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Integrating Canvas and Power BI for Evidence-Based Assessment of ABET Student Outcomes in a Mechanical Engineering Program

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Abstract

This paper presents a systematic approach to program-level assessment in a Mechanical Engineering program that integrates Canvas-based data collection, standardized rubrics, and Microsoft Power BI visualizations to evaluate ABET Student Outcomes. Program outcomes are defined within Canvas, aligned with ABET criteria, and mapped to assessment tasks across the curriculum, while standardized rubrics embedded in assignments ensure consistent evaluation of student performance and enable automated collection of assessment data. The paper details the Canvas assessment process, including how outcomes are linked to coursework to streamline data collection and management. Assessment data are exported and organized for analysis in Microsoft Power BI, where dynamic dashboards illustrate outcome achievement levels, performance trends, and cohort comparisons, providing insights for program improvement and evidence-based decision-making. This integrated approach reduces the manual burden of data handling, enhances the reliability and transparency of assessment results, and promotes continuous program improvement. By combining a learning management system with advanced visualization tools, this approach transforms program assessment and offers a replicable model for other engineering programs seeking to improve the efficiency, effectiveness, and impact of ABET-related assessment processes.

Introduction

Assessment of student learning outcomes is a central component of ABET accreditation and a critical driver of continuous improvement in Mechanical Engineering (ME) programs. However, many programs struggle to balance the need for rigorous, outcomes-based assessment with the realities of faculty workload, data management, and consistency across multiple courses and instructors. These challenges are particularly troublesome in large programs with complex curricula.

Accreditation by ABET requires engineering programs to demonstrate systematic assessment and continuous improvement of student outcomes. While most programs collect substantial assessment data, challenges remain in ensuring consistency across courses, minimizing faculty workload, and translating raw data into actionable insights. These challenges are often exacerbated in large programs with multiple sections, instructors, and service courses.

To address these challenges, the Mechanical and Nuclear Engineering Department at Kansas State University has implemented an integrated assessment framework leveraging existing institutional tools: the Canvas LMS, Oracle PeopleSoft Campus Solutions (Student Information System), Microsoft Power BI, and Microsoft Forms. Canvas is used as the primary mechanism for collecting outcome-based assessment data through standardized rubrics. PeopleSoft connects the outcome data to the student demographic metadata providing the opportunity to filter by gender, major, transfer, first generation, GPA, ethnicity, and/or academic status. This data is provided in aggregate form to Power BI, thus anonymizing the student identity so that the software can provide visualization, and analysis of those data. Forms provides a repository for

instructors to provide details about how they completed the assessment and upload examples of assessed work. This paper documents the structure of this assessment system, the processes used to collect and analyze data, and the ways in which results are reviewed and used to support continuous program improvement.

Assessment Framework and Data Collection

The ME program employs a structured process to ensure that ABET Student Outcomes drive assessment activities. At the beginning of each accreditation cycle, or following significant curriculum changes, the Undergraduate Committee (UGC) reviews all required courses in the curriculum to determine their alignment with the ABET Student Outcomes. While many courses may support a given outcome, a minimum of three courses per outcome are designated for formal assessment and provided to the faculty in the form of an assessment matrix as shown in Figure 1. These courses are intentionally distributed across the curriculum to capture student performance at multiple stages of academic development. In addition, every required curriculum course is aligned with at least one student outcome.

ABET Outcome	ME 101	ME 212	ME 400	ME 512	ME 513	ME 533	ME 535	ME 570	ME 571	ME 573	ME 574	ME 575
1			■	■	■	▒	▒	▒	■	▒	▒	■
2	▒					■				■	▒	■
3	■	▒				▒	■			▒	▒	■
4	■					▒				▒	■	▒
5	■						▒	▒		▒	■	■
6							■	■				▒
7	■									■		■

▒ Class related to outcome
■ Class related to outcome and assessed

Figure 1: Courses Assessed Matrix

Performance Indicators and Rubrics

Each ABET Student Outcome is evaluated using a set of clearly defined performance indicators that articulate observable and measurable student achievement. For example, ABET Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics [1] includes performance indicators related to problem and input data identification, formulation, evaluation, and solution verification. Each performance indicator is assessed using a four-level rubric (Poor, Inadequate, Adequate, Exemplary), with intentionally general descriptors to allow application across multiple courses and assessment artifacts.

As noted by Burrack and Thompson [2], the seven ABET Student Outcomes are implemented within Canvas through its “Outcome” functionality, a feature restricted to users with administrative privileges. Standardized rubrics corresponding to these outcomes are centrally curated and made available for import into any Canvas assignment designated as an assessment artifact. This centralized approach ensures uniformity in evaluation practices while preserving instructional autonomy, enabling faculty to select appropriate assessment artifacts such as

examinations, homework assignments, laboratory reports, or project presentations that are aligned with course objectives and programmatic requirements.

