

The impact of COVID-19 on engineering assessment practice: sustaining innovative assessment post-pandemic

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ABSTRACT

CONTEXT

Engineering is a hands-on and practical discipline, so engineering education is expected to be more hands-on and practical compared to other disciplines. However, engineering education often uses exams as the main mode of assessment. During the COVID-19 pandemic, many courses previously taught face-to-face were moved online, and had to move away from invigilated, face-to-face exams. This was both a challenge and an opportunity for engineering educators to re-conceptualise assessment.

PURPOSE OR GOAL

The aim of this study was to investigate what changes, if any, were made to engineering assessment practices because of COVID-19, and which of them were maintained. We investigated reasons why one course convener chose a 'snapback' to their pre-COVID-19 assessment practices – which relied on exams – while another took the opportunity to replace exams with other forms of assessment. We also examined what support conveners received during and after the pandemic, and how this influenced their decisions.

APPROACH OR METHODOLOGY/METHODS

We used a case study approach to compare two courses, Course 1 and Course 2. The two courses are both first year engineering courses with both contributing to the Aeronautical and Mechanical Engineering degrees, and Course 2 also contributing to the Civil engineering degree. The two courses were chosen because they are taken by approximately the same cohort of students. Course 1 is offered in semester 1 while Course 2 is offered in semester 2. For each course, the course outlines for 2019 to 2022 inclusive were compared to identify changes in course learning outcomes and assessment plans. The conveners were interviewed using a semi-structured interview protocol to explore the reasons for the changes made during and post-COVID-19 lockdowns, and the alignment between their learning outcomes and assessment.

ACTUAL OR ANTICIPATED OUTCOMES

By 2022, one course convener had reverted their course almost completely to the pre-COVID-19 assessment plan and course learning outcomes, following substantial changes made in response to COVID-19. The course learning outcomes for the other course were unchanged throughout, but the assessment was changed in response to COVID-19 and these changes, which included replacing the final exam with a portfolio and introducing reflective writing, were maintained post-COVID-19. The interviews elucidate why the two conveners did or did not 'snapback' to their pre-COVID-19 assessment plans.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The comparison of the two courses provides insight into how change can be supported, and, importantly, how change can be sustained. Recommendations are provided.

KEYWORDS

Engineering education, assessment, COVID, change management.

INTRODUCTION

The last few years saw a fundamental shift in the higher education sector as a result of the COVID-19 pandemic. Before 2020, some universities dabbled in online education (Tucker, Halloran, & Price, 2013), and as such, frameworks for online education already existed (Redmond et al., 2018; Garrison, Anderson, & Archer, 2000). However, when the sector as a whole required a significant change, universities were found to be largely unprepared for the transformation at scale (Slade et al., 2021; Rapanta et al., 2020).

Over the last few years, numerous challenges have been identified, and valuable lessons have been learned (Turnbull, Chugh, & Luck, 2021). Despite implementing a variety of assessment and online education approaches, not all of them have proven to be transformative. In his very popular blog, Peter Bryant discusses University of Sydney's approach to assessment during COVID-19. They not only shifted assessment to online but took a transformative approach to assessment design, focusing on authenticity and active learning (Bryant, 2021). In his reflection, Bryant questions the sustainability of the changes made across the sector, with many academic staff feeling exhausted and uncomfortable with the changes they've had to endure while teaching and assessing online. Bryant (2021) reports that many "...can't wait to be able to run face to face exams again" as if that would help them overcome all the problems associated with a poor online assessment design (Bryant, 2021). This is what he describes as a 'snapback', a desire to go back to the way things used to be. Instead of learning from this experience, it seems many of us just want to do exactly that, 'snapback' to face-to-face teaching and invigilated exams.

In this study, we focus on what this has meant for our institution and the engineering discipline assessment practices in particular. We hope that while this study focusses on a single institution, and a somewhat unusual one, the findings may speak to those teaching in engineering more broadly, identifying not only challenges but also opportunities that arise as we transition to a post-COVID-19 teaching environment.

