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Building an Effective ABET ETAC Assessment Program from the Ground Up

Dr. Qudsia Tahmina, Ohio State University

Dr. Qudsia Tahmina, The Ohio State University at Marion

Dr. Tahmina is an Assistant Professor of Practice at The Ohio State University at Marion. She teaches First Year Engineering and second year Electrical and Computer Engineering courses. Dr. Tahmina is involved in the curriculum development and ABET assessment process for the Engineering Technology program offered at the regional campuses of The Ohio State University.

Ms. Kathryn Kelley, Ohio State University

Kathryn Kelley serves as executive director of OMI; she has more than 20 years' experience in program leadership and strategic communications at industry-oriented higher education, economic development and statewide technology organizations. She collaborates with state and national partners to develop regional and national public policy to support manufacturing innovation, advocate for small- and medium-sized manufacturing needs within the supply chains and remove barriers between academia and industry.

Activities include: - Managing NIST MEP funded program on "Manufacturing 5.0" to develop a framework and set of tools to guide MEP staff assisting small- and medium-sized manufacturing firms in their journey toward digital integration. - Completing ODSA-funded project on Ohio Advanced Manufacturing Technical Resource Network roadmaps organized by manufacturing processes to determine manufacturing needs and technical solutions for machining, molding, joining/forming, additive manufacturing. - Collaborating with state and national partners on advanced manufacturing education pathways and engineering technologist manufacturing career programs - Served as lead coordinator of a Bachelor of Science in Engineering Technology degree program at The Ohio State University focused on curriculum development and approval, securing industry support and promoting program to internal/external audiences. - Published a US Economic Development Agency-funded engineering technology future skills report to be published in Economic Development Quarterly (Feb. 2020) - Served as Ohio principal investigator on a $2.24M US Department of Defense Office of Economic Adjustment Defense Manufacturing Assistance Program and $300K Defense Cybersecurity Assurance Program - Producing and hosting "Manufacturing Tomorrow," a podcast series with 2,000+ subscribers to highlight innovative manufacturers and the academic partnerships that propel their efforts

She is dedicated to researching and issuing action-provoking reports on advanced manufacturing trends, workforce development and disruptive technologies.

Aimee T. Ulstad, Ohio State University

Aimee Ulstad, P.E is an Associate Professor of Practice in the Integrated Systems Engineering Department at The Ohio State University. Prior to joining the faculty at Ohio State, Aimee was an industry professional in various field in engineering for over 30 years. Aimee received her degrees in Mechanical Engineering and Masters in Business Administration from Ohio State. She began her career as a packaging equipment engineer at Procter and Gamble, then moved to Anheuser-Busch where she worked for over 27 years. She worked as project manager, engineering manager, utility manager, maintenance manager, and finally as the Resident Engineer managing all technical areas of the facility. During her tenure, the brewery saw dramatic increases in productivity improvement, increased use of automation systems, and significant cost reductions in all areas including utilities where they received the internal award for having the best utility usage reduction for 2014. Since joining Ohio State, Aimee has joined the American Society of Engineering Educators and serves as the treasurer of the Engineering Economics division.

Work in Progress: Building an Effective ABET ETAC Assessment Program from the Ground up

Abstract

This paper is the first of what is expected to be a multi-year process of establishing and developing an assessment process for accreditation of the new Bachelor of Science in Engineering Technology (BSET) program at a higher education institution that has previously granted Bachelor of Science in Engineering degrees. The new degree program was launched in Autumn 2020 at the regional campuses of The Ohio State University, which have traditionally been feeder campuses.

To prepare for a new and effective degree program, an assessment team was formed. The committee was charged to develop a plan for program assessment by following the criteria defined by the Engineering and Technology Accreditation Commission (ETAC) of the Accreditation board of Engineering and Technology (ABET). Team members collaborated with faculty and administrators to gather information about the curriculum and developed a plan of action and timeline for the assessment in the first year of the program offering. They also attended webinars and participated in ABET-coordinated sessions to educate themselves on the eligibility requirements and criteria to prepare for accreditation. Preparing a robust framework involved establishing program educational objectives, streamlining the process for assessment of student learning outcomes and maintaining a data management and sharing system offered by the university. Other tasks included developing a mechanism for mapping program educational objectives to ABET student outcomes to course goals and integrating learning management system as a tool to help in decision making and continuous improvement of the program.

The purpose of this paper is twofold: a) to communicate the process of building an effective assessment program for ABET accreditation from the ground up; and b) to share best practices with others who offer degree programs in Engineering Technology or similar degrees.

