. With few exceptions, e.g., student interviews, the data is readily available in each course gradebook and is simply transferred to our Excel-based Assessment Matrix. Using the ranges presented in Table 1, all grades are next assigned as (E), (A), (M) or (U). Once student performance data is collected, step 3, the EAMU vector raw score and average is computed. Next, the EAMU vector raw score and average are then flagged based on the criteria defined in Table 2. Last, the resulting flags then trigger continuous improvement discussions during the end of semester assessment activities.

Expected Level of Attainment of Each Student Outcome

A cohort is an entire class of Naval Architecture and Marine Engineering students, i.e., all Program students in a particular course are assessed. If students from other programs are enrolled in the course, only cohort grades are considered for assessment purposes.

FIGURE 2
ATTAINMENT OF STUDENT OUTCOMES



A Student Outcome is considered to be attained when all of the Performance Indicators for that Outcome have been successfully demonstrated by the Program students. The Performance Indicator is declared to have been attained if Program students in at least one of the Barometric Assessments have successfully demonstrated that Performance Indicator. If Performance Indicators aren't achieved, then remedial actions determined through faculty discussions are warranted. Figure 2 summarizes this process.

The assessment matrix flags presented in Table 2 indicate whether a BA, PI or SO has been attained. Green flags indicate that student performance is very high, triggering discussions to consider the level of

rigor and grading consistency for that BA. This trigger does not indicate a lack of attainment of the BA, it rather considers the merit of the particular assessment vehicle.

A yellow flag indicates that a majority of students in the cohort are below marginal performance. A yellow flag triggers discussion on potential course improvements. Continuous improvement is not required but should be thoughtfully considered. A yellow flag also illustrates grade distribution within the assessment vehicle. For purposes of overall assessment, the BA is still considered attained with a yellow flag.

A red flag is a trigger for continuous improvement action and a failure to attain that BA. Red flags are taken very seriously, and the course review discussions are valued as the first line of continuous improvement efforts. If all BAs fail for the same PI, the PI also fails, and the Student Outcome is not attained.

Flags for the trends are visual indicators of the 3-year trend, and can be used as a warning of a possible red flag in the future, or that the rigor of the BA may need to be adjusted (for a green trend). 3-year trend flags do not factor into BA attainment.

EXAMPLES OF EAMU VECTOR IN ASSESSMENT ACTIVITY

The EAMU Vector is tracked in a Microsoft Excel table for each Student Outcome, subdivided into Performance Indicators and Barometric Assessments. The spreadsheet-based format allows users to input data in a familiar software environment. Once the EAMU Vector is calculated, the pre-programmed Excel spreadsheet color-codes based on the two criteria:

1. The current EAMU average is colored red, yellow, or green for that year if it falls into one of the flagged categories.
2. The 3-year trend is colored red, yellow, or green if it falls into one of the flagged categories.

The color-coded spreadsheet provides a quick visual display of Student Outcomes. Each individual course can observe its role in assessment activities, or overall Student Outcome attainment can be observed on a programmatic level. It is again important to note that any color-coded cell requires a discussion amongst faculty and stakeholders.

Table 3 shows a sample of Student Outcomes using the EAMU Vector. It shows the ABET Student Outcome, the Barometric Assessment Courses, the Barometric Assessment and student performance on that particular assessment using the EAMU Vector. The colored-coded performance averages and the three-year trend are displayed for Student Outcomes 1, 2 and 3. The results show two particular problem areas highlighted in red:

1. Student Outcome 1: the final exam grade in Ship Structures (1356)
2. Student Outcome 2: the ship cost assignment in Ship Design/System Integration (1444)

In both of these cases, student performance on these assessment vehicles is below average. The three year trend also indicates that year-over-year, student are performing worse on this barometric assessment. These results would trigger continuous improvement in these courses.

The crewing assignment associated with Student Outcome 2 is color coded yellow. This indicates that although not problematic, there is a downward trend in student performance. Similarly, there is a 3-year average downward trend on the Propulsion Plant Trade-Off assignment. These results, again, should trigger discussion among faculty who will reach consensus on whether continuous improvement is required.

Table 3 also illustrates some areas where students are consistently above average. Students are performing well on the heat exchanger assignment in Marine Engineering (1355) and on the final presentations in Ship Design/System Integration (1444). This high-level of performance may be attributed to a variety of mechanisms including the students, the instructor, grading, rigor of the problem, etc.