University of New South Wales (UNSW) Canberra is an unusual university campus. It is a small campus, located on the grounds of the Australian Defence Force Academy (ADFA) in Canberra. The annual student intake is around 340 students, approximately 300 of whom are Australian Defence Force (ADF) Trainee Officers who are concurrently undertaking military training on the ADFA base, and around 20 commissioned officers who also have military duties on base. The remaining students are civilian students, some of whom are defence-related civilians. For all the ADF students, their timetabled UNSW classes are their 'place of parade' and they are required to attend. Hence, attendance rates prior to COVID-19 lockdowns were near 100% and there was no requirement to run classes or assessment online. So, all undergraduate teaching and assessment was delivered face-to-face with no hybrid or online options.

As a result, in March 2020 when Canberra went into lockdown for the first time, very few teaching staff were experienced with online teaching or assessment. As described in Townsend et al. (2022), support was provided to conveners of semester 1 courses to rapidly move from face-to-face to online teaching and assessment. Overall, the transition was a success. A combination of triaging at school level to ensure appropriate support was offered to all conveners, as well as school and university wide emergency policies, enabled all 55 semester 1 undergraduate courses to shift online, with minimal disruptions to teaching and learning; with very few course learning outcomes needing to be delayed to later semesters.

In semester 2 of 2020, teaching and assessment remained online, but support for conveners was largely withdrawn as it was assumed that by then academic staff would have had time to plan for the transition. In 2021, face-to-face teaching and assessment resumed, only to be disrupted by a second lockdown in semester 2 of 2021. Since then, teaching delivery has returned largely to face-to-face mode, however, there has been a change in assessment practices with assessment offered in various formats, some online and others face-to-face depending on the decisions of the teaching staff.

Here we explore how and why assessment practices in the School of Engineering and IT at UNSW Canberra have changed as a result of transition to online assessment during COVID-19, and what practices were retained in the post-COVID-19 period.

METHODOLOGY

This study is part of a larger investigation looking at engineering assessment practices and how they have changed at the UNSW Canberra School of Engineering and IT from pre-COVID-19 (2019), to during COVID-19 (2020 and 2021), and post-COVID-19 (2021 and 2022).

Our research methodology adopts a case study approach (Yin, 2014) to compare two courses by examining their course outlines and identifying approaches to assessment practices pre-, during and post-COVID-19. A comparative analysis was undertaken of the assessment tasks for both courses over time. The assessment tasks used in both courses were categorised as quizzes, exams, lab reports, tutorials, and portfolios based on the task descriptions in the course outlines.

The two courses considered are both first year engineering courses with both contributing to the Aeronautical and Mechanical Engineering degrees, and Course 2 also contributing to the Civil engineering degree. The two courses were chosen because they are taken by approximately the same cohort of students. Course 1 is offered in semester 1 while Course 2 is offered in semester 2.

Both courses are introductory courses, which provide foundational knowledge and skills for later year courses in the degree program. Course 1 has a strong focus on design and manufacturing skills, including CAD and hands-on workshop skills. Course 1 also has content specifically related to the profession of engineering, including ethics. Course 2 has a laboratory component which supports development of design skills, but is otherwise more content focused, providing scaffolding for technical courses in the second year. The two courses have similar contact hours and prior to COVID-19 had similar assessment plans. During COVID-19, both courses were heavily modified to accommodate a move to online. In the following years, Course 1 largely reverted or 'snapped-back' to its pre-COVID-19 format while the Course 2 maintained the changes made during COVID-19.

The changes made, and the reasons why the two conveners took such different approaches post-COVID-19, were explored in a semi-structured interview (Adams, 2015) with each course convener answering 13 questions that focused on their assessment practices and the rationale behind those practices over the time period of interest. Interviews were conducted via the Zoom platform with the auto-transcription tool used to generate interview transcripts. The interviews were conducted in compliance with the project ethics approvals (HC210289 and HC210174) and data stored accordingly. The interview data was analysed to explore the course conveners' assessment practice decisions in the post-COVID-19 environment and a deductive approach was adopted to investigate their reasons for the changes they made during and post-COVID. This qualitative data was used to triangulate the quantitative results from the course outlines by providing insights into why changes were made.