Introduction

Higher education institutions value accreditation and strive to acquire the accreditation status not only to offer quality education and services to students but also to build confidence among the public in the value of the program the institutions have to offer. Accrediting bodies highlight the need for program assessment, evaluation and continuous improvement as a quality assurance process to help maintain the rigor and relevance of the program to the professions it serves. Accreditation status encourages confidence among students that the educational experience offered by the institution meets the global standards, enhances the employment opportunities, and provides access to federal grants and scholarships. Admission into higher education institution to obtain a degree is a biggest investment for a student; therefore, there is a need for careful consideration and awareness about accredited programs to make informed decisions. Institutions offering degrees in multiple disciplines focus on accreditation at institutional level as well as program level. The criteria for each accreditation are different and therefore the regulatory councils do not mandate processes and offer flexibility to institutions in determining independent processes to ensure that they are meeting the criteria. Accreditation Board of Engineering and Technology (ABET) is a nonprofit, non-governmental organization with ISO 9001:2015 certification that accredits postsecondary, degree-granting programs in applied and natural science, computing, engineering, and engineering technology [1]. Since the paper is focused on engineering technology degree, the relevant accreditation council and criteria are discussed.

A new Bachelor of Science in Engineering Technology (BSET) degree program was developed to address the growing needs for highly skilled college graduates with the manufacturing engineering technology focus at the regional campuses of The Ohio State University. To deliver the quality educational experience and provide technical and professional skills needed for students to succeed, it is critical that the program has met the standards and received recognition for its quality. An assessment team was formed and charged to develop a plan for program assessment by following the criteria defined by ABET ETAC. This paper will discuss the process of building an assessment program from the ground up, including mapping program educational objectives to student outcomes, establishing performance indicators to assess the competence related to outcomes, and building a framework to identify, collect, and evaluate data to guide the curriculum to improve the efficacy of the program.

This paper is organized in the following order: I. Overview of the Engineering Technology Program, II. Criteria for ABET ETAC Accreditation, III. Design an Assessment Process, IV. Analysis of the Approach, and V. Best Practices. The paper concludes with summary and recommendations for future work.

I. Overview of the Engineering Technology Program

History

Manufacturing in the state this engineering technology program is offered has continued to grow in productivity and add value by automating processes and focusing on high-value production activities. Due to the automation, job roles in manufacturing have become more important for production and require a higher level of skill sets. For example, many traditional roles can be replaced with the robotics coordinator. These high-skill jobs pay well, offer exceptional benefits and high-tech environment. The importance of STEM education and skills has gained widespread acceptance not only among educators but also among government agencies and policy makers. Technological growth and innovation in complex manufacturing processes has resulted in an increased demand for talent possessing higher, more complex, and complementary skills necessary to perform tasks [2]. The biggest demand for the educational institutions is to help students invest in developing skills that lead to good jobs, while fulfilling manufacturers needs for skilled engineers that can enhance their productivity and cost competitiveness. To tackle the current and projected skill challenges, community colleges and technical schools started investing in realigning the existing curriculum, developing new programs and building partnership with area manufacturers to identify and address specific needs. These partnerships will not only support students but also help colleges develop new certificate or associate degree programs.

Graduates from this engineering technology programs will be expected to work in manufacturing, product design, testing, construction, or technical services and sales. Some graduates might consider engineering entrepreneurship, facilities management, or operations management. Offering a four-year engineering technology degree program would be a step closer to providing manufacturers with highly skilled, technically adept employees. The degree program would offer the foundation of analytical and soft skills to help them move up in their career to managerial and leadership positions. In response to the growing needs for highly skilled college graduates possessing broad training in manufacturing engineering technology, a proposal for the new Bachelor of Science in Engineering Technology (BSET) degree program was submitted to the university's college of engineering in 2018. It was then approved by the state's department of higher education in 2019.

Delivery Model

An interdisciplinary integrated program was developed to be administered by the regional campuses because of their strong history of supporting the needs of their surrounding communities and collaboration with co-located community/technical colleges and area manufacturers. A unique characteristic of this program is that it will be offered at four regional campuses within the university system. The program's curriculum has been established to remain similar across campuses to ensure consistency in attainment of goals and outcomes.

Curriculum

Curriculum for the BSET program was developed after researching engineering technology programs at other institutions in the nation, conducting focus groups with area manufactures and collaborating with the neighboring technical colleges. Curriculum developers from University's Institute for Teaching and Learning helped develop program educational objectives, courses, and the course goals. An engineering technology and engineering degree are closely related fields of study with differences in curriculum and career paths. Engineering emphasizes developing new theories, analysis methods, and advanced concepts to solve open-ended complex problems, while an Engineering Technology emphasizes hands-on application, real-world processes, and implementation. Engineering Technology coursework includes basic math-algebra, trigonometry, applied calculus with the focus on applications of engineering discipline. College-level science courses also emphasizes applied physics and chemistry. General education courses include topics such as natural, social, and behavioral sciences, history, visual and performing arts, writing and information literacy that are necessary for graduates from a four-year degree program. The curriculum is geared to combine traditional engineering concepts that are most relevant to address current and future challenges faced by manufacturing engineers. Since manufacturing technologies combine core principles of electrical, mechanical, and industrial engineering training along with management and leadership skills, engineers need to possess broad as well as applied skill sets in those areas. The BSET program offers hands-on knowledge and expertise to integrate theory and practice, solve real-world problems, conduct research and become independent learners [3]. The program will prepare students to use systems-based approaches to engage effectively in problem solving within complex, fast-paced manufacturing plants. The four-year curriculum was designed and presented during the 2019 ASEE Annual Conference [4].

