Creating a Course "Dashboard" to Continually Assess and Improve the Quality of Education

Tabe Ako Abane, Purdue University at West Lafayette (COE)

Tabe Abane is a PhD student in Engineering Education at Purdue University. He holds an MA in Leadership in Education (2023) from Liverpool John Moores University (UK), a Bachelor of Technology in Renewable Energy (2018), and a Five-Year Diploma in Mechanical Engineering and Teaching (2015) from the University of Bamenda (Cameroon). His dissertation research focuses on how engineering students develop systems thinking in socioenvironmental contexts. Using Social Constructivism and Mental Models theory, he examines collaborative approaches to systems thinking. As part of his research assistantship, he contributes to projects aimed at improving doctoral engineering student retention, advisor relationships, and laboratory transitions, enhancing graduate student success and academic experiences.

Maxell Lumbera, Purdue University at West Lafayette (COE)

Maxell Lumbera is a PhD student at the School of Engineering Education at Purdue University. He holds a Master's and Bachelor's degrees in Civil Engineering from the Institute of Civil Engineering, University of the Philippines Diliman. His current research focuses on engineering instructors' experiences in implementing pedagogies in their classrooms. He is an Assistant Professor at the University of the Philippines Diliman, with more than 10 years of experience teaching in undergraduate civil engineering. He has been the coordinator of various team-taught courses such as engineering mechanics, undergraduate research projects, and capstone courses. He has also worked as the Deputy Director for Academic Programs in his institution, giving him familiarity to quality assurance and program assessment. He is also an active member of the Philippine Institute of Civil Engineers, Inc., serving as a technical speaker for environmental and energy engineering and civil engineering education inter-specialty group.

Dr. Robin Adams, Purdue University at West Lafayette (PWL) (COE)

Robin S. Adams is Professor in the School of Engineering Education at Purdue University and holds a PhD in Education, an MS in Materials Science and Engineering, and a BS in Mechanical Engineering. She researches cross-disciplinarity ways of thinking, ac

Creating a Course Dashboard to Continually Assess and Improve the Quality of Education

Abstract

This paper develops a program dashboard designed to continuously assess and improve the quality of education. Continuous assessment and improvement of education are essential for maintaining the quality and integrity of educational excellence and achieving effective learning outcomes. To be successful in this effort, a program dashboard is needed as a tool and platform for providing real-time visibility into student learning gains. The purpose of this study is to design an interactive program dashboard for an 8-week workshop-style design course in an engineering program that visualizes students' performance based on nine compassionate design assignments graded in a grading management system (Gradescope). This pilot study uses a systematic stepwise methodology to capture eight steps in gathering and processing data toward generating a dashboard for continuous quality improvement. The dashboard uses pie charts to visualize how students develop specific skills for each assignment, a bar chart that visualizes students' scores and progress for individual assignments, and radar plots that show students' actual achievements and reflections on their learning. Our findings indicate that visualizing students' learning in a dashboard provides opportunities to tailor feedback to address their specific learning needs and supports student scaffolding. Continuous quality improvement requires both a mechanism to collect feedback on students' learning and a dashboard that visualizes how the feedback is used to improve the quality of instruction and learning integrity.

Keywords: Dashboard, Continuous quality improvement, Grading, Feedback, Rubric

Introduction

Educational institutions face increasing pressure to demonstrate the effectiveness of their instructional methods, particularly due to accountability measures and accreditation requirements [1]. One standard method used for continuous quality improvement (CQI) of instruction is through different feedback mechanisms [2] for instance, anonymous course review by students at the end of course sessions. In this process, students provide anonymous evaluations through feedback, which is part of internal quality assurance conducted at the end of each course [3], [4]. However, there is disagreement among experts and educational stakeholders on the effectiveness and benefits of these practices in the quality improvement of instruction [4]. There is, therefore, a growing need for a shift towards more innovative and effective ways to qualitatively and quantitatively assess the quality of instruction. This pilot study focuses on designing a dynamic program dashboard as a tool that offers instructors a clear picture of students’ overall performance and how they engage with feedback. With this information, instructors can better support students' learning journeys. Dynamic dashboards of this nature highlight areas where students are successfully scaffolding their knowledge and where they might need additional support, leading to a more personalized and impactful learning experience.

Background and Literature Review

This section discusses continuous quality improvement, continuous assessment, and the importance of aligning learning objectives, assessments, and rubrics. Additionally, the literature emphasizes the significance of feedback and concludes with the importance of visualizing feedback through data analytic dashboards.

Continuous Quality Improvement (CQI) in education is a complex process that utilizes multiple methods to evaluate and improve educational practices. A key method for capturing CQI in education is implementing continuous assessment of student learning outcomes (SLOs) [5]. Implementing continuous assessment involves seamlessly integrating the teaching-learning process, offering real-time feedback, identifying areas of strength and weakness, and allowing for adjustments to instructional strategies that enhance student engagement [6], [7].

Increased engagement is closely linked to improved learning outcomes and greater overall satisfaction with the educational experience [8]. Findings indicate that students' perceptions of service quality in higher education are closely connected to their experiences [9]. This is especially significant because student retention and performance are vital indicators of program and institutional success and accreditation. For instance, ABET 2025-26 criteria for accrediting engineering programs maintain Criterion 4, Continuous Improvement, as a separate criterion [10]. Criterion 4 explicitly mandates that the program must consistently employ suitable, documented processes to assess and evaluate the extent to which student outcomes are achieved. The results of these evaluations must be systematically used as input for the program’s continuous improvement efforts.

Clarity and alignment between learning objectives, assessment, and rubric-based feedback clarify expectations for both instructors and students [11], prompt students to evaluate their work based on a set of criteria, and promote a sense of ownership and responsibility for their learning [2], [12]. This self-assessment process is integral to continuous improvement, as it empowers students to take an active role in their learning, which is essential for achieving Continuous Quality Improvement (CQI) in instruction [13], [14]. Rubrics also allow instructors to reflect on how their assessments align with learning objectives [13], [15].

A rubric provides an opportunity for tailored and actionable feedback, which is essential for enhancing educational quality. Studies reveal that structured feedback systems significantly improve the quality of feedback provided to students [16]. This iterative approach enables instructors to adjust their instructional strategies based on student performance, leading to better educational outcomes [17]. To maximize its effectiveness, feedback should always be aligned with clear learning objectives [18]. This alignment ensures that students understand what is expected of them and receive constructive guidance on how to improve, fostering a more impactful and personalized learning experience.

One way to picture the effectiveness of feedback on students' learning is through data analytics [19]. Studies have discussed the importance of real-time feedback in learning environments, particularly through the use of learning analytics dashboards as tools for visualizing learning progress and outcomes [20], [21]. A dashboard is a data visualization tool that showcases key

performance indicators (KPIs) and metrics in a clear and accessible way [19]. In the educational context, these dashboards compile and display data as charts and diagrams on student performance and program outcomes [22], facilitating systematic tracking of student progress and program effectiveness. For educators, dashboards can simplify workflows and improve communication within teams, which is crucial for collaborative educational settings [23]. By displaying data in a clear and understandable format, dashboards allow educators to share insights with students and colleagues, promoting a culture of transparency and ongoing improvement [24]. This approach supports informed self-assessment, planning and enhances the overall educational experience for students. Additionally, dashboards can inspire students by empowering them to self-regulate their learning and track their progress. This self-regulation is key to cultivating a growth mindset, encouraging students to take ownership of their educational journey and actively engage with their development [25].

Continuous assessment is an essential component of the educational framework [26], especially in design education, as it plays a crucial role in guiding both teaching and learning practices [27] and enhancing academic performance [28]. Therefore, creating a comprehensive assessment model can also offer a systematic approach to evaluating educational quality across multiple dimensions, such as student satisfaction and learning outcomes. This model can help ensure that all aspects of the educational experience are thoroughly and consistently assessed, leading to improvements in teaching methods and overall academic performance [29].

Description and Justification of the Course

The course is a one-credit and eight-week workshop-style course. These workshops aim to build an understanding of interdisciplinary design practices through readings, discussions, and activities. They provide a jumping-off point for launching capstone projects. The workshops focus on identifying opportunities for compassionate design through iterative cycles of research, problem framing, solution generation, and exploration of options regarding their potential achievements, usability, and implementation. This course was chosen for this study due to its two unique features: first, since the course is relatively short, each assessment can be carefully and thoroughly reviewed to identify elements that can be transferred to longer courses. Second, unlike traditional courses with structured answers, each assignment allows students to bring unique perspectives into design tasks, offering a very unstructured approach to creating a rubric. These unique features of course assessments provided opportunities to inform both structured and unstructured courses. For this course, the outcomes were as follows:

- Identify, explain the benefits of, and demonstrate the appropriate use of informed designing practices for defining a design problem and/or opportunity;
- Identify, explain the benefits of, and demonstrate the appropriate use of interdisciplinary thinking practices;
- Demonstrate effective communication;
- Make knowledge explicit in ways that support continual learning; and
- Contribute meaningfully and participate in collaborative inquiry

Gradescope

This work used Gradescope to assess students' scripts. Gradescope is a cutting-edge online grading platform developed by a team at Stanford University [30], simplifying the assessment process in educational environments. It effectively manages grading a wide range of handwritten and digitally submitted assessments, including exams, homework, and lab reports [31]. It significantly reduces grading time for large classes [32], and identifies common errors and trends in student understanding, which can inform instructional strategies and curriculum adjustments. Gradescope is now utilized by over 2,600 institutions [33], demonstrating its widespread acceptance and usefulness in education.

Methodology

This study used a systematic stepwise methodology. The stepwise methodology is a systematic approach used in statistical analysis, particularly in regression models, to select the most relevant predictors for a model [34], [35], [36]. The stepwise methodology has been adapted for non-statistical analysis that involves a sequence of well-defined steps guiding researchers or practitioners through the various stages of a project or study [37], [38], it ensures that each phase is fully completed before moving on to the next [39], [40]. This method was chosen for this study because of its structured nature that promotes better organization, transparency, and reproducibility of results.

Table 1 reports the eight distinct but interrelated steps we used to gather the information for designing the dashboard. Steps 1 through 5 occur in the order of appearance; however, each was validated through one-hour weekly discussions with the program director and course instructor (Step 7), both of whom had extensive experience in design education. Their input and expert judgment were vital in defining the decision context and guiding the decision-making process.

Step 6 involved re-grading the scripts. While the project started with a new cohort of students, we have been using the scripts from previous cohorts, which have already been evaluated by the course instructor. As such, we referred to this process as 're-grading the scripts'. We re-graded, without the knowledge of the previous marks assigned to them, to generate the data needed to design the dashboard for continuous improvement. This approach removed any pressure on the consequences of final grades on students' academic progress and allowed us to review the scripts several times objectively.

Step 8 was supplementary but necessary. Since the instructor, course outline, grading management system, and assessments were unchanged (except for the new cohort of learners), class observations allowed us to gauge the current classroom dynamics and observe any trends with the course instructor and the entire research team.

Table 1. Steps, Items, Description, and Justification of Information Gathering

Steps	Item	Description and Justification
1	Learning objectives	We reviewed existing literature on design thinking, identified and addressed any duplicate or redundant language in the learning objectives, and ensured that the course objectives are aligned with the course content.
2	Alignment between the learning objectives and assessments	We matched each assessment item with the corresponding learning objectives at this step.
3	Rubric	Since students' responses and answers varied significantly, the researchers developed a rubric that defined five key elements: doing research, making observations, problem framing, idea/reasoning fluency, and scaffolding.
4	Harmonized Rubric	We compared our rubric with that of the instructor. We looked for commonalities, discussed differences with the research team, and established a harmonized rubric. At this stage, we also checked for alignments in the learning objectives, assessment, and rubric.
5	Feedback	We developed dynamic feedback with specific keywords to address potential areas where students could lose points and what they needed to improve on subsequent assessments. Although fixed and generic feedback would simplify grading, it might seem automated to students, so generic feedback was reserved for areas where all students faced similar challenges.
6	Re-grading scripts in Gradescope	First, we graded the scripts independently and made notes in Gadescope visible to other instructors. Second, one of us acted as a student in Gradescope while the other continued as an instructor. This was done to visualize the rubric and feedback from the students' perspectives. This iterative process was repeated multiple times for each assignment to adjust the rubric and feedback.
7	Stakeholder Engagement	We validated each step through discussions with the principal investigators, who each served as the program director and course instructor.
8	Class observation	We observed the new cohort for approximately 70% of the eight-week course. During the observation, we engaged in a few group discussions and observed overall student engagement.

Re-grading Compassionate Design Assessments

Students completed a set of nine assignments collectively referred to as Compassionate Designs (CDs). Compassionate Design (CD) tasks and skills are reported in Table 1. The numbers represent the number of questions asked per skill for each CD. For example, Compassionate Design 1 (CD1) had 1 question related to "doing research," CD2 had 2 questions related to doing research, and CD3 had zero (0) questions on doing research. Similarly, "making observations" had 2 questions in CD1, 3 in CD2, 2 in CD3, 0 in CD4, and so on. These provided the framework for tailoring and developing the rubric and providing feedback.

Table 2. Compassionate Design (CD) tasks versus Skills

Compassionate Design	**CD1**	**CD2**	**CD3**	**CD4**	**CD5**	**CD6**	**CD7**	**CD8**	**CD9**
Skills									
Doing Research	1	2	0	2	5	1	5	4	3
Making Observations	2	3	2	0	1	4	1	3	5
Problem Framing	3	4	1	3	4	3	2	2	5
Idea/reasoning fluency	4	2	3	4	3	5	3	1	0
Scaffolding	0	5	4	1	2	2	4	5	3

Course Dashboard

In the process of designing the dashboard, we have seen two elements of engineering design that come to play, namely solution iteration and client feedback. Through this project, we have seen the development of the dashboard from an initial abstract idea to a more structured one. This is where the feedback from the program head and the course instructor became valuable. With the regular weekly meetings with them, we were able to confirm, validate, and refine ideas as we see them fit. Shown in **Figure 1** are two stages of dashboard development, at least two weeks apart, from brainstorming to design iteration 1, before we transformed the dashboard into its current form as shown in **Figure 2**.

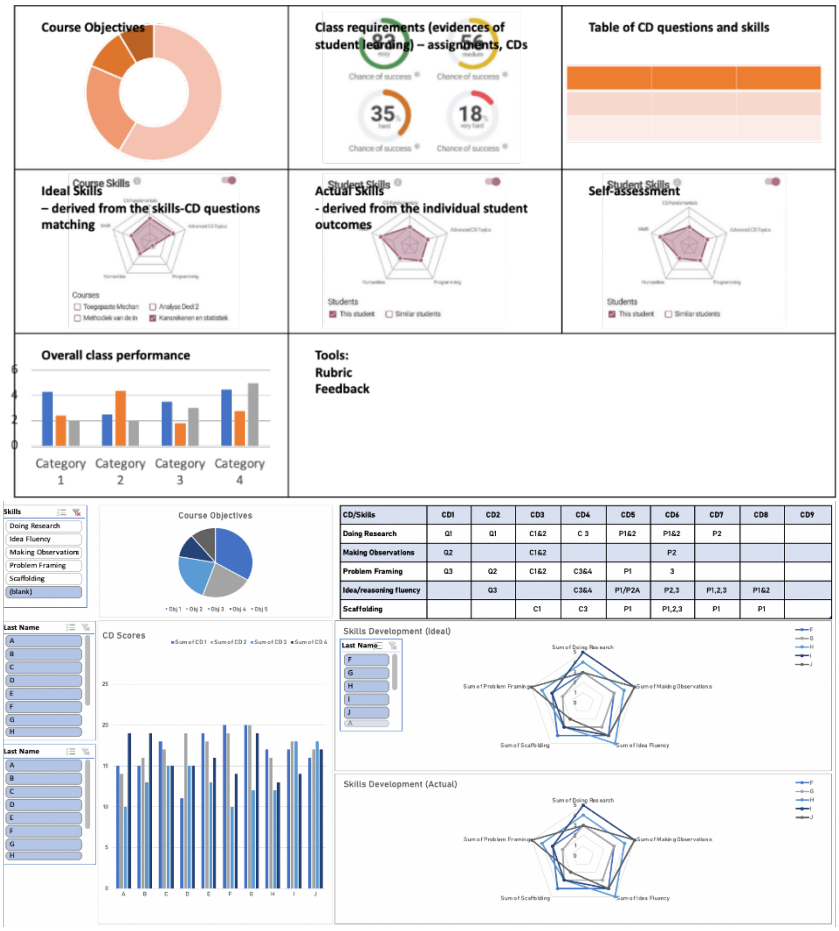
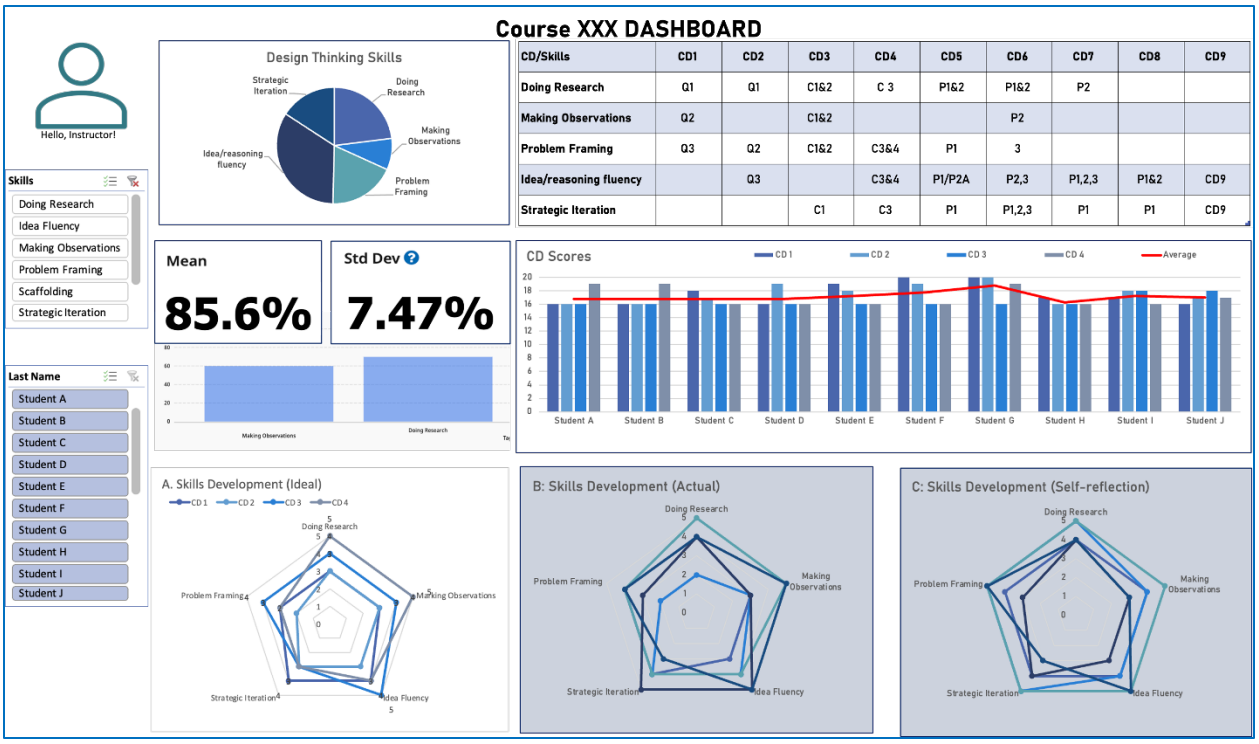


Figure 1. Dashboard models showing development from brainstorming stage (top) to design iteration (bottom)

Data for the analysis were gathered from students' performance grades on the Compassionate Design tasks. The Gradescope facilitated the grading and collection of this performance data. The data was then further analyzed in MS Excel, utilizing different dashboard configurations to gain deeper insights into students' performance and progress. In particular, we made use of pie and bar charts, and radial plots/statistical plots. Mean score and standard deviation were directly available in Gradescope. While the dashboard in **Figure 2** is initially designed to facilitate the immediate assessment of the course instructor, we could easily tweak some of its elements to provide a student version of the dashboard.



CD/Skills	CD1	CD2	CD3	CD4	CD5	CD6	CD7	CD8	CD9
Doing Research	Q1	Q1	C1&2	C 3	P1&2	P1&2	P2		
Making Observations	Q2		C1&2			P2			
Problem Framing	Q3	Q2	C1&2	C3&4	P1	3			
Idea/reasoning fluency		Q3		C3&4	P1/P2A	P2,3	P1,2,3	P1&2	CD9
Strategic Iteration			C1	C3	P1	P1,2,3	P1	P1	CD9

Figure 2. Sample dashboard for an eight-week engineering design course

We provide the descriptions of the major elements of the sample dashboard in **Figure 2** from top to bottom, then left to right.

- Basic information: This includes the course instructor's profile and drop-down menus to filter out specific skills and/or student data. In so doing, the instructor could have a bird's eye view of the class performance vis-a-vis the student's individual performance. As such, specific interventions can be planned out for the entire class or few students, depending on the context needed.
- Pie chart: It shows the percentage of each design thinking skill covered in the course. This was directly deduced from **Table 2**. This element could trigger self-reflection on the side of the instructor and could serve as a basis of classroom decisions should activities are seen to feed towards a certain skill or outcome as opposed to a more balanced approach.
- Table of skills: This table maps out and connects classroom activities, in this case, compassionate design (CD) exercises, to skill development. In the context of this course, analysis of these activities revealed five core skills cultivated through the course: doing research, making observations, problem framing, idea/reasoning fluency, and scaffolding. Notably, CD6 stands out for addressing all five skills, particularly emphasizing problem-framing and knowledge-building through targeted research. This aligns with the assignment's aim to delve deeper into specific compassionate design issues, fostering a holistic understanding among students. Such mapping empowers students, instructors, and program heads to visualize the sequential progression of skills development. In this course, we have seen the progression of task complexities, starting with those requiring

foundational abilities like doing research and making observations and moving towards to those emphasizing higher-order skills such as idea/reasoning fluency and scaffolding.

- Mean and Standard Deviation: The dashboard also features descriptive statistics summarizing student performance. Metrics such as class mean and standard deviation are already available in the Gradescope and could help provide a high-level overview to the course instructors. Keeping them visually accessible to instructors is beneficial to facilitate within semester adjustments and more detailed analyses.
- Bar Chart: The bar chart shows students' individual scores and progress in learning across each CD. Raw scores from Gradescope are processed further to produce these plots visible in the dashboard that are useful to track individual student's progress across individual requirements. If the class statistics are useful for overall class adjustments, these bar charts are helpful to identify specific students who need further support and to track the impact of such personalized interventions across the semester.
- Radial Plots (A, B, and C): Finally, the radial plots on the bottom part of the dashboard provide three perspectives on skill development: **A-intended (ideal), B-actual, and C-self-assessed**. Comparing these lenses highlights the alignment or potential misalignment between instructional goals and student outcomes. For example, discrepancies between intended and actual skill development might indicate areas where instructional strategies could be adjusted. Similarly, variations between actual and self-assessed skills provide insight into students' metacognitive abilities and perceptions of their learning journeys. The radial plots are also a good example of how we intend to make the development of the students visible when it comes to specific skills. As they progress throughout the semester, we expect the instructors and students to see how the compassionate design exercises contribute to their skills development.

What makes this current version of the dashboard stronger compared to the previous versions is its greater emphasis on the integrity and quality aspects of the continuous quality improvement cycle. Program integrity components (i.e., pie chart and table) show the course's intended learning outcomes through specific classroom activities, while program quality components (i.e., mean and standard deviation report, bar chart, and the three radial plots) describe the actual student learning. The information on whether the course widens or narrows the gap between program integrity and quality can be displayed in this dashboard.

Our dashboard integrates several key elements to track metrics and indicators over time for both individual students and the entire class. This setup supports detailed data visualizations and reporting on student performance trends. The dynamic and interactive features of the dashboard ensure that instructors have real-time access to the most current information. For instance, if a significant discrepancy between the ideal and actual skill development is observed, instructors can immediately adjust their lesson components. This proactive approach is unlikely to occur if instructors rely solely on student feedback collected at the end of the semester. By leveraging this dashboard, educators can make timely and informed decisions, ultimately enhancing the learning experience and improving overall student outcomes.

Future Works

This study primarily relied on data from previously graded assignments, which allowed for a retrospective analysis of student performance, skill development, and course alignment. While this approach provided valuable insights, it also posed limitations, particularly the absence of real-time interactions and iterative feedback processes that are essential to a learner-centered educational environment. Future research should extend this study by implementing it in different classroom settings, where dynamic feedback loops between students and instructors can be captured. Such a setting would allow us to evaluate not only the outcomes but also the processes through which students develop skills and achieve course objectives. Moreover, we also see the need for not only a dashboard interface for instructors but also an interface for students to see the gains they make in their learning and areas for improvement.

Conclusion

Ultimately, the success of any educational program hinges on its ability to continuously adapt and improve. The dashboard developed in this study represents a significant step towards realizing this goal by providing a powerful tool for data-driven decision-making and continuous quality improvement. By creating a dynamic and interactive program dashboard for an eight-week engineering design course, the study demonstrates the potential of leveraging technology to enhance the teaching and learning experience. The study addresses the growing need for innovative methods to assess and improve the quality of engineering instruction, particularly in light of increasing pressure to demonstrate program effectiveness and meet accreditation requirements. The interactive and dynamic dashboard offers substantial benefits to all educational stakeholders. For instructors, it serves as a powerful tool for data-driven decision-making, enabling them to refine instructional strategies, provide targeted feedback, and adapt their teaching to better meet students' needs. For students, the dashboard enhances their learning experience by offering transparency into their progress and fostering a sense of accountability for their development. Moreover, by providing clear and actionable insights, the dashboard promotes collaboration and shared responsibility among program heads, instructors, and students, reinforcing a culture of continuous improvement.

Acknowledgments

We acknowledge Dr. Morgan Hynes for granting us access to his class for observations, providing the rubric of his class, and contributing to developing the methodology for this work.

References

[1] J. P. Spillane, J. L. Seelig, N. L. Blaushild, D. K. Cohen, and D. J. Peurach, "Educational System Building in a Changing Educational Sector: Environment, Organization, and the Technical Core," *Educ. Policy*, vol. 33, no. 6, pp. 846–881, Sep. 2019, doi: 10.1177/0895904819866269.

[2] C. Slown *et al.*, "California State University Monterey Bay: A Model of Iterative Assessment Practice," *Assess. Update*, vol. 34, no. 3, pp. 1–16, May 2022, doi: 10.1002/au.30299.

[3] P. C. Abrami, S. d'Apollonia, and P. A. Cohen, "Validity of student ratings of instruction: What we know and what we do not.," *J. Educ. Psychol.*, vol. 82, no. 2, pp. 219–231, Jun. 1990, doi: 10.1037/0022-0663.82.2.219.

[4] P. Spooren, B. Brockx, and D. Mortelmans, "On the Validity of Student Evaluation of Teaching: The State of the Art," *Rev. Educ. Res.*, vol. 83, no. 4, pp. 598–642, Dec. 2013, doi: 10.3102/0034654313496870.

[5] R. I. Urofsky and C. L. Bobby, "The Evolution of a Student Learning Outcomes Focus in the CACREP Standards in Relation to Accountability in Higher Education," *Couns. Outcome Res. Eval.*, vol. 3, no. 2, pp. 63–72, Dec. 2012, doi: 10.1177/2150137812452562.

[6] R. Hernández, "Does continuous assessment in higher education support student learning?," *High. Educ.*, vol. 64, no. 4, pp. 489–502, Oct. 2012, doi: 10.1007/s10734-012-9506-7.

[7] P. Juric, M. Brkic Bakaric, and M. Matetic, "Motivational Elements in Computer Games for Learning Mathematics," *Int. J. Emerg. Technol. Learn. IJET*, vol. 16, no. 10, p. 275, May 2021, doi: 10.3991/ijet.v16i10.20417.

[8] N. Holmes, "Student perceptions of their learning and engagement in response to the use of a continuous e-assessment in an undergraduate module," *Assess. Eval. High. Educ.*, vol. 40, no. 1, pp. 1–14, Jan. 2015, doi: 10.1080/02602938.2014.881978.

[9] M. Yavuz and D. Gülmez, "The Assessment of Service Quality Perception in Higher Education," *TED EĞİTİM VE BİLİM*, vol. 41, no. 184, Apr. 2016, doi: 10.15390/EB.2016.6187.

[10] "Criteria for Accrediting Engineering Programs, 2025 - 2026," ABET. Accessed: April 29, 2025. [Online]. Available: http://abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2025-2026/

[11] R. E. Tractenberg, "The Assessment Evaluation Rubric: Promoting Learning and Learner-Centered Teaching through Assessment in Face-to-Face or Distanced Higher Education," *Educ. Sci.*, vol. 11, no. 8, p. 441, Aug. 2021, doi: 10.3390/educsci11080441.

[12] P. Dawson, "Assessment rubrics: towards clearer and more replicable design, research and practice," *Assess. Eval. High. Educ.*, vol. 42, no. 3, pp. 347–360, Apr. 2017, doi: 10.1080/02602938.2015.1111294.

[13] M. Miknis, R. Davies, and C. S. Johnson, "Using rubrics to improve the assessment lifecycle: a case study," *High. Educ. Pedagog.*, vol. 5, no. 1, pp. 200–209, Jan. 2020, doi: 10.1080/23752696.2020.1816843.

[14] A. A. A. Hasan, "Effect of Rubric-Based Feedback on the Writing Skills of High School Graders," *J. Innov. Educ. Cult. Res.*, vol. 3, no. 1, pp. 49–58, Aug. 2022, doi: 10.46843/jiecr.v3i1.52.

[15] University School of Education, Guru Gobind Singh Indraprastha University, New Delhi 110078, India, S. Gupta, and S. Chauhan, "Exploring the Use of Rubrics as a Self Assessment Tool for Pre-service Teachers," *Int. J. Inf. Educ. Technol.*, vol. 10, no. 10, pp. 781–786, 2020, doi: 10.18178/ijiet.2020.10.10.1458.

[16] S. V. Flynn and D. G. Hays, “The Development and Validation of the Comprehensive Counseling Skills Rubric,” *Couns. Outcome Res. Eval.*, vol. 6, no. 2, pp. 87–99, Dec. 2015, doi: 10.1177/2150137815592216.
[17] E. Liang, S. Singhal, J. Yang, and A. Kumar, “Cut Down, Continue, Commence: Resident and Attending Perceptions of a Standardized, Face-to-Face Feedback System,” *MedEdPublish*, vol. 10, no. 1, 2021, doi: 10.15694/mep.2021.000001.1.
[18] B. Wisniewski, K. Zierer, and J. Hattie, “The Power of Feedback Revisited: A Meta-Analysis of Educational Feedback Research,” *Front. Psychol.*, vol. 10, p. 3087, Jan. 2020, doi: 10.3389/fpsyg.2019.03087.
[19] C. Vieira, P. Parsons, and V. Byrd, “Visual learning analytics of educational data: A systematic literature review and research agenda,” *Comput. Educ.*, vol. 122, pp. 119–135, Jul. 2018, doi: 10.1016/j.compedu.2018.03.018.
[20] J. Han, K. H. Kim, W. Rhee, and Y. H. Cho, “Learning analytics dashboards for adaptive support in face-to-face collaborative argumentation,” *Comput. Educ.*, vol. 163, p. 104041, Apr. 2021, doi: 10.1016/j.compedu.2020.104041.
[21] K. Verbert *et al.*, “Learning dashboards: an overview and future research opportunities,” *Pers. Ubiquitous Comput.*, Nov. 2013, doi: 10.1007/s00779-013-0751-2.
[22] Y. Yilmaz *et al.*, “Developing a dashboard for program evaluation in competency-based training programs: a design-based research project,” *Can. Med. Educ. J.*, Apr. 2022, doi: 10.36834/cmej.73554.
[23] D. Dowding *et al.*, “Dashboards for improving patient care: Review of the literature,” *Int. J. Med. Inf.*, vol. 84, no. 2, pp. 87–100, Feb. 2015, doi: 10.1016/j.ijmedinf.2014.10.001.
[24] C. Boscardin, K. B. Fergus, B. Hellevig, and K. E. Hauer, “Twelve tips to promote successful development of a learner performance dashboard within a medical education program,” *Med. Teach.*, vol. 40, no. 8, pp. 855–861, Aug. 2018, doi: 10.1080/0142159X.2017.1396306.
[25] A. Vázquez-Ingelmo, F. J. García-Peñalvo, R. Therón, and M. Á. Conde, “Representing Data Visualization Goals and Tasks through Meta-Modeling to Tailor Information Dashboards,” *Appl. Sci.*, vol. 10, no. 7, p. 2306, Mar. 2020, doi: 10.3390/app10072306.
[26] A. Moura, A. Graça, A. MacPhail, and P. Batista, “Aligning the principles of assessment for learning to learning in physical education: A review of literature,” *Phys. Educ. Sport Pedagogy*, vol. 26, no. 4, pp. 388–401, Jul. 2021, doi: 10.1080/17408989.2020.1834528.
[27] T. T. Olkaba and G. O. Bongase, “Practices and challenges of continuous assessment in colleges of teachers’ education in the west Oromia region, Ethiopia,” *Sci. Pedagog. Educ.*, vol. 0, no. 3(36), pp. 4–15, Apr. 2020, doi: 10.15587/2519-4984.2020.196346.
[28] S. O. Sangoniyi and A. M. Gbolagade, “RELATIONSHIP CONNECTING CONTINUOUS ASSESSMENT AND EXAMINATION SCORES IN MATHEMATICS IN SOUTH-WEST NIGERIA COLLEGES OF EDUCATION,” *J. Educ. Pract.*, vol. 6, no. 1, pp. 35–47, May 2022, doi: 10.47941/jep.859.
[29] R. Marciniak, “Quality Assurance for Online Higher Education Programmes: Design and Validation of an Integrative Assessment Model Applicable to Spanish Universities,” *Int. Rev. Res. Open Distrib. Learn.*, vol. 19, no. 2, May 2018, doi: 10.19173/irrodl.v19i2.3443.
[30] N. Chen, Z. Dong, H. Yang, F. Li, and X. Ma, “A study of marking utility models based on principal component analysis and integer programming,” *Highlights Sci. Eng. Technol.*, vol. 62, pp. 137–147, Jul. 2023, doi: 10.54097/hset.v62i.10436.

[31] Chima Abimbola Eden, Olabisi Oluwakemi Adeleye, and Idowu Sulaimon Adeniyi, “A review of AI-driven pedagogical strategies for equitable access to science education,” *Magna Sci. Adv. Res. Rev.*, vol. 10, no. 2, pp. 044–054, Mar. 2024, doi: 10.30574/msarr.2024.10.2.0043.

[32] J. L. Falconer, “Grading Exams and Homework More Efficiently and Effectively,” *Chem. Eng. Educ.*, vol. 53, no. 2, 2019, doi: 10.18260/2-1-370.660-108014.

[33] V. H. Gonzalez, S. Mattingly, J. Wilhelm, and D. Hemingson, “Using artificial intelligence to grade practical laboratory examinations: Sacrificing students’ learning experiences for saving time?,” *Anat. Sci. Educ.*, vol. 17, no. 5, pp. 932–936, Jul. 2024, doi: 10.1002/ase.2360.

[34] M. Wang, J. Wright, A. Brownlee, and R. Buswell, “A comparison of approaches to stepwise regression on variables sensitivities in building simulation and analysis,” *Energy Build.*, vol. 127, pp. 313–326, Sep. 2016, doi: 10.1016/j.enbuild.2016.05.065.

[35] N. Sun, S. Yang, and W. W. Yeh, “A proposed stepwise regression method for model structure identification,” *Water Resour. Res.*, vol. 34, no. 10, pp. 2561–2572, Oct. 1998, doi: 10.1029/98WR01860.

[36] J. M. Wagner and D. G. Shimshak, “Stepwise selection of variables in data envelopment analysis: Procedures and managerial perspectives,” *Eur. J. Oper. Res.*, vol. 180, no. 1, pp. 57–67, Jul. 2007, doi: 10.1016/j.ejor.2006.02.048.

[37] G. A. Antoniou, G. Biondi-Zoccai, F. Versaci, and S. A. Antoniou, “A Stepwise Approach to Systematic Reviews and Meta-analyses of Endovascular Interventions,” *J. Endovasc. Ther.*, vol. 27, no. 5, pp. 805–817, Oct. 2020, doi: 10.1177/1526602820939084.

[38] J. J. Michalek, F. M. Feinberg, and P. Y. Papalambros, “Linking Marketing and Engineering Product Design Decisions via Analytical Target Cascading*,” *J. Prod. Innov. Manag.*, vol. 22, no. 1, pp. 42–62, Jan. 2005, doi: 10.1111/j.0737-6782.2005.00102.x.

[39] S. Kennedy-Clark, “Research by Design: Design-Based Research and the Higher Degree Research student,” *J. Learn. Des.*, vol. 6, no. 2, pp. 26–32, Sep. 2013, doi: 10.5204/jld.v6i2.128.

[40] F. Copola Azenha, D. Aparecida Reis, and A. Leme Fleury, “The Role and Characteristics of Hybrid Approaches to Project Management in the Development of Technology-Based Products and Services,” *Proj. Manag. J.*, vol. 52, no. 1, pp. 90–110, Feb. 2021, doi: 10.1177/8756972820956884.