Assessment Artifacts and Documentation

Due to the broad nature of the standardized outcome rubrics, faculty are required to submit detailed assessment documentation for each assessment instance. This process begins with faculty reviewing the assessment matrix (Figure 1) to identify appropriate assessment artifacts within their courses. While a single artifact may address all performance indicators for a given outcome, multiple artifacts may be selected when necessary to ensure comprehensive coverage.

For each assessment instance, faculty complete a structured assessment plan using Microsoft Forms. This form captures essential data, including semester, course, instructor, and outcome assessed. Faculty also specify how each performance indicator is evaluated within the chosen artifact and define criteria for categorizing student performance as Poor, Inadequate, Adequate, or Exemplary. This documentation enables the program coordinator to verify alignment with programmatic assessment requirements and maintain consistency across courses. Additionally, the form supports uploading electronic copies of assessment artifacts to a secure, cloud-based repository, providing direct evidence for accreditation review and facilitating transparent, auditable assessment practices.

Use of Canvas for Outcome-Based Data Collection

Canvas serves as the primary data collection platform for the assessment system. Faculty assesses student work by completing outcome-based rubrics within Canvas (Figure 2) and submission of those completed rubrics automatically populates the program-level assessment database in the university's data warehouse. This process captures not only rubric scores, but also contextual metadata such as course, instructor, term, and selected student demographic attributes drawn from the university's student information system.

Criteria	Ratings				Pts
1.1 Problem and Input Data Identification threshold: 3.0 pts	4 pts Clearly identifies the problem and all associated key input data.	3 pts Identifies the problem along with some key input data.	2 pts Does not clearly identify the problem; may identify some key input data.	1 pts Fails to identify the problem type or key input data needed.	4 pts
1.2 Problem Formulation threshold: 3.0 pts	4 pts Correctly formulates the problem, demonstrating how the physical theory can be expressed mathematically, including any approximations or deficiencies.	3 pts Expresses applicable theory mathematically with minor errors; may not fully express limitations of the theory.	2 pts Struggles to connect theoretical formulations; many parts are missing or incorrect; does not express limitations of the theory used.	1 pts Uses formulas from class/lecture without understanding their applicability to the problem.	4 pts
1.3 Evaluation threshold: 3.0 pts	4 pts Correct solution approach and accurate results.	3 pts Correct solution approach with minor errors.	2 pts Correct solution approach but with significant errors in computations or units.	1 pts Incorrect solution approach. Unable to solve.	4 pts
1.4 Solution Verification threshold: 3.0 pts	4 pts Carefully checks the solution, ensuring appropriate units, correctness, and relevance.	3 pts Most of the solution is checked and shown to be correct and relevant to the problem.	2 pts Attempts to check the solution but inadequately verifies accuracy or relevance to the problem.	1 pts Incorrect units or grossly incorrect solution; no attempt to verify the solution.	4 pts

Figure 2: An example of a Canvas rubric

Importantly, student anonymity is preserved in the assessment database. Demographic data are used only in aggregate form to support disaggregated analyses (e.g., by major or transfer status) when appropriate.

The primary advantage of leveraging Canvas for assessment lies in its ability to eliminate redundant data entry and manual aggregation, significantly reducing faculty workload. By embedding outcome-based rubrics directly into assignments, faculty evaluate student work as part of their normal instructional workflow, while assessment data are automatically captured for program-level analysis. This integration ensures that data collection occurs seamlessly without requiring additional steps outside the teaching process.

In some cases, rubric scores may contribute to or fully determine the assignment grade in Canvas; however, this is not a requirement. Alternatively, rubrics can be applied within non-graded modules, enabling outcome-based assessment without influencing final course grades. This flexibility allows programs to maintain a clear distinction between grading and assessment, preserving instructional autonomy while ensuring systematic data collection.

Data Visualization and Analysis Using Power BI

The assessment database generated through Canvas is integrated with Microsoft Power BI by Kansas State University's Office of Assessment. Power BI provides highly customizable dashboards that enable dynamic filtering and visualization of assessment data based on associated metadata. This capability supports disaggregated analyses, such as identifying differences in performance between continuing students and transfer students, thereby informing targeted strategies for continuous program improvement. For Mechanical Engineering programs, a critical feature is the ability to filter by major, allowing faculty to review results for an entire service course while isolating data for Mechanical Engineering students enrolled in that course. This functionality enhances the precision and relevance of assessment insights, ensuring that program-level decisions are grounded in accurate, outcome-specific evidence.

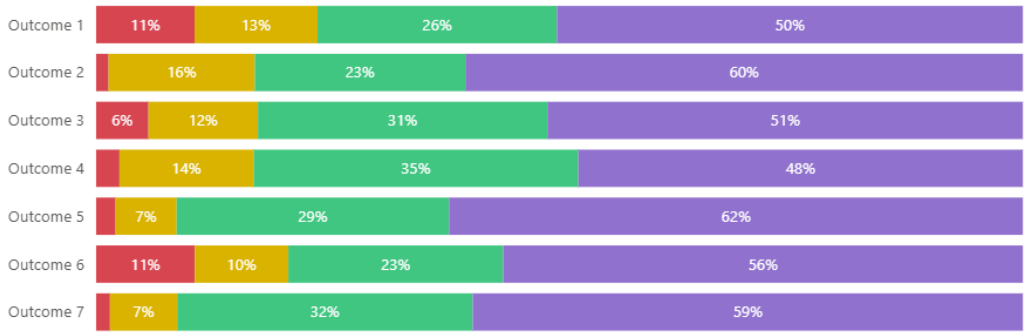

Figure 3: Microsoft Power BI's display of aggregated assessment data by outcome (Red - Poor, Yellow - Inadequate, Green - Adequate, or Purple – Exemplary)

After filtering the data appropriately, Power BI enables automated generation of interactive dashboards that display outcome attainment (Figure 3), percentage of students achieving proficiency (defined as Adequate or Exemplary) (Figure 4), and longitudinal trends. Users can

filter results by outcome, performance indicator, course, or assessment cycle, allowing rapid identification of strengths and areas for improvement.

Additionally, users can drill down into a specific outcome to see the achievement levels of each performance indicator inside an outcome as well as the proficiency of each performance indicator. At finer levels of detail, Power BI enables analysis by performance indicator or individual course, supporting targeted instructional interventions.

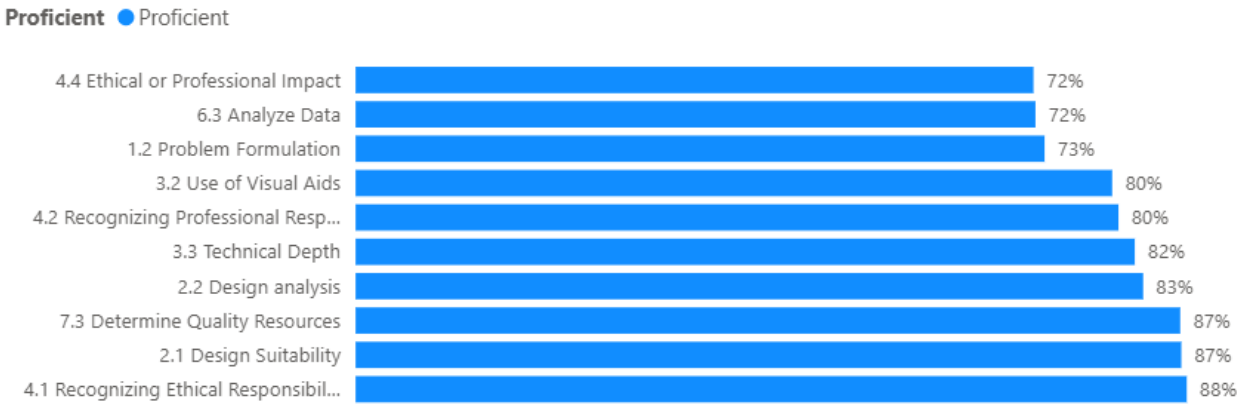

Figure 4: Power BI's display of performance indicators by proficiency (attaining a 3 or 4 defined as Adequate or Exemplary in the rubric)

If a tabular format is preferred by the end user, Power BI can generate detailed tables that complement graphical dashboards, as shown in Figure 5. Tabular visualizations are particularly valuable for accreditation documentation, faculty review, and longitudinal analysis, as they allow stakeholders to extract exact values. By offering both interactive dashboards and customizable tables, the system accommodates diverse user preferences and ensures that assessment results are accessible, transparent, and actionable.

Achievement Levels	1) Poor		2) Inadequate		3) Adequate		4) Exemplary	
Outcome	%	#	%	#	%	#	%	#
2029 Outcome 1								
1.1 Problem and Input Data Identification	6%	19	5%	14	12%	35	77%	206
1.2 Problem Formulation	8%	23	18%	51	31%	91	43%	118
1.3 Evaluation	12%	35	15%	44	19%	56	54%	153
1.4 Solution Verification	16%	45	8%	23	6%	19	70%	197

Figure 5: Power BI's tabular visualization of assessment results

Review Process and Continuous Improvement

Assessment results are reviewed through a structured, multi-stakeholder process. Data are presented and discussed during the annual faculty retreat, Industrial Advisory Council meetings, student advisory board meetings, and Undergraduate Committee deliberations. Faculty are required to document course-level continuous improvement actions as part of their annual reviews, ensuring accountability and follow-through.

Power BI visualizations play a central role in these discussions by enabling faculty to quickly identify trends and drill down into specific outcomes or courses. When deficiencies are identified, targeted instructional changes are implemented and tracked in subsequent assessment cycles.

Discussion and Lessons Learned

Several key lessons have emerged from implementation of this integrated assessment system. First, embedding assessment within existing instructional workflows significantly increases faculty participation and data quality. Second, standardized rubrics improve consistency without constraining instructional creativity. Third, interactive data visualization tools such as Power BI are essential for transforming large datasets into actionable insights.

After implementing this approach to ABET data collection, the program gained the ability to filter assessment results across multiple dimensions such as outcome, performance indicator, and course level to track student progress longitudinally throughout the curriculum. This visibility has enabled the program to respond more effectively to ensure that students achieve proficiency by the time they reach their capstone courses.

For example, analyses conducted through Power BI revealed that students were not consistently meeting expectations related to ethical and professional responsibilities. This insight prompted targeted curricular changes, including revised content in the introductory course and the addition of an equivalent one-credit hour module on professional ethics in the capstone sequence. Since these changes have been implemented, assessment scores in this area have shown a substantial positive shift.

Perhaps most importantly, the system transforms assessment from a compliance-oriented task into a substantive component of program decision-making. Faculty engagement with assessment data has increased markedly due to improved accessibility, transparency, and ease of use. Prior to the system's implementation, assessment results were presented only during selected faculty meetings, with summaries and visualizations prepared by the undergraduate program coordinator. This approach often limited interpretation to the coordinator's perspective and limited broader faculty insight.

With the adoption of Power BI, all faculty members can now independently access the dashboard, explore the data from their own viewpoints, and contribute interpretations. This expanded access has generated more meaningful discussions and has helped identify unsuspected trends. Furthermore, because the data are continuously updated and available on demand, faculty can consult the dashboard whenever questions arise or when they need evidence to inform course revisions or adjustments.

It is important to acknowledge that the implementation of this system also revealed areas in need of refinement. As with any new process, integrating the system across multiple courses presented initial challenges. In response to recurring faculty questions, the program developed a series of ten-minute walkthrough videos that explained how to import and use the rubrics in a course as well as how to fill out the Microsoft Form. This significantly improved implementation and reduced faculty frustration.

Additionally, the use of a general rubric for each outcome occasionally resulted in varied interpretations of how the criteria should be applied within specific courses. To address this, the faculty collectively reviewed the rubrics during a department meeting and incorporated required explanatory statements into the Microsoft Form used for assessment submissions. These statements document how each instructor applied the rubric in their course context. The undergraduate program coordinator then reviews these submissions to help maintain a consistent interpretation of the outcomes and ensure alignment across the curriculum.

Conclusions and Future Work

The integration of Canvas and Microsoft Power BI provides a scalable and systematic framework for assessing ABET Student Outcomes in engineering programs. By embedding standardized rubrics into existing instructional workflows, the approach minimizes faculty workload while ensuring consistent, auditable data collection. Automated aggregation reduces human error and delivers a structured reporting process that meets accreditation requirements with greater efficiency and transparency.

Beyond compliance, this model transforms assessment into a strategic tool for continuous improvement. Power BI's advanced analytics and interactive dashboards enable longitudinal trend analysis, demographic disaggregation, and evidence-based decision making. These capabilities allow programs to identify performance gaps, implement targeted interventions, and foster a culture of accountability and improvement. This technology enabled framework elevates assessment from an obligation to a cornerstone of academic excellence and program sustainability.

Looking ahead, one potential enhancement involves connecting the assessment responses captured in Microsoft Forms directly to Power BI. Integrating these sources would consolidate an even greater portion of the program's assessment data into a single, accessible platform to support faculty decision-making. Additionally, if faculty enter their qualitative comments through Microsoft Forms during assessment discussions, those comments could be automatically imported into a Power BI table. This integration would streamline data collection, reduce manual transfer, and further strengthen the continuity and transparency of the assessment process.

References

[1] ABET Engineering Accreditation Commission, *Criteria for Accrediting Engineering Programs*, ABET, Baltimore, MD.

[2] D. Thompson and F. Burrack, "Canvas (LMS) as a Means for Effective Student Learning Assessment Across an Institution of Higher Education," *Journal of Assessment in Higher Education*, vol.2, no. 1, 2021.