Since the program is new, regional campuses had to explore outreach strategies and attract students to the major. One of the strategies was to have an overlap between engineering and engineering technology programs for the first year. This overlap of coursework would allow campuses to retain students and offer opportunity for students to explore engineering technology major and make an informed decision on which educational path to take. First-year courses such as physics, fundamentals of engineering and general education courses remain same for engineering and engineering technology students. In addition to these courses, new courses were developed to teach introductory topics in engineering technology in the first year. The curriculum is shared with the industry partners for feedback and revision to ensure the materials, topics and applications are in relevance with the current industrial operations in manufacturing. The BSET program is designed to meet the program educational outcomes for accreditation by Engineering Technology Accreditation Commission (ETAC) of ABET.

II. Criteria for ABET ETAC Accreditation

Since the program is offered at regional campuses, there was a need to carefully review the ABET ETAC requirements to ensure proper understanding of terminology and definitions. An ongoing process of assessment and continuous improvement lays the foundation of a successful program. As stated on the ABET website for assessment planning, the process is related to the following three criteria: Criterion 2: Program Educational Objectives, Criterion 3: Student Outcomes and Criterion 4: Continuous Improvement [1]. Accreditation will be assessed once students have graduated, in compliance with ABET accreditation protocol. The initial ground-breaking steps for establishing the program educational objectives was completed in Autumn 2019 [4]. ABET Criterion 3: Student Outcomes involve outcomes with an effective process of periodic review and revision of the outcomes.

Student outcomes for the baccalaureate degree programs under general criteria [5] include:

(1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined engineering problems appropriate to the discipline;

(2) an ability to design systems, components, or processes meeting specified needs for broadly defined engineering problems appropriate to the discipline;

(3) an ability to apply written, oral, and graphical communication in broadly defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;

(4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and

(5) an ability to function effectively as a member as well as a leader on technical teams.

Since the BSET program has a manufacturing focus, the program will provide graduates with instruction in technical and leadership skills necessary for manufacturing competitiveness and to enter careers in manufacturing process and systems design, operations, quality, continuous improvement, lean manufacturing, and sustainability. Hence, the program criteria include instruction of the topics as mandated by the Society of Manufacturing Engineers (SME):

a: materials and manufacturing processes;

b. product design process, tooling, and assembly;

c: manufacturing systems, automation, and operations;

d: statistics, quality and continuous improvement, and industrial organization and management; and

e: capstone or integrating experience that develops and illustrates student competencies in applying both technical and non-technical skills in successfully solving manufacturing problems.

For the purpose of this study, the ABET student outcomes from program criteria are named with the lead society's acronym SME such as SME_a, SME_b, SME_c, SME_d and SME_e.

III. Design an Assessment Process

ABET defines assessment as "a framework through which you can identify, collect and prepare data to evaluate the attainment of student outcomes and program educational objectives" [1]. It is a process of establishing guidelines and protocols which allow programs to evaluate outcomes, obtain feedback and make evidence-based decisions that lead to program improvement.

Development of an assessment process is dynamic and require significant planning and coordination. It is well known that higher education institutions face challenges in designing and establishing assessment mechanisms but most of these challenges are due to the nature and design of the program. Previous studies have shown that successful assessment strategies for assessment can be developed for programs with same curriculum offered at different campuses [6]. To develop a robust assessment mechanism, departments must create a team of experts and train them to oversee the assessment process and provide guidance to the administration on curriculum revision and changes to the program. The support from the management is essential to sustain the process and encourage faculty involvement. Industry partnership also plays a vital role in the curriculum development as well as assessment of goals. Feedback from the professionals while the courses are being developed helps embed real world scenarios into assignments and projects.

Assessment team and training

The assessment process began with the launch of the new program in Autumn 2020 and the team comprised of the executive director of the university's manufacturing institute, a faculty lead, course designers and faculty from two regional campuses. The team was trained on institutional data policy to ensure protection of the university's institutional data. Since the team is expected to work on assessment data, which includes student names, course numbers and grades, it is critical that the members be trained on data security, privacy, and compliance.

To automate the assessment process, colleges and departments rely on the learning management systems to assist with data collection and storage. Since the university uses Canvas learning management system, the team was required to complete the affiliate training. Additional training modules included Family Educational Rights and Privacy Act (FERPA) and CyberSecurity training.

Formation of assessment teams and establishing roles and responsibilities was encouraged by many researchers and the functions of an effective team has been discussed [7]. The assessment team was required to study the most recent version of the criteria carefully, determine timeline for sustainable process, schedule faculty meetings to discuss the assessment plan, obtain assessment data and faculty feedback each semester and provide recommendations for curriculum revision and continuous improvement.

Data Management System

Data collection is a critical part of assessment process. Therefore, it is necessary to have a centralized location where data can be stored, shared, and managed. It was decided that the cloud content management and file sharing services offered by the university will be used to avoid any privacy and data breach issues. Shared folders were created to store content for ABET accreditation process and assessment results. Since the BSET program is offered at four regional campuses, it is necessary to carefully organize the data relevant to each campus. Information about the program development, course offerings, faculty, syllabi, and assessment results, etc. reside on the cloud. Since it is the first engineering technology program at the university, the program will be seeking an initial accreditation which requires submitting the readiness review. Therefore, an effective strategy is to follow the readiness review template to organize the content. According to the readiness review document, folders were created and organized systematically.

Mapping Objectives to Student Outcomes

Four program educational objectives (PEOs) were developed for the BSET program in Spring 2019 [3]. Graduates are expected to possess the following skills:

PEO 1. Systems Thinking and Problem Solving: The successful student will be able to effectively solve problems by applying the appropriate engineering technologies, tools, and techniques within systems of equipment, controls, and people.

PEO 2. Professional Skills/Communication: The successful student will be able to demonstrate, appreciate, and master interpersonal communications skills in the modern workplace.

PEO 3. Business Management: The successful student will be able to understand business terminology, analyze the value of alternatives, and communicate their business, societal and global impacts effectively.

PEO 4. Continuous Improvement: The successful student will be able to optimize processes and systems with respect to quality, timeliness, and continuous improvement.

These PEOs are mapped to ABET student outcomes as seen in Table 1. It must be noted that as third- and fourth-year courses are being developed, the mapping in the table is expected to be revised.

		ABET Student Outcomes									
		1	2	3	4	5	SME_a	SME_b	SME_c	SME_d	SME_e
BSET Program	PEO1	x	x		x		x	x	X	x	x
	PEO2			x		x					x
	PEO3			x		x				x	x
	PEO4	x	x	x	x		x	x		x	x

Table 1: Mapping Program Educational Objectives of the BSET program to ABET Student Outcomes

Mapping Courses to Student Outcomes

ABET requires proper documentation and effective process for periodic review of student outcomes by all programs requesting accreditation. For past several years, direct assessment of student outcomes has become the keystone for engineering and engineering technology programs. Direct assessment involves data collection from tests, homework problems, projects, surveys, and other assessments in the course. It also requires analysis and interpretation of results to provide recommendations for changes to the courses. To perform the direct assessment, the team first mapped courses to student outcomes with a broad understanding of the topics to be covered in the courses. Since third- and fourth-year courses are not developed yet, the mapping is expected to change. The team then determined performance indicators that align well with the student outcomes and curriculum of the program. The performance indicators serve to assess the competencies. In order to assess the performance indicators, the assessment team solicited recommendations from faculty for mapping performance indicators to their course assessments. Based on the recommendations, the performance indicators were mapped to the course assessments including homework assignments, exams, projects, lab assignments and final presentations.

Since the program is new, the assessment team was concerned about the progress of the students and retention in the second year. Therefore, the rationale to begin assessment of student outcomes in the first semester was to ensure students' progress is monitored. Since the introductory courses are taken by all the students in the major, it was the best venue to evaluate student's performance. One of the unique qualities of this process is to focus on the assessment of the non-core courses such as mathematics and physics to evaluate student performance and recommend curriculum revision to maintain rigor. With the help of assessment, faculty were able to address the concerns with the students in their first semester and provide support for students struggling in the courses. Mathematics, physics, and engineering fundamentals courses are assessed in the first semester.

Due to the unique characteristic of this program, outcomes must be assessed at all regional campuses within the university system. So, the assessment team was tasked with scheduling meetings with the faculty to train them on assessment of outcomes in their courses. Another important factor with mathematics, physics and engineering fundamentals courses was the identification and segregation of the engineering technology students from engineering students for assessment purposes. So, the assessment team identified students who declared their major as engineering technology and shared that information with the faculty to perform assessment of only those students.

