Embedding human and social perspectives* into engineering education

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Link to video

https://youtu.be/ZoCsm86Cjd0?si=_eLxBiwQ-FjoUvOW

Type

Reflective learning activity

Context

Suitable for Level:

☒ Early stage
☒ Middle stage
☒ Late stage

41059 Mechanical Design Fundamentals Studio 1 (MDFS1) is the first studio experience for mechanical and mechatronic engineering students at the University of Technology Sydney with a cohort of +250 students.

The subject involves going through the engineering design process to construct a robot for the Warman Design and Build Challenge, teaching students how to tackle complex engineering problems. The 12-week semester is divided into 3-week sprints, modeled after the agile framework in engineering projects. Each sprint ends with a design review where teams present their progress and discuss how feedback guided their decisions. The first three reviews are formative, and the final review is graded, requiring integration of all prior feedback.

Individually, students submit an Engineering Design Portfolio that showcases four artefacts documenting their design and decision-making processes. Throughout the semester, guidance and feedback is provided to create these artefacts through scaffolded design exercises. This portfolio serves both as a tool for assessing their skills and as a resource when seeking their first internships opportunities. Throughout this journey students document their learning in an Engineering Design Journal (EDJ). This notes their progress, learning, and reflection on their studio experiences to help

develop their critical thinking skills and prepares them for future engineering challenges as reflective practitioners. (https://lx.uts.edu.au/blog/2024/05/01/constructing-robots-in-formative-feedback-driven-sprints/)

The formative sprints in MDFS1 are designed with a focus on dialogic feedback (Carless 2012) and feedback literacy (Carless and Boud, 2018), key elements of the active learning approach adopted in the subject. Feedback literacy, as defined by Carless and Boud (2018), refers to "the understanding, capacity, and dispositions needed to make sense of feedback and use it to enhance one's work and learning." The formative sprints were structured to prioritise learning and feedback over grades, aligning with Sadler's (2010) concept of assessment fidelity, which emphasises the importance of accurately reflecting a student's achievement in their final grade. By emphasising feedback, the formative sprints ensure that grades reflect the students' demonstrated understanding at the conclusion of the subject, rather than being an accumulation of early marks.

We use an active learning approach, which is based on student-centred learning. We provide a learning environment for active student engagement, metacognitive development and personalised learning experiences. This is achieved through flexible delivery methods and the supportive role of tutors to facilitate this learning method. These elements collectively aim to promote higher-level learning outcomes among students.

The feedback-driven sprints, scaffolded EDJ, tutor engagement and practices such the what we shortly present were designed to foster reflection-in-action during activities and reflection-on-action afterward, promoting continuous learning and improvement (Schön, 1983).
This approach encourages continuous learning, with students critically assessing their work, making necessary iterations, and driving improvements. At all times, feedback is at the fore of the learning experience. Students are encouraged to seek feedback, use feedback and to give feedback. They are in this way learning to be reflective practitioners because they are thinking about what iterations to make, changes, improvement or innovations to their project.

Due to the open-ended learning environment in the studio, we also embedded a more guided reflection aiming to develop empowered, confident and self-motivated learners. One of the reflection tools is a simple table where students record the **highlights, lowlights and aha-moments** of their learning.

Details of subject/learning activity/assessment task
In order to capture the reflections at scale, students access a Microsoft Form. The corresponding sections have a textbox for students to respond. This practice has been used as an in-class activity and an outside-of-class activity, where students simply scan a QR code or visit a link. The following details and questions in the reflective activity are:

Highlights, Low Lights & Aha Moments

Your detailed reflections are crucial. They not only help you understand your learning patterns better but also assist your educators in tailoring their teaching to suit your unique learning style. Strive to fill each section as comprehensively as possible, and remember, every bit of self-reflection is a step towards a more enriched educational journey.

Highlights – Satisfying:

Purpose: This section is for you to reflect on and share the positive aspects of your learning experience.

What to Include: Identify any moments where you felt successful in understanding or applying concepts. Highlight any positive interactions you had, moments where you felt particularly engaged or motivated, or if you found certain materials or methods effective.

Lowlights – Blocks:

Purpose: Use this section to discuss any challenges or obstacles you faced in your learning.