OUTCOMES

As described above, in 2019 at UNSW Canberra all undergraduate teaching was delivered fully face-to-face. So, when Canberra went into lockdown in 2020, and all teaching had to be delivered online, substantial changes had to be made to the way teaching and assessment were carried out. In the years following, some conveners such as Convener 1 (Course 1) returned to pre-COVID-19 ways of teaching and assessing, while others such as Convener 2 (Course 2) chose to maintain changes they had made in 2020.

Assessment tasks pre, during and post COVID-19

As shown in Figure 1, the assessment plans for the two courses were similar in 2019. Both courses had a large fraction of the assessment weighting allocated to a combination of final exam and quizzes, 50% for Course 1 and 70% for Course 2. All exams and quizzes were timed, face-to-face, closed book and invigilated. While Course 1 did not have any laboratory task shown in Figure 1, there was a competency-based hand tools and machining component with a satisfactory/unsatisfactory requirement that students had to meet to pass the course. The tutorial tasks required students to work in groups, in class, and every 2-3 weeks submit their work individually for grading. The reports were assignment based and focused on meeting Engineers Australia requirements with students working through ethical scenarios while also demonstrating problem solving skills. For Course 2, there was a single laboratory task, which students did in groups and wrote a report on for the 10% laboratory component, as well as hands-on mini experiments in tutorials which were assessed via the assignment component. Both courses had a traditional closed book invigilated final exam in 2019.

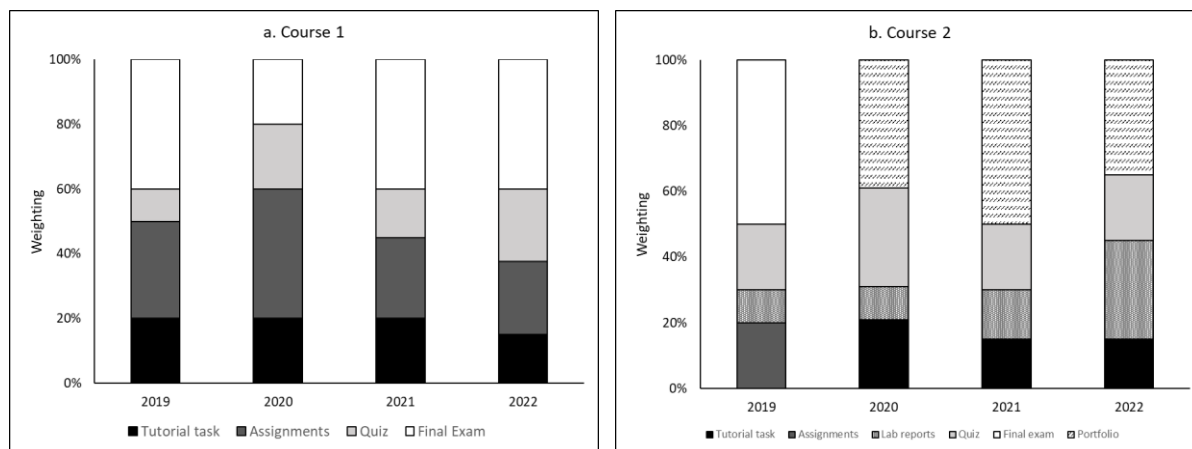


Figure 1. Different types of assessment tasks and associated weightings used in a. Course 1 and b. Course 2 for 2019 to 2022.

In 2020, when courses were required to shift from fully face-to-face to fully online, university and school level policies were implemented to support student wellbeing. These included for semester 1 (and hence, Course 1) all undergraduate grading to move to Satisfactory/Fail, based on whether course learning outcomes were demonstrated. Also, final exams had to be online, open-book and had a time limit of no less than 24 hours. For semester 2, these restrictions were lifted, but all teaching and assessment was still required to be online.

Course 1

Figure 1(a) shows that Course 1 still had the same assessment tasks in 2020 as in 2019, however, due to the COVID-19 emergency assessment policy requiring all grading to change to Satisfactory/Fail, the weighting in Figure 1 for Course 1 for 2020 is indicative only and as such, all tasks are equally weighted. However, Convener 1 still used numerical grading to determine whether a student received a Satisfactory or a Fail. They explained their approach and interpretation of the policy as:

We didn't have any marks anymore, right? So, the way we handled it in this class, is that we would still have numerical kind of ranges. ... For example, the assignment is worth 10 marks or something ... and we wanted to ... see a student having 50%, or more. It was just easier to handle it like that.