BSET Courses	**ABET Student Outcomes**									
	1	2	3	4	5	SME_a	SME_b	SME_c	SME_d	SME_e
Fundamentals of Engineering I			x							
Calculus I for Engineering Technology	x									
Calculus II for Engineering Technology	x									
Physics I for Engineering Technology	x									
Physics II for Engineering Technology	x									
Manufacturing Processes 1				x		x	x			
Introduction to Engineering Technology			x					x		
Fundamentals of Engineering II		x	x		x					
Manufacturing Processes 2		x		x	x	x	x			
Engineering Graphics			x					x		
Excel Adapted for Engineering									x	
Programming in C++	x									
Business Tools			x							
Electric Circuits				x						
Material Science with Applications				x		x		x		
Project Management					x					
Statistics with Applications in Quality			x	x					x	
Mechanical Processes		x				x	x			
Industrial Automation PLC 1	x	x	x	x	x			x		
Industrial Safety and Ergonomics	x							x		
Operations Management									x	
Industrial Automation PLC 2		x						x		
Facility Layout Integration		x		x			x			
Leader/Change Management			x		x					
Lean/Six Sigma					x					
Capstone 1										x
Industrial Robotics							x		x	x
Electrical Applications in Industry	x					x		x		
Capstone 2 - Green Belt					x					x

Table 2: Mapping BSET courses to ABET Student Outcomes

From the table, it is evident that each outcome has been mapped to at least two or three courses in the program and it was intentionally done to address lack of data for assessment. In case of course cancellation, data from another course could be assessed to measure the competence of the outcome. Also, this mapping will be revised based on faculty feedback after the initial offering of the courses.

Performance Indicators

Assessment of student outcomes requires establishing performance indicators to assess the competence related to the outcomes, creating a framework to identify, collect, and evaluate data and finally incorporating the results and feedback into curriculum to close the loop. Performance criteria, performance vectors and performance indicators have been described in many articles to be the guidelines through which performance could be measured [9, 10]. Performance indicators were developed in Summer 2020 and the assessment process began in Autumn 2020. For the purpose of this study, the ABET student outcomes are defined as student learning outcomes (SLOs). Performance indicators for the student learning outcome 1 is shown in Table 3. Remaining performance indicators are given in the appendix. In these initial stages of the program, it is expected that the effective assessment strategies will continue to evolve. At the conclusion of each semester, the assessment team will evaluate results and make informed decisions and provide guidance for revision of curriculum, performance indicators and their mapping. The assessment team strives to create and maintain an effective quality improvement process to ensure that the graduates are well prepared for their careers in manufacturing field.

ABET Student Learning Outcome	Performance Indicators: Student can……..	SLO Code
(1) An ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problem appropriate to the discipline	a) apply basic mathematical principles of algebra, trigonometry, calculus to model broadly defined manufacturing engineering problems	SLO1_a
	b) apply scientific principles used to solve broadly defined manufacturing engineering problems	SLO1_b
	c) apply engineering tools and/or methods to broadly defined manufacturing engineering problems	SLO1_c
	d) uses modern business/analytical/project management tools to broadly defined manufacturing engineering problems	SLO1_d

Table 3: Performance Indicators for ABET Student Learning Outcome 1

Assessment Tool and Rubrics

Canvas Learning Management was used for assessment of performance indicators and student outcomes. All the courses at regional campuses are delivered using the same learning management system and the most effective approach was to embed rubrics into Canvas course shells. This approach helps in providing support from course development experts to streamline the process for outcomes assessment using the learning management system. Rubrics were developed using standard 1 to 5 Likert scale with 5: Consistently exceeds expectations, 4: Exceeds expectations, 3: Meets expectations, 2: Needs Improvement, and 1: Inadequate. In

Canvas, the scales were consolidated into four main categories: 5-4: Exceed Expectations, 3: Meets Expectations, 2-1: Needs Improvement and 0: Inadequate.