TABLE 3
SAMPLE STUDENTS OUTCOMES USING EAMU VECTOR

SO1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and				2019-20					2018-19					2017-18					3-yr.
Performance Indicators		Barometric Assessment Courses	Barometric Assessment	E	A	M	U	Avg	E	A	M	U	Avg	E	A	M	U	Avg	Trend
SO1-1	Identify, formulate and solve complex engineering problems.	1355 Marine Engineering	Heat Exchanger Homework Assignment	21	4	0	0	2.84	14	4	0	2	2.50	16	3	0	0	2.84	-0
		1356 Ship Structures	Final Exam Grade	2	3	11	8	0.96	3	8	5	4	1.50	3	13	1	1	2.00	-0.52
		1242 Applied Naval Arch & Marine Engr	Great Boat Race	13	11	1	0	2.48	21	4	2	0	2.70	8	4	4	0	2.25	0.115
SO2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety,				2019-20					2018-19					2017-18					3-yr.
Performance Indicators		Barometric Assessment Courses	Barometric Assessment	E	A	M	U	Avg	E	A	M	U	Avg	E	A	M	U	Avg	Trend
SO2-1	Apply engineering design to produce solutions that consider the environment, and vessel and crew/passenger safety.	1442 Principles of Ship Design	Intact Stability Submittal	8	8	0	0	2.50	9	8	0	0	2.53						
		1453 Ship Propulsion Design	Propulson Plant Trade-off Submittal	8	8	4	0	2.20	7	3	7	0	2.00	13	10	0	0	2.57	-0.18
		1444 Ship Design/System Integration	Crewing Submittal	8	8	0	4	2.00	10	7	0	0	2.59	4	19	0	0	2.17	-0.09
SO2-2	Apply engineering design to produce solutions that consider economic, global, and cultural and social (national) factors.	1444 Ship Design/System Integration	Final Project Report (Executive Summary)	12	8	0	0	2.60	9	8	0	0	2.53	11	12	0	0	2.48	0.061
		1444 Ship Design/System Integration	Cost Submittal	4	8	0	8	1.40	0	0	0	17	0.00	15	8	0	0	2.65	-0.63
SO3: an ability to communicate effectively with a range of audiences				2019-20					2018-19					2017-18					3-yr.
Performance Indicators		Barometric Assessment Courses	Barometric Assessment	E	A	M	U	Avg	E	A	M	U	Avg	E	A	M	U	Avg	Trend
SO3-1	Demonstrate effective writing of technical material (clarity, references, graphics,	1355 Marine Engineering	Major-specific Position Paper	14	12	0	0	2.54	11	7	1	0	2.53	3	6	0	0	2.74	-0.1
		1453 Ship Propulsion Design	Individual Propeller Submittal	16	4	0	0	2.80	16	0	0	0	3.00	17	6	0	0	2.74	0.03
SO3-2	Demonstrate effective oral presentation of technical material.	1444 Ship Design/System Integration	Final Presentation	20	0	0	0	3.00	12	5	0	0	2.71	12	9	2	0	2.43	0.283

RESULTS AND RECOMMENDATIONS

Flagged assessments during the assessment review process leads to a more productive conversation than a simple pass/fail criterion. Referencing flagged assessments promotes faculty equity-mindedness in assessment discussions, e.g., “The final exam didn’t align well with the course material and should be revisited” versus a pass/fail criterion which often ;leads to a deficit-minded conversation, e.g., “Students these days are not ready for college.”

Often, ABET Assessment can easily be disassociated with the accredited program of study. To counter this, adopting a mindset that flags are an automatic trigger for discussion allows for ABET Assessment to permeate all continuous improvement efforts, rather than be viewed as a separate and extra effort.

The three-year trend has only been in practice for three semesters, but it has already helped to lead to discussions about potential grade inflation or re-racking of course material. For example, in Principles of Ship Design (1442) the EAMU Vector was flagged green for one assessment, and there was a follow-on discussion to revisit the rigor of this assignment and grading in order to check for potential grade inflation. Also, faculty teaching Engineering Material Science (1204) used several factors including a red flagged EAMU Vector on the final exam grade to revisit the exam and ensure that the depth and breadth of the final exam was appropriate. After modifications to the final exam, the Barometric Assessment changed from a red flag to a yellow flag. These examples illustrate that the ABET Assessment of Student outcomes with this approach is closely tied to the continuous improvement of the course.

ABET Assessment should not be an extra lift, but fully incorporated into other continuous improvement efforts of the curriculum. Annual assessment doesn’t need to be a burden if it’s organically rooted in a course.

CONCLUSION

When programs adopt the new ABET Criterion 3 Student Outcomes, it is important to recognize that a robust assessment framework requires more than a direct mapping from the legacy SOs (a) – (k) to the SOs 1 – 7. Changes to the language, definition and certain verbiage of the Criteria necessitates a comprehensive review of the mapping between SOs and to subsequent levels of an assessment architecture. Additionally, programs must recognize the need to assess attainment of all elements of a Student Outcome, demonstrated in this paper by subdividing Student Outcomes into Performance Indicators that both break apart the Student Outcome and interpret for measurement the Student Outcome.

The Naval Architecture and Marine Engineering Program implemented an EAMU Vector to achieve a higher fidelity in the measurements that support attainment of Student Outcomes. Rather than using a singular data point for analysis, five data points are used to assess and evaluate student performance, namely each value of the EAMU Vector along with the average. This formulation of student performance provides an effective year-on-year trend of the average student performance that can further discussion about continuous program improvement.

A byproduct of the EAMU Vector, average, and trend are the implementation of flags, including high, moderately low, and low, that have aided discussions of continuous improvement in a very positive way both during Course Reviews and Program Reviews. These discussions, along with the use of Barometric Assessments taken directly from courses in the curriculum have allowed for the ABET continuous improvement process to be more entrenched in the Program continuous improvement process, which is the original desire of ABET for accreditation.

ACKNOWLEDGEMENT

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