What to Include: Describe any topics or concepts that were difficult to understand, any moments where you found it hard to stay focused or engaged, or any teaching methods that didn't work well for you.

Aha- Moment

Purpose: Here, reflect on any new insights or realizations you gained about your learning process or the subjects you are studying.

What to Include: Share any a-ha moments where something suddenly clicked, or discuss new strategies that helped you learn more effectively. You can also talk about any new interests or motivations you discovered about yourself.

Recommendations

What are the benefits to student learning? What are the strengths of this activity/approach?

Student benefits

This reflective practice benefits students by guiding them to practice self-reflection of their learning experience, making them more self-aware and promoting active engagement with their own learning.

Highlights: This involves identifying and celebrating successful learning experiences, which reinforces positive behaviors and strategies. It is part of **positive reinforcement** and **self-efficacy** development.

Lowlights: This requires acknowledging and analysing challenges or obstacles faced during the learning process. It is aligned with **critical reflection** and **problem-solving**, encouraging learners to identify areas for improvement.

Aha Moments: This focuses on new insights or realizations, promoting **metacognition** and **adaptive learning.** It helps learners recognise their growth and adapt their strategies for future success.

Educator benefits

For educators, this approach offers a deeper understanding of student learning patterns, enabling the tailoring of teaching methods and the removal of identified barriers. By reviewing these pivotal moments, we enhance our teaching strategies and significantly contribute to a responsive, learner-centered educational environment. This practice empowers us to decode the multifaceted nature of learning, ensuring that each student's educational journey is as rewarding and effective as possible.

Understanding students **highlights** helps in replicating successful strategies both for individual learners and across the classroom. Whilst reflecting on **lowlights** allows us to adjust our teaching strategies, remove barriers to learning, and provide additional support where necessary. The **aha-moments** are perhaps the most useful ones, as they are rarely captured in SFS responses and often signal a deep understanding and integration of knowledge. Capturing these instances is crucial as they can guide us in refining our approach to teaching complex ideas, making learning more effective and enjoyable.

Lessons Learned

When used in a classroom setting, the uptake is much larger than when they are asked to fill outside of class. We do not want to enforce students to complete it, as it is not a mandatory practice. However, when done face-to-face, they are less likely to skip over it and see it as an additional task to complete. As a coordinator, I identified issues with the written feedback provided by the teaching team and used these insights to offer constructive feedback to the tutors. This also prompted the idea of designing a form for students to provide feedback on our feedback, which is a separate resource from this one. Additionally, I addressed a gap in instructions and lab resources that had previously gone unnoticed. Recently, I implemented an additional query to the form to obtain student consent to utilise a third-party GenAI source for reviewing large cohort responses, optimising the process.

This approach is transferable and can be used in varying classroom settings, outside of the classroom when mentoring students, tutors or for personal self-reflection. This was also implemented as part of a post-session survey for my tutors to reflect on the semester, and their insights have been equally valuable as those of the students. By encouraging reflective practice among tutors, we gained valuable feedback on teaching methods, tutor engagement, and areas for improvement.

Attachments

pdfs, jpegs, links to videos or other resources illustrating your story.
NB. Ensure permission is granted for any student work and or images.
The submission in its entirety must be compliant with publication under Creative Commons License.

https://forms.office.com/r/1ggreWuZpn

Other recommended resources

https://lx.uts.edu.au/blog/2024/05/01/constructing-robots-in-formative-feedback-driven-sprints/

Carless, D. (2012). Trust and its role in facilitating dialogic feedback. In D. Boud & E. Molloy (Eds.), *Feedback in higher and professional education: Understanding it and doing it well* (pp. 90-103). Routledge.

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & Evaluation in Higher Education, 43*(8), 1315-1325. https://doi.org/10.1080/02602938.2018.1463354

Sadler, D. R. (2010). Beyond feedback: developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education*, *35*(5), 535–550. https://doi.org/10.1080/02602930903541015

Schön, D. (1983). The Reflective Practitioner: How Professionals Think in Action. London: Temple Smith.

Lidfors Lindqvist, A., Willey, K., Lidfors, L., & Francis, B. (2023). *Formative sprints to improve feedback, learning, and fidelity in practice-based activities*. In Proceedings of the 2023 Australasian Association for Engineering Education Conference (AAEE 2023). Gold Coast.