The majority of the assessment tasks for Course 1 remained unchanged, apart from the workshop competencies being postponed to a later course. Otherwise, the greatest change involved in-class tests and the final exam. The in-class test was changed to an online format. Convener 1 and the teaching team for the course developed several online Moodle lessons aimed at supporting students in practicing problems on their own, leading up to the online test.

The final exam was changed to an assignment format which was then submitted online as well. With these changes, the new assessment plan enabled assessment of four out of five course learning outcomes, with only workshop skills not able to be taught or assessed.

When asked about the challenges to moving online in 2020, Convener 1 mentioned not only the challenges for the Course 1 teaching team, and for the students, but also difficulties with guest lecturers not wanting to present online:

I had to convince guest speakers to actually do it online. Some were happy, some were not that happy, but I still was able to get 6 guest speakers to do it online.

In 2021 all courses were required to have a COVID-safe back-up plan for both teaching and assessment, but these were not required in Semester 1 and most exams were run face-to-face, and were closed-book, timed and invigilated.

Looking at the Course 1 assessment plan for 2021, it was almost a complete return (a 'snapback') to the 2019 assessment plan. The only difference being a small increase in the weighting of exams and quizzes from a combined weight of 50% to 55%. The additional 5% came from a decrease in the weighting of assignments from 20% to 15%. In 2022, the weighting of exams and quizzes increased further to 62.5%, by decreasing the weighting of both assignments and tutorials.

It is important to remember that for Course 1, the change from face-to-face to online was done as an emergency measure with little warning. Changes had to be made with a view to finding solutions that could be implemented immediately, rather than considering changes that would be sustainable or desirable in the longer term. This may have contributed to the convener's decision to 'snapback' to the pre-COVID-19 assessment plan with only minor changes to weightings.

Convener 1 indicated that the shift to online for some of their assessment tasks, such as quizzes and final exam, resulted in them being unsure how much of the foundational knowledge students actually had:

I didn't feel that some of the students were really demonstrating the knowledge that I wanted them to demonstrate.

Their concern was further compounded by an increase in plagiarism cases during 2020:

There was a lot of plagiarism, more than in previous years, more than any other year. Even though the students didn't have the pressure of getting a specific mark, right? They just had to show that they were passing all the [course] learning outcomes.

They found this frustrating and disappointing, and going back to face-to-face and to the in-class test "kind of gave us more control."

However, even though Figure 1 implies a 'snapback' to pre-COVID-19 ways of assessing, Convener 1 did note that their teaching had changed:

. . . I was basically moving all these class tests to an online form, [and] some of the tools that I developed, some of the resources that I developed here, I'm still using . . . to this day. Like, for example, these Moodle lessons. I encourage students to go on and do them.

So, students now taking the fully face-to-face version of Course 1 are benefitting from resources developed to support online learning during COVID-19.

Course 2

In contrast to the experience of Convener 1, the convener of Course 2, which runs in the second semester, had time to plan and consider longer term teaching and course learning outcomes. In 2019, Course 2 had a traditional exam and quiz focused assessment plan, with quizzes and exams contributing 70% of the assessment. In 2020, when all assessment had to move online,

the quizzes were kept and moved to online and open book, but the exam was replaced by a portfolio and the assignments with weekly tutorial tasks. The weekly tutorial tasks comprised the submission of a solution to one tutorial problem, the review of another student's solution including grading against a simple rubric, and a response to the review received. This was done to support regular engagement with the course material, and engagement between students who might otherwise be isolated. This peer review was deemed by Convener 2 as a practice that was aligned with the culture of the campus.

Our students, they're getting ... leadership training. They are supposed to be able to give feedback. They're supposed to be able to lead and command So, they need to be able to do this and not be too precious about it, and they need to be able to have it done to them as well.

In addition, in 2020, a new laboratory task, a projectile launcher design-build-test, was developed that could be done at home and lab kits were provided to students.