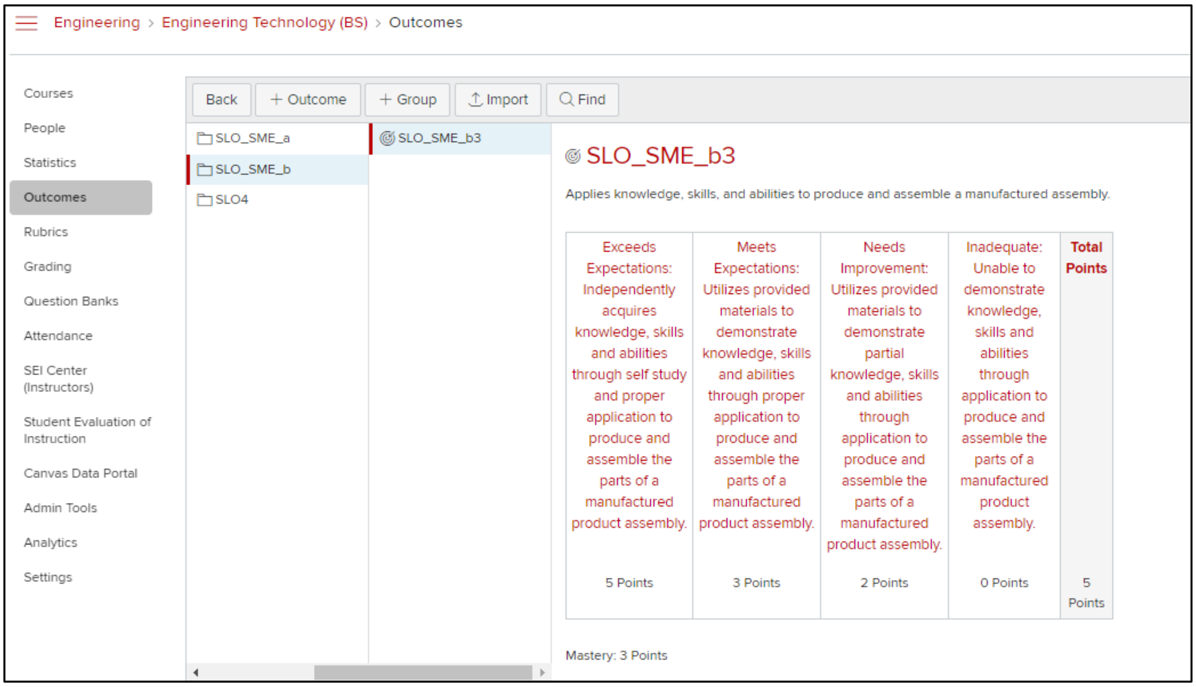

Figure 1: Canvas view of the Rubrics for Performance Indicator SLO_SME_b3 from administrative side

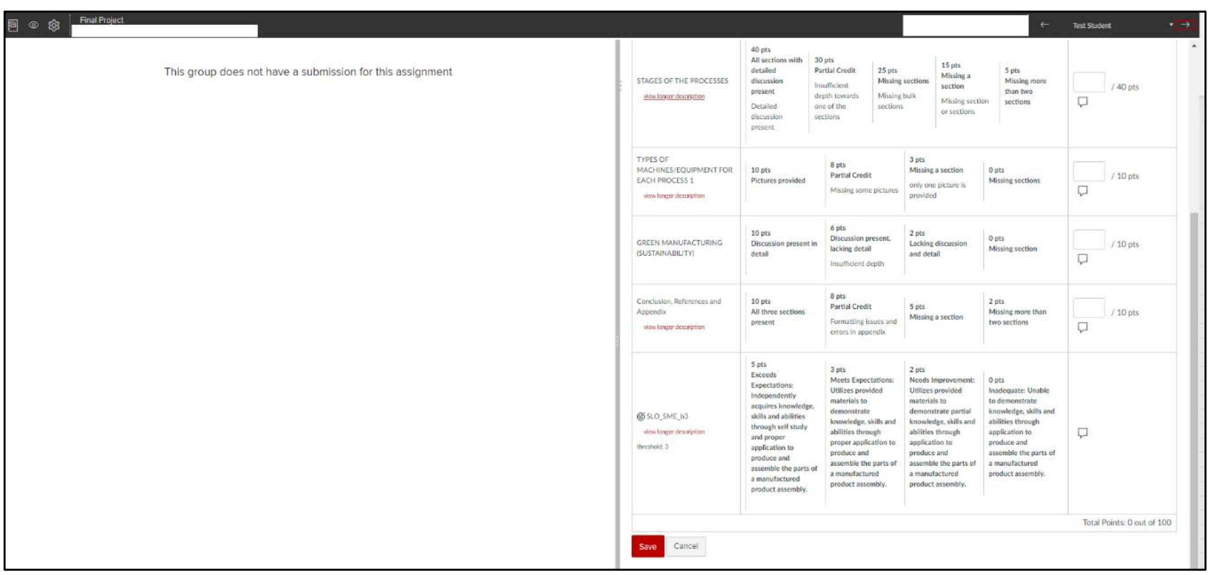

Figure 2: Canvas view of the rubrics for Performance Indicator SLO_SME_b3 from instructor side

Figure 1. shows the Canvas view of the rubric from the administrative side for performance indicator (SLO_SME_b3). The descriptors for each of these scales are determined by the

assessment team and then reviewed by the faculty for accuracy and alignment with the expectations in the course. Figure 2. shows the Canvas view of the rubric from the instructor side for the same performance indicator as in Figure 1. As it can be seen that the rubrics appear in the grading section of Canvas and is ready to be assessed by the instructor. Faculty training sessions were organized by the assessment team prior to the start of the semester and training materials were shared. Assessment team sent regular emails to faculty reminding them to complete the assessments in their respective courses.

At the end of the semester, each student received an assessment score on the scale of 1 to 5 indicating their performance on the assigned problem. At the conclusion of the assessment, instructors were required to download the spreadsheet from Canvas and upload it to the shared cloud centralized location along with the student artifacts from the course. The spreadsheets with assessment scores and student artifacts were evaluated by the assessment team.

Assessment Period

Once the rubrics are developed and imported into course shells, the assessment process could begin. The process must be periodic in order to allow continuous improvement. The assessment cycle is not yet determined for the program, however, the results from the assessment in the first semester will provide guidance to establish the cycle. The assessment team is planning on assessing some student outcomes in one semester and the remaining in another semester to distribute the workload among the faculty. With the current approach, it is expected that student outcomes will be assessed several times before their graduation which might enhance the quality of the program.

In the first semester when the program was launched, Autumn 2020, the outcomes (1), (3), (4), SME_a, SME_b and SME_c are assessed. The courses that were used for assessment were Mathematics – Calculus, Engineering Mathematics, Engineering Physics, Fundamentals of Engineering I and II, Introduction to Engineering Technology, Manufacturing Processes 1 and Engineering Graphics. Table 4 shows the Autumn 2020 schedule for assessment, which course was assessed for which outcome. The assessment cycle is supposed to be developed in Spring 2021 after learning from the results of Autumn 2020 assessment and instructor experience with the Canvas rubrics.

ABET Student Learning Outcomes	**Autumn 2020 Schedule**							
	Calculus I for ET	Calculus II for ET	Physics I for ET	Physics II for ET	Fundamentals of Engineering I	Introduction to ET	Manufacturing Processes I	Engineering Graphics
SLO1	x	x	x	x				
SLO3					x	x		x
SLO4							x	
SLO_SME_a							x	
SLO_SME_b							x	
SLO_SME_c						x		x

Table 4: Schedule for data collection and assessment of student learning outcomes in Autumn 2020

Assessment Results and Discussion

At the end of each semester in which a course is assessed, the instructor downloads the assessment of competence measured in the course from Canvas along with the student submissions. In addition, instructors will complete the curriculum worksheet with the information about the course numbers, schedule, course delivery mode (online, hybrid or in-person) and syllabus. Faculty meetings are arranged in the beginning of the semester to offer training on assessment, mid-semester check-in and at the end of the semester to collect assessment results and feedback. Any recommendations for improvement, either from the course instructor or from the assessment team are documented in the assessment summary document, which were stored on university's cloud storage. In Autumn 2020, courses were offered in online and hybrid formats due to COVID-19 restrictions and that eased the process of assessment since students were required to submit the work on Canvas. Evaluation of the accumulated data from assessment is a key factor in determining actions for program's continuous improvement. The collected information in the course portfolios were analyzed during term break and the results were disseminated during faculty meetings. The assessment team had established task structures and expectations for faculty to allocate time efficiently through regular meetings. The administrative support has also helped in communicating expectations to the faculty about this assessment process. The deans at the regional campuses played a key role in the assessment process encouraging the faculty member to train on the rubrics and assess students' performance in courses. Discussions during the faculty meetings and feedback via email resulted in expression of recommendations for closing the loop and promote equivalence and consistency among all regional campuses, setting the base for continuous improvement.

Results from Autumn 2020 assessments showed that the current mapping for most of the courses is accurate, however, instructors of Introduction to Engineering Technology course suggested that SLO_SME_c is not a good fit for the performance indicator or the student outcome. Therefore, this mapping will be removed for future assessments. It was also noted that the assessment of math and physics courses add a layer of complexity since these courses are offered in the College of Arts and Sciences and faculty at regional campuses use different assignments within courses. Therefore, it was decided that the math and physics courses will not be used for assessments. However, the Fundamentals of Engineering I and Fundamentals of Engineering II courses will still be used since they are offered in the College of Engineering and the curriculum changes are regulated by the college and course content remains consistent throughout all regional campuses. Assessment and feedback from all campuses will be gathered, a template of the assessment report generated for each outcome will be developed. A template for outcome is shown in the Table 5. below. For the SLO5, there is only one performance indicator, and it has been mapped to six courses. The results of assessment and the percent of students achieving the expected level of competence will be determined and summary of feedback along with the comments from the instructors will be compiled into this report. In addition, student's feedback will be collected in the form of end-of-course survey.

ABET Student Learning Outcomes - Performance Indicator (PI) Code	Criteria	Course	Assessment in course	% Meeting Expectations - Campus 1	% Meeting Expectations - Campus 2	% Meeting Expectations - Campus 3	% Meeting Expectations - Campus 4	Summary of Feedback and Comments from Instructors and Students
(5) an ability to function effectively as a member as well as a leader on technical teams - SLO5	75%	Fundamentals of Engineering II	CATME Team Evaluations					
	75%	Manufacturing Processes II	Team Evaluation survey					
	75%	Project Management						
	75%	Leader and Change Management						
	75%	Lean and Six Sigma						
	75%	Capstone 2 - Green Belt						

Table 5: Template of the assessment report generated at the conclusion of the assessment cycle

IV. Analysis of the Approach

As programs develop their assessment process, there is not simply one strategy that would work. Previous studies have shown that all assessment methods include some bias and have limitations [8]. In this study, it was observed that the assessment process will be tedious due to the program being offered at regional campuses. Since the program will submit the self-study report for ABET accreditation on behalf of all the campuses, it is critical that the same curricula be offered, and assessment results be combined to provide instructions for continuous improvement. After careful consideration of the criteria and policies, the assessment team has determined the assessment approach to ensure compliance with the different criteria and equivalency between regional campuses. The most appealing characteristic of this ABET assessment process is building collaborations among regional campuses and identifying strengths and weaknesses to improve teaching efficacy. The assessment team believes that this approach is effective for the program and it will continue to evolve as student enrollments increase and higher-level courses start being offered at these campuses.

V. Best Practices

Some of the best practices from this assessment process will be listed below in hopes that they provide guidance for new programs that are planning to prepare for ABET accreditation. Some practices apply to programs that are offered at different campuses.

- Establishing an assessment team and training the members on the fundamentals of assessment, policies, and criteria for ABET accreditation and other pertinent policies of the institution are some preliminary steps for an effective assessment process for the BSET program.

- A data management system for online materials and storage is a necessary investment for institutions. Technological advancements have imposed use of online educational platforms not only for teaching but also for assessments and evaluation of goals and outcomes. Collection and categorization of student work from the first-year to the final-year courses allows learning, development, and progress to be exhibited at the time of ABET accreditation site visits. Therefore, maintaining course portfolios for assessment of each outcome will be helpful.
- Collaboration with the faculty is critical for any process within the institution since they are on the front lines interacting with the students on a regular basis. Therefore, assessment of student outcomes, course evaluations and any revisions must involve faculty. For programs offered at different campuses, faculty collaborations will result in an inclusive environment and help attain uniformity across the board.
- Support from administration is necessary for academic processes. Program chairs, college deans and directors will help in communicating expectations to faculty and staff and reinforcing the assessment tasks to accomplish goals within the expected timeline.
- Curriculum developed for the program and offered at all campuses must maintain rigor and equivalence using same syllabi. Depending on the instructor's expertise in the area, homework assignments, exams, lab exercises and projects could differ in complexity or depth. Therefore, the assessment team should work together with faculty to develop course assessments.
- Developing performance criteria or indicators that are mapped closely to the student outcomes helps in assessing attainment of the outcomes. Also, developing rubrics that relate to student performance on a particular activity and embedding them into the learning management system not only help disseminate expectations but also offer standardized assessment across all students in the program.
- To ensure that graduates of the program are being prepared to tackle current challenges in the industry, it is important to building partnership with manufacturing firms. These collaborations will also help support curriculum revisions, co-op experiences and professional development for students.

Summary and Future work

In general, this paper provides guidelines for new engineering technology programs developing assessment process for ABET accreditation. Although ABET provides updates every year about criteria for accreditation, there is no standard process prescribed by ABET for assessment and attainment of student outcomes. This is because curriculum, instruction, personnel, and processes vary from program to program. The authors believe that this paper will help institutions offering programs at multiple campuses develop a robust process for assessment of student outcomes. The paper will help guide the programs in developing courses with institutional missions and program educational objectives in mind. Also, mapping program educations objectives to ABET outcomes and developing performance indicators will help align the coursework to ABET criteria for ease of assessment of student outcomes.

At the conclusion of the first year, the assessment team is planning to evaluate the assessment results and establish guidelines for continuous improvement process, which is informally called "closing-the-loop" for the first-year courses. More data needs to be collected to evaluate the efficacy of the program; however, improvements in the courses at the conclusion of each year serves to be beneficial in the long term. The next step for the team is to develop an assessment cycle that allows for systematic distribution of workload for the members and the faculty teaching the courses. Although performance indicators and rubrics help with the direct assessment of outcomes, ABET suggests utilizing indirect assessments techniques as a secondary approach. Evidence that supports achievement of knowledge and learning imparted by the instruction can be collected by employing multiple assessment methods. A comprehensive assessment program will contain both direct and indirect assessment methods to maximize strength and validity of an approach. The assessment team will create exit surveys for students and faculty to assess the organization of the content, attainment of course goals and alignment of the coursework to ABET student outcomes mapped to it. In addition to feedback from students and faculty, input from administration and industry partners will be solicited.

The assessment team will have a lot more to learn in order to establish a cohesive plan aligned with ABET accreditation process. Therefore, the team will be participating in annual symposium organized by ABET and other conferences to learn about valuable resources, refine ideas and approach and get feedback as they embark upon the journey of accrediting the BSET program.

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