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Reflection in Action: Using GenAI to Respond to the Student Voice at Scale

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CONTEXT
Reflective activities are often employed in higher education to promote metacognition and reflective practice. The data captured by these activities frequently include useful insights for both students and teaching staff. Students could benefit from greater exposure to the reflections of others by learning about the resources, behaviours and learning strategies that their peers discover, and gaining a greater sense of belonging that comes from struggles being shared. Teaching staff could benefit by gaining greater insight into how students are experiencing their subjects and the difficulties that they face. Until recently, however, it hasn't been feasible to analyse and synthesise reflection data in large cohorts in a timely manner, which means that this useful and insightful data is frequently ignored or only used for cursory assessment, and students frequently disengage from reflective activities because they can't see the outcome or purpose of them.

PURPOSE
The purpose of this paper is to present the implementation of a reflective activity called *Highlights, Lowlights and Aha-moments*, and a process by which GenAI can be used to quickly derive themes, trends and recommendations in large cohorts.

APPROACH
This paper presents two case studies in which automated summarisation of reflection data has been employed. In the first case study, students enrolled in a studio subject complete the reflective activity in-class at the commencement of a new sprint, and the data is immediately summarised and presented back and discussed with students during class. In the second case study, students enrolled in a large introductory programming subject complete weekly reflections in their own time, and the data is summarised and presented during the weekly lecture.

ACTUAL OUTCOMES
In both case studies, the efficient processing of large sets of reflection data has enabled teaching staff to engage their students in timely and open discussions about how the cohort is experiencing the subject and what is and isn't working for them. The observed benefits for students have been numerous: they engage more actively in the reflective practice because they can see clear benefits from doing so; they engage more thoughtfully in their learning as they gain a better understanding of what it takes to do well, and they relate more closely to peers and teaching staff as they gain a sense of belonging and of being heard.

CONCLUSIONS
In this paper we present a simple and actionable process for capturing and synthesising student reflections. Teaching staff who adopt this process will be better equipped to tap into the student voice and respond to their needs in a timely way.

KEYWORDS
Reflection, genAI, student voice.

Introduction

Reflection and feedback are both critical components of effective learning in engineering education. Importantly, reflection is not only a tool for student learning, but also a valuable source of feedback for educators. When students engage in structured reflection, the often provide rich they surface insights into their understanding, challenges, and misconceptions, providing rich, formative input that can inform teaching practice and course design. Schön's (1983) concepts of reflection-in-action and reflection-on-action frame reflection as both the immediate and retrospective analysis after the completion of a task. These practices help students navigate complex, real-world problems by linking theory to action in dynamic ways. Boud et al. (1985) emphasise that reflection is central to learning from experience, highlighting how structured reflection enables students to critically evaluate their work, recognise areas for improvement, and build self-awareness. Reflection and feedback are both critical components of effective learning in engineering education. Similarly, Nicol (2010) proposes that feedback should be understood as a dialogic process, where learners actively engage with feedback to develop independent judgment and self-regulation skills, rather than as one-way transmission of information. Dialogic feedback is the interaction of sharing explanations, negotiation of meanings, and clarification of expectations Carless (2012). Boud et al. (1985) emphasise that reflection is central to learning from experience, highlighting how structured reflection enables students to critically evaluate their work, recognise areas for improvement, and build self-awareness. Similarly, Nicol (2010) proposes that feedback should be understood as a dialogic process, where learners actively engage with feedback to develop independent judgment and self-regulation skills, rather than as one-way transmission of information. Together, structured reflection and dialogic feedback support deeper learning by encouraging critical thinking, promoting ownership of learning, and bridging the gap between academic tasks and professional engineering practice.

Building on this foundation, a reflective tool was developed to prompt students to record and analyse their *highlights*, *lowlights*, and *aha moments* throughout project-based activities. The tool scaffolds both reflection-in-action and reflection-on-action, and facilitates dialogic feedback through structured peer and educator engagement. This approach aims to embed reflective practice more deeply into the learning process and enhance students' capacity for self-directed, professional learning. By being able to receive timely input from students, utilising digital technologies, allows facilitators to make informed decisions to enhance the learning experience (Willis et al., 2021). The purpose of this paper is to present the implementation of a reflective activity called *Highlights, Lowlights and Aha-moments*, and a process by which Generative Artificial Intelligence (GenAI) can be used to quickly derive themes, trends and recommendations in large cohorts.

No formal research methods were employed, and no student data is reported or analysed. Instead, the paper reflects on the design and delivery of the activity and summarisation process, and shares observations based on the authors' lived experience as educators. These impressions were informed by interactions with students during class discussions, lectures, and informal feedback, as well as the perceived impact on student engagement and teaching practice. The purpose of this paper is therefore not to evaluate student outcomes per se, but to offer a practical model that other educators might adopt, adapt, or extend in their own teaching contexts.

Activity and Process Design

Structuring the reflection activity

Table 1 presents the reflection questions that were posed or shared to students via an online form, which were sourced (with minimal adaption) from the Highlights, Lowlights & Aha-Moments guided reflective tool by Lidfors Lindqvist and Francis (2024).

Table 1: The guided reflective tool adopted from Lindqvist and Francis (2024).

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.

Highlights capture a moment of achievement or satisfaction, *lowlights* capture reflection on challenges or blockers, and *aha-moments* capture the sudden realisation when something clicked which often also relates to a sudden positive emotion (clarity and/or satisfaction). The tool is a variation of the traditional "highlights, lowlights and insights" which used in various contexts to capture reflections on observations, performance or experiences. Although the traditional method may capture Aha-Moments, insights are often a broader and deeper understanding gained from additional reflection and analysis of an experience. Promoting students to focus on aha-moments in particular allows for capturing the essence of the learning itself rather than just the final learning outcomes. Lidfors Lindqvist at al., (2024) first embedded this method to support dialogic feedback at scale. Prior to its implementation dialogic feedback mainly occurred between in-class facilitators and students. Neglecting the differences in level of experience between the different facilitators, and facilities where students worked, which provided different levels of support. As supported by Carless (2012) the dialogic feedback is the interaction of sharing explanations, negotiation of meanings, and clarification of expectations. Willis et al (2021) suggest that digital feedback loops can have a positive impact on both students and teaching staff. This method provides a feedback loop for co-creation, negotiation and setting student expectations.

Administering the reflection activity

The reflection activity described above is a series of three open-ended questions and thus is trivial to administer using any online survey platform. In case study 1 the activity was administered synchronously in class, and students were directed to the survey using a QR code presented in the teaching materials. In case study 2 it was administered asynchronously outside of class, by embedding it as an activity in the Learning Management System. Each approach has advantages and disadvantages that will be discussed in the *Reflections* section below. In either case the online survey was specifically configured to avoid collecting any identifying details about the respondents, to ensure the reflection data was anonymous at the point of collection. This approach was chosen to project student privacy and encourage honest reflection. In both case studies the activity was repeated on a regular basis throughout the teaching session (every third week in case study 1, and weekly in case study 2).

Summarising student responses

When the reflection activity described above is administered frequently in a large cohort, it generates a large amount of data that is impractical to analyse manually in a timely way. GenAI provides a straightforward process for analysing it automatically at scale: one simply pