Scalable Competency Assessments as an alternative to threshold assessment

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ABSTRACT

CONTEXT

In Outcomes-based Education, the evaluation of a student's attainment of the learning outcomes is assessed by their demonstration of competency in the assessments. However, in a traditional threshold hurdle environment, the students might only demonstrate competency in 50% of the learning outcomes. Competency hurdles are common in the field of medicine, where they are often applied to critical demonstrations of competency, such as clinical placements. By applying competency hurdles to engineering assessments, we can ensure that a particular learning outcome (and associated Practice Domains) is evidenced for every student passing the unit. In this study, we implemented competency hurdles on targeted assessments in a unit of study.

PURPOSE

The purpose of the research was to determine how student performance can be improved when replacing threshold-based hurdles with competency-based hurdles in electrical and computer systems engineering units.

APPROACH

A core unit at the undergraduate first-year level was selected for revision. The feasibility of the competency hurdle, including available staffing and cost, was considered when developing a revised assessment regime. The revised units were delivered in October 2024 and Semester 1, 2025. The new assessment competency hurdles that directly map to specific learning outcomes are evaluated via comparative cohort measures between like-offerings on performance and student feedback.

OUTCOMES

Using competency hurdles instead of threshold hurdles enables better mapping of student success against a specific learning outcome. This enabled the provision of more targeted feedback to revise specific skills and gives students the chance to improve student engagement on a weekly basis.

RECOMMENDATIONS

Designing the assessment regime around key competency criteria, along with marked assessments for baseline knowledge, is better than listing every piece of assessment as a "threshold" hurdle requirement.

KEYWORDS

Assessment, Outcomes-Based Education, Competency, Hurdles

Introduction

A hurdle is a compulsory requirement for a student to pass an assessment. Threshold hurdles are assessment conditions that require students to attain a minimum or 'threshold' mark in order to satisfy the hurdle requirement. In this context, the threshold is typically set at 45% of the available marks. In contrast, competency hurdles are binary pass/fail assessments where students must demonstrate satisfactory achievement of all specified pass criteria to pass the hurdle requirement. These two hurdle types are central to many higher education assessment frameworks, but raise significant concerns when compared against contemporary pedagogical paradigms, particularly in the light of the shift towards outcomes-based education (OBE) and competency-based learning (CBL).

Recent developments in learning pedagogy, supported by advances in technology and institutional policy reforms, have exposed fundamental limitations in traditional assessment regimes. These regimes rely heavily on ‘threshold’ hurdles applied across the two dominant assessment categories – in-semester (continuous) assessments, and final assessments. A fundamental limitation of threshold-based assessment regimes is their inability to ensure that each student has individually achieved the intended learning outcomes without additional safeguards such as assessment mapping. For instance, a student may pass a unit by attaining 50% of the total available marks; however, this does not guarantee that any specific learning outcome has been satisfactorily demonstrated. Rather, it is possible for students to perform well in certain areas while failing to show competence in others, thereby undermining the validity of the overall pass as evidence of comprehensive learning. The assumption that a cumulative mark of 45% in a given hurdle category equates to satisfactory learning is therefore misguided, as it does not necessarily align with the attainment of each assessed outcome (Biggs & Tang, 2011).

In contrast, competency hurdles are more aligned with the principles of OBE, where the emphasis is on whether students can demonstrate specified skills or knowledge, rather than on their relative performance across a distribution of marks. Competency-based assessment regimes seek to ensure that all students meet predefined standards, thereby improving the validity and fairness of assessment (Spady, 1994; Harden, 2007). These approaches are especially pertinent in professional degrees, such as engineering, where graduates are expected to demonstrate minimum standards of competence for accreditation and practice (Engineers Australia, 2021).

Furthermore, the growing emphasis on blended and online learning has shifted the function of in-semester assessment towards driving engagement through formative tasks. However, this shift has also been accompanied by grade inflation, as participation is often rewarded regardless of demonstrated competence (Bloxham, Hughes, & Adie, 2016). In engineering education specifically, the professional emphasis on team-based assessment—while pedagogically valuable—can also dilute individual accountability, further contributing to inflated grades and undermining the purpose of rigorous, outcome-aligned assessment practices.

Thus, a key challenge for higher education assessment is reconciling traditional threshold-based assessment with competency-oriented regimes that better reflect both educational intent and professional standards. Universities must consider a transition to more robust competency hurdles to ensure that assessments are valid measures of student achievement, particularly in disciplines where outcome assurance is critical.

Ethical approval for this study was granted by the Monash University Human Research Ethics Committee (MUHREC) project number 2025-47220-128246.

Context

The first-year engineering program within the Faculty of Engineering at Monash University is underpinned by an outcomes-based education (OBE) framework. In this model, the course-level learning outcomes are explicitly aligned with the Engineers Australia Stage 1 Competency Standard, which articulates the graduate competencies expected for professional accreditation and practice (Engineers Australia, 2021).

At the unit level, learning outcomes are constructed using the Structure of Observed Learning Outcome (SOLO) taxonomy, which provides a hierarchical model for articulating learning complexity—from surface to deep learning—through the use of clearly defined verbs (Biggs & Collis, 1982). These verbs inform both curriculum design and assessment construction, promoting constructive alignment, a principle where learning activities and assessment tasks are intentionally designed to support the achievement of the intended learning outcomes (Biggs & Tang, 2011). As a result, the assessment in each unit is directly linked to both the cognitive level of the outcomes and the professional competencies required of graduates, thereby enhancing the transparency and accountability of student achievement (Harden, 2007).

The unit selected for this study is a large, first-year core engineering unit, with annual enrolments ranging between 2000 and 2500 students, delivered across two international campuses. This unit serves as a foundational component of the engineering curriculum and is structured into two distinct assessment streams: a practical component and a theoretical component. The practical component includes hands-on activities, which are assessed through a design project and laboratory practical classes, enabling students to develop and demonstrate applied skills in problem-solving and engineering practice. The theoretical component comprises engagement-based and knowledge-assessment tasks, including weekly pre-workshop quizzes, workshop participation quizzes, a mid-semester test, and a final examination, each designed to assess student understanding of fundamental engineering concepts.

The unit's delivery model reflects a blended learning approach, where asynchronous materials such as weekly pre-workshop readings and instructional videos provide students with foundational knowledge. These materials are complemented by face-to-face workshops, which facilitate peer interaction, problem-solving, and instructor-led clarification. Learning is further reinforced through practical classes, which link theoretical knowledge with hands-on learning, and weekly practice problem sheets, which serve to consolidate student understanding and provide opportunities for self-assessment and formative feedback (Garrison & Vaughan, 2008).

This unit thus provides a rich context for examining the effectiveness and limitations of current assessment structures—particularly in terms of threshold versus competency hurdles—and their alignment with outcomes-based education principles and professional competency standards.

The unit has eight Learning Outcomes (LO), which are presented in the unit handbook (Monash University, 2025):

1. Discuss requirements of a smart system from component to integrated perspective.
2. Define programs using Python, discern problem-solving strategies in decomposing problems using algorithms and describe software engineering processes.
3. Select fundamental circuit analysis techniques to solve problems in circuits that contain common electrical and electronic components.
4. Propose a design solution in response to a given scenario through requirements and functional analysis, evaluate that solution from an integrated system perspective.
5. Identify appropriate engineering tools and techniques to develop and validate a solution.
6. Identify the ethical considerations of data collection and analysis in engineering designs that may impact the suitability of solutions.
7. Describe project progress and outputs to stakeholders in review meetings, demonstrations and documentation.
8. Identify roles and responsibilities within a team and reflect on self and team behaviours that contribute to the successful conduct of a project.

Implementation of a CBE Assessment Regime

In response to concerns about the limitations of traditional threshold hurdle-based assessment, the selected first-year engineering unit underwent a systematic redesign of its assessment scheme, guided by principles of minimal assessment and competency-based education (CBE). The primary objective of this redesign was to remove threshold hurdles and implement competency hurdles, ensuring that all students who pass the unit demonstrate that they meet specific learning outcomes

(LOs). This shift enables more accurate verification of student learning and skill attainment, aligning with professional accreditation standards (Harden, 2007; Spady, 1994). An additional goal of the redesign was to minimise the impact on teaching staff by adapting or re-appropriating existing assessments rather than creating entirely new assessment tools, thereby supporting sustainable change management in assessment practice (Boud & Falchikov, 2006).

This transition is outlined in Table 1, which shows how components of the previous assessment regime were translated into new competency assessment modalities. It illustrates the continuity and adaptation of assessment tasks, highlighting which components were retained, revised, or repositioned within the new framework. By strategically mapping existing assessments to competency-aligned tasks, the redesign struck a balance between pedagogical integrity and operational feasibility.

Table 1: Translation of the existing assessment to new assessment modalities.

<table>
<tr><th>Prior Assessment Item</th><th>Weight</th><th>Type</th><th>Hurdle</th><th>LO</th></tr>
<tr><td>Pre-Workshop Quiz</td><td>1.25</td><td>F</td><td rowspan="7">T</td><td>2,3</td></tr>
<tr><td>SE Workshop Worksheet</td><td>1.25</td><td>F</td><td>2</td></tr>
<tr><td>Lab Worksheet</td><td>4</td><td>F</td><td>2,3,5</td></tr>
<tr><td>EE Lab Prelim</td><td>1</td><td>F</td><td>3</td></tr>
<tr><td>Workshop Engagement</td><td>2.5</td><td>F</td><td>1,2,3</td></tr>
<tr><td>Mid-Semester Tests</td><td>15</td><td>S</td><td>2,3</td></tr>
<tr><td>Project</td><td>25</td><td>S</td><td>All</td></tr>
<tr><td>Final Assessment</td><td>50</td><td>S</td><td>T</td><td>1,2,3,5</td></tr>
</table>

<table>
<tr><th>New Assessment Item</th><th>Weight</th><th>Type</th><th>Hurdle</th><th>LO</th></tr>
<tr><td>Theory Competency Quiz</td><td rowspan="3">20</td><td>F</td><td rowspan="3">C</td><td>2,3</td></tr>
<tr><td>Software Practical Competency</td><td>S</td><td>2,5</td></tr>
<tr><td>Electrical Practical Competency</td><td>S</td><td>3,5</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Workshop Engagement</td><td>4</td><td>F</td><td></td><td>1,2,3</td></tr>
<tr><td>Content Tests</td><td>10</td><td>S</td><td></td><td>2,3</td></tr>
<tr><td>Project</td><td>26</td><td>S</td><td></td><td>All</td></tr>
<tr><td>Final Assessment</td><td>40</td><td>S</td><td></td><td>1,2,3,5</td></tr>
</table>

Type: F = Formative, S = Summative. LO = Learning Outcome.
Hurdle: T = Threshold, C = Competency

The implementation of competency hurdles was designed around three critical unit learning outcomes—LO2, LO3, and LO5—which focus on both theoretical knowledge and practical application. These outcomes represent core competencies required not only for passing the unit but also for success in discipline-specific second- and third-year units. Marks were then awarded through engagement with a project and other assessments, including content tests and workshop engagement tasks. The only hurdle tasks are the competency-based items, marked as “C” in Table 1. The remaining assessments are not part of any hurdle. A final examination provided summative assessment for mark differentiation, allowing stratification between students achieving minimum standards (Pass/Credit) and those performing at a high level (Distinction/High Distinction). The examination is run as a closed-book, invigilated assessment.

Given that the unit serves a broad and diverse cohort of students—most of whom do not continue into electrical engineering specialisations—the project was redesigned to reflect a minimum standard, ensuring relevance and accessibility for all students. This demonstrates the importance of contextualising assessment to meet the diverse needs of students in a common core unit (Biggs & Tang, 2011).

The competency hurdle was operationalised through three discrete assessment components:

- Theory Competency Quizzes (Formative)
- Software Practical Competency Task (Summative)
- Electrical Practical Competency Task (Summative)

The theory competency quizzes assessed students' understanding of weekly content topics. These quizzes allowed unlimited attempts, with only the highest score recorded, encouraging mastery learning (Black & Wiliam, 1998). Quizzes provided no immediate feedback, only a mark, simulating summative conditions. In parallel, companion practice quizzes with variant questions were provided for feedback-rich practice without contributing to final grades, fostering self-directed learning (Ericsson, 2006).

The software practical competency task assessed students' ability to develop functional, well-documented code in alignment with a provided coding standard, focusing on problem-solving and technical communication. The electrical practical competency task required students to design and construct simple circuits using passive components and MOSFETs, draw circuit diagrams, and correctly use electrical laboratory instruments (e.g., multimeter, oscilloscope). Both tasks were summative, completed independently, and assessed face-to-face during scheduled sessions. Students were given up to one attempt a week across four weeks to pass each task, with a fifth final attempt available as needed. Failure to pass any component of the competency hurdle results in automatic unit failure, consistent with high-stakes, professional-standard assessment (Harden, 2007).

The learning design was scaffolded to support students' success in these tasks. For example, the software competency task became available in Week 3, with assessments conducted from Weeks 4 to 7, while the electrical competency task was introduced in Week 7, with assessments running from Weeks 8 to 11, synchronised with relevant teaching content.

Successful completion of all three competency assessments contributed 20% to the final unit grade, ensuring student engagement while preserving the integrity of the competency hurdle. Additional changes included replacing scheduled mid-semester tests with flexible 'anytime' content tests, which allowed students to self-select the timing of summative assessments. These tests evaluated the two major content domains—software and electrical/materials—and mirrored the format and rigour of the final exam, supporting authentic assessment and learner autonomy. To further manage student workload and reduce stress, practical classes were streamlined to focus on project-relevant content, freeing Weeks 9 to 11 for project work. This allowed students to concentrate on application and consolidation, while minimising the introduction of new content in the final weeks (Sweller, 2011).

Students are permitted to use generative AI in the practical competency task, as well as the project as both these assessment types include an interview component which assesses students' understanding of the work submitted. Students are required to declare their use of AI in their submission.

The assessment regime was rolled out in three implementation stages to facilitate iterative refinement:

- Stage One: Introduction of learning competency assessments as part of practicals.
- Stage Two: Establishment of standalone, unweighted competency hurdle assessments.
- Stage Three: Full implementation with weighted competency hurdles.

This phased rollout enabled iterative adjustments to assessment difficulty, timing, and logistical processes, informed by student and staff feedback, particularly regarding marking logistics and assessment scheduling.

Evaluation

The impact of the redesigned competency-based assessment regime was evaluated using both quantitative performance data and qualitative student feedback, with a focus on measuring the extent to which the new assessment structure improved learning outcomes, differentiated student performance, and enhanced student satisfaction.

Figure 1 presents performance metrics comparing student achievement in the Clayton campus cohort before and after the implementation of the new regime. The results demonstrate that the baseline level of student knowledge and learning outcome attainment significantly improved post-implementation. Specifically, the in-semester performance data indicates that a greater proportion of students were able to demonstrate competence in basic learning outcomes, affirming the effectiveness of the competency hurdles in ensuring minimum standards were met across the cohort.

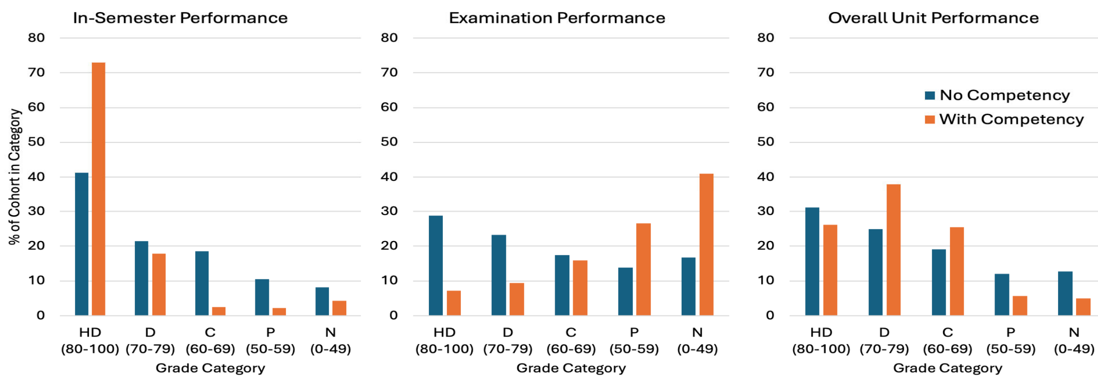

Figure 1: (a) In-Semester Performance, (b) Examination Performance, (c) Overall Unit Performance results pre- and post-implementation.

Within this framework, the final examination, which only contains ‘hard’ questions, played a critical role in distinguishing higher-performing students from those who met the minimum pass threshold. The restructured examination, marked out of 40, functioned primarily as a mark 'top-up' mechanism, designed to elevate students from a Pass to Credit level on average, while allowing students with a high level of mastery to achieve Distinction (D) or High Distinction (HD) grades. The distribution of exam marks demonstrated that the new assessment format was effective in identifying and rewarding excellence, with the overall unit performance curve aligning more closely with the typical grade distribution.

Importantly, all unit failures resulted from competency hurdle failures. These students were predominantly disengaged, with limited participation or delayed effort across the semester. However, a subset of these students attempted the assessments but lacked sufficient grasp of content to pass, highlighting a need for early engagement and timely support strategies.

In terms of student satisfaction, results from the Unit Evaluation results (see Table 2) showed an overall satisfaction score of 3.84/5, with a higher score of 4.18/5 indicating that students felt the assessment regime enabled them to effectively demonstrate the learning outcomes.

Written feedback included numerous positive comments regarding the value of the competency hurdles in supporting learning:

> *"The competency hurdles were a great way to improve and test my knowledge. Loved having heaps of questions to do to improve as well."*

> *"I like the learning competencies which force us to learn the content, and provide good way to see your weaknesses in the unit."*

> *"I found that the learning competencies kind of pushed me to actually understand what is going on in the unit, which is good."*

"Whilst I was completing the competency hurdles, it was a bit annoying, especially the fact that you have to get 90%, but I realised that this actually improved my understanding of the content, as this way, I was understanding the content as I go along. So, in retrospect, I like the concept of competency hurdles and the practical ones too were extremely rewarding."

Table 2: Unit Evaluation Results

University Wide Items (Summary)

	Responses	Median	%Strongly Agree/Agree
The Learning Outcomes for this unit were clear to me	333	4.11	77.48%
The instructions for Assessment tasks were clear to me	334	3.91	65.27%
The Assessment in this unit allowed me to demonstrate the learning outcomes	333	4.18	79.58%
The Feedback helped me achieve the Learning Outcomes for the unit	334	3.93	67.66%
The Resources helped me achieve the Learning Outcomes for the unit	331	3.98	69.49%
The Activities helped me achieve the Learning Outcomes for the unit	334	4.10	75.45%
I attempted to engage in this unit to the best of my ability	333	4.46	85.59%
Overall, I was satisfied with this unit	333	3.84	62.46%

Faculty Wide Items (Summary)

	Responses	Median	%Strongly Agree/Agree
The assessment tasks helped me to develop the knowledge and skills required for this unit	334	4.14	79.94%
I understood the grading criteria used in assessing my work	333	3.97	69.07%
This unit contained a good mix of theory and practical application	332	4.44	85.24%
The Moodle site was engaging and enhanced the learning experience	334	3.93	67.37%
The lectures were valuable for my learning	334	3.98	70.36%

A noteworthy outcome of the assessment redesign was a reduction in student stress, as noted in student comments on the flexibility of deadlines and the possibility of passing the unit prior to the final exam:

"I appreciate that by putting all the competency hurdles in place students are able to pass the unit without having to worry about the exam too much."

"I like having the theory competencies and tests able to be completed without deadline as it reduces stress and allows you to understand the content."

However, students also raised constructive feedback, particularly regarding the difficulty level of the electrical competency task. Several students expressed concerns that the task was too challenging for those not pursuing electrical engineering specialisations. In response, the instructional team acknowledged this issue and has adjusted the difficulty of this task in future offerings to better reflect the core-level expectations of a common first-year unit.

Additional unsolicited feedback from a third-year student affirmed the fairness and transparency of the assessment structure:

"The unit was a super fun experience overall and I have walked out of the course with a much deeper appreciation of the electrical/software side of things than I thought I would have".

To supplement unit evaluation data, the unit team administered an anonymous feedback survey focused on the theory learning competencies. Results confirmed that most students found these competencies useful for identifying misconceptions and staying up to date with unit content. However, some students noted that just missing the required pass mark in quizzes led to increased workload and frustration, especially when multiple attempts were needed. Others suggested implementing a feedback mechanism for incorrect answers to facilitate deeper understanding and error correction.

In summary, the competency-based assessment regime was successful in improving learning assurance, student engagement, and assessment fairness, while also generating actionable insights for further refinement. The evaluation highlights the potential of competency hurdles to enhance both pedagogical outcomes and student experience when carefully aligned with unit learning outcomes and supported by flexible, transparent assessment structures.

Recommendations and future work

The findings of this study support the continued use and refinement of competency-based assessment in large, first-year engineering units, particularly within OBE. Based on the evaluation of implementation outcomes, several key recommendations can be made:

Identify Core Capabilities for Competency Design - In designing competency-based assessment, it is critical to identify the core capabilities embedded within the unit learning outcomes. These should reflect critical concepts and fundamental skills that are essential for progression within the program and aligned with graduate attributes and professional competencies. LOs should be mapped to specific, assessable competencies, ensuring that each hurdle task corresponds directly to demonstrable skills. The use of SOLO taxonomy verbs in learning outcomes supports this alignment by clarifying the cognitive level required, and should be leveraged to design appropriate, level-specific assessment tasks.

Early Intervention Strategies - Students who fail due to late engagement or lack of preparation could benefit from early warning systems, such as automated alerts triggered by inactivity or low quiz scores in the first third of a semester. These mechanisms could prompt timely academic support, improving retention and success rates.

Feedback Mechanisms - Targeted feedback for incorrect responses, particularly in early quiz attempts, could enhance formative learning and reduce student frustration (Nicol & Macfarlane-Dick, 2006).

Scaling and Resource Management - Further research should explore scalable assessment models to moderate staff workload while maintaining assessment validity and reliability

Longitudinal Tracking of Competency Outcomes - Future work should examine how competency hurdle performance in first-year units correlates with student progression, retention, and performance in later-year units, in order to test the predictive validity of competency assessments.

Student Workload and Assessment Load Monitoring - Some students perceived the overall assessment burden to be high, especially when narrowly missing quiz pass thresholds. Future iterations should explore streamlining assessment volume without compromising learning assurance.

Conclusions

This study demonstrated the successful transition from a threshold-based to a competency-based assessment regime in a large, first-year engineering unit. The redesign ensured that students who passed the unit demonstrated explicit learning outcomes, particularly in theory and practical competencies, aligning with the Engineers Australia Stage 1 Competency Standards. Student feedback affirmed the educational value and fairness of the competency hurdle approach, while also identifying areas for improvement in task difficulty calibration and feedback provision.

The results support the broader adoption of competency-based education in higher education settings, particularly in engineering and other professional programs where learning assurance is critical. Future work should continue to refine the implementation model, monitor long-term student outcomes, and explore scalable solutions for competency assessment in large-enrolment contexts.

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Acknowledgements

The authors would like to acknowledge the use of generative AI tools, including ChatGPT by OpenAI and Grammarly, in the preparation of this manuscript to support drafting, language editing, and clarity improvements. Generative AI was not used in the conduct of the research project; all ideas are the authors' own.

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