The portfolio, which replaced the final exam as the 'capstone' task, was weighted at 40% in 2020 and consisted of a problem set from which students solved a subset of problems, and reflective writing tasks in which students were asked to explicitly address the course learning outcomes and draw on evidence from all earlier assessment tasks. Convener 1 explained their reason for replacing the exam with a portfolio as a desire to use more authentic assessment:

I didn't think an exam was going to be all that useful ... I don't think it's the best way to assess in engineering, because ultimately in engineering, as with in fact any discipline, you don't complete your degree and then as a practicing [professional], do exams. You complete your degree ... [and] as an engineer, you design stuff. You do safety checks on things. You check other people's designs. You do ... project management, that sort of thing. You don't go and sit and do exams as a professional.

The students were required to include all work submitted during semester, with the feedback received on it, in their portfolio, as well as the new work – the problem set and reflective writing. The educational rationale was that:

... [through the portfolio] students will bring together everything they've done and link it explicitly to the course learning outcomes, demonstrating how they've met them. And there was also one final [reflection] within the portfolio, a final overall reflection, summarising what they've learned in the course, what they will do differently if they had to do it again, what advice they would give to someone starting the course next year, and what they were going to take forward into next year

Hence, there was a focus on learning, and on feedback as a feedforward tool for improving subsequent performance. Again, this is consistent with the students' military training, in that it mirrors the 'after-action review' process (Morrison and Meliza, 1999) they are taught.

No course learning outcomes for Course 2 were dropped from 2019 to 2020, however it is important to note that this course did not have workshop competencies that could only be assessed on campus.

In 2021, Semester 2 Canberra again went into lockdown, and the COVID-safe back-up plan had to be implemented for Course 2. With lockdowns in place, the quizzes were again run online and open book, but the weighting was reduced to 20%. The same at-home lab was used, but the weighting was increased to 15%.

A key criterion for the new assessment regime was to "reward them with lots of marks when they did what they needed to do", that is:

It was a 'do the work, you'll get the marks', demonstrate to me that you can do this, and you'll be fine. And you've got time to do it, and I will help you do it. So [the] assessment plan ... [was] designed to be low stress for students, if not [the convener's] workload.

When face-to-face teaching resumed in 2022, the quizzes were run in closed-book, invigilated mode again, with the weighting of 20% maintained. The 2019 laboratory task, a bridge design-build-test project was reinstated, and the at-home lab was also kept, hence the laboratory weighting increased from 15% to 30% in 2022, and the portfolio was also retained rather than a final exam.

So, overall, Course 2 was moved from a very traditional exam-based assessment plan in 2019 to a more innovative and, arguably, more authentic assessment plan in 2020 which was maintained through 2021 and 2022.

Convener 2's attitude was in stark contrast to that of convener 1. Convener 2 observed that there is "an obsession with academic integrity..." and stated that:

[Cheating is] going to happen, that's going to happen in the workplace as well. I've had colleagues pass off stuff that I created. ... that we throw away valid assessment practices, just given the occasional student might cheat on it, I think [that] is silly.

Their desire for more authentic assessment outweighed their concerns about academic integrity for Convener 2.

Comparison of Course 1 and Course 2

When comparing the two courses, it's important to consider the different contexts: one had to move online as an emergency measure, while the other had time to plan.

Responding to the rapidly changing policy environment was a challenge for many course conveners of semester 1 and many academics had their own interpretation of the new assessment policy. Some found it challenging to apply it in the way it was intended, and there were potentially two reasons for this. First, some academics struggled to understand how to 'actually' assess against course learning outcomes. This new approach challenged the way they thought about assessments. It also revealed in some instances that course learning outcomes were written poorly, using verbs that made course learning outcomes ambiguous and subjective. At the time, many academics realised that their course learning outcomes needed updating which required a formal review and approval process. The second reason is that the numerical approach to assessment is easier to implement. So, even with the new policy in place, some staff still assessed students using numerical values and then reported their final grade as Satisfactory or Fail based on the numerical grading, as was the case with Convener 1. In addition, we suspect that some staff potentially lacked confidence assessing using the non-numerical approach, finding it foreign and difficult to implement despite the existing literature about 'ungrading' (Gibbs 2019, Blum 2017).

No such challenge existed for Convener 2 as by then the emergency policies were lifted, so, while they had to ensure that all teaching and assessment was delivered online, the policies around assessment were the ones they were already familiar with – the problems they faced were largely technical, rather than conceptual. Hence, the main challenge in semester 2 was implementation, and most of the challenges with this had already been worked through in semester 1 (Townsend et al., 2022).

There was also a withdrawal of support for course conveners to change their teaching and assessment practices after Semester 1 2020. This is not to say that there was no support – but the high level of individualised support provided during Semester 1 2020 to enable the rapid transition to online was reduced to the 'business as usual' level of support provided pre-COVID-19. However, despite the reduced support, Convener 2 was able to make and maintain changes.

[Before COVID] I was hesitant to change things. I guess I didn't feel like I would have support if I wanted to... So, it was almost like I made changes in a sneaky way. It's like COVID gave you the liberty of an excuse to make those changes... And I have not gone back. ... I'm not a believer in the sanctity of exams.

Convener 2 also described having a background in education research which gave them confidence in their decisions around teaching and assessment practices, even when there was a withdrawal of support. With the primary focus on the emergency transition during COVID-19, if Convener 1 wanted to make substantial changes post-COVID-19, other than simply 'snapping-back', they would have needed to actively seek support, while taking time to think and plan in an environment where many academics were fatigued or exhausted (O'Brien et al., 2023; Velez-Cruz & Holstun, 2022; Bryant, 2021). These 'opportunities in disguise' that the pandemic brought for curriculum review, evaluation and redesign (O'Brien et al., 2023) are also adding more to the workload of an already exhausted workforce.

CONCLUSIONS AND RECOMMENDATIONS

It is important to note that changes in education are continuing and new challenges are already upon us, for example Generative AI (Gillespie et al., 2023). So, how do we get academics to plan and implement necessary changes?

What we have learnt from this case study is that to achieve successful and sustainable change, there needs to be (1) a legitimate stimulus for change, (2) individuals need to have a capacity and confidence to make pedagogically informed changes, and (3) there needs to be time to plan and implement change.

COVID-19 was a legitimate stimulus for change; it required courses to be moved online whether the sector was ready and willing or not. However, it did not necessarily require a course convener to re-conceptualise their approaches to teaching and assessment, beyond the technical requirements of moving online. As such, it was insufficient in itself to maintain changes long term. Convener 1 did not see value in retaining most of the changes long term. In fact, they saw the online assessment as less robust, providing less accurate measures of student learning. For Convener 2, COVID-19 presented an opportunity to implement changes they had already been wanting to make. So, for them COVID-19 was a stimulus for change as they were not satisfied with the pre-COVID-19 assessment plan. Therefore, to make transformative and sustainable changes in engineering education, there needs to be a legitimate stimulus from the perspective of the course convener.

The changes made by Convener 2 were also enabled because they had a strong pedagogical content knowledge to draw upon, while the Convener 1 did not. So, despite the withdrawal of educational support, Convener 2 was able to make sustainable changes themselves. Therefore, to make transformative and sustainable changes in engineering education, staff need to have a capacity and confidence to make pedagogically informed decisions.

One of the important differences between the two conveners was the time they had to plan their move to online. Convener 1 had around 40 hours between the announcement of lockdown and when the first classes were expected to be delivered online while Convener 2 had several weeks. Convener 1 was teaching in a rapidly evolving policy environment, while Convener 2 was not; by semester 2 the policy environment was relatively stable. Although there was a great deal of support available to Convener 1, this did not mitigate the time pressure that Convener 1 was under to make and implement decisions about teaching and assessment. Therefore, to make transformative and sustainable changes in engineering education, there needs to be an adequate time to plan and implement change.

In summary, to ensure transformative and sustainable changes in engineering education, we recommend meeting these essential criteria:

1. a stimulus that is legitimate from the perspective of the course convener.
2. staff with a capacity and confidence to make pedagogically informed decisions.
3. staff time allocated to planning and implementing changes.

By ensuring these criteria are met, we make it more likely that changes introduced by teaching staff will lead to more sustainable teaching and assessment practices, and improved learning outcomes for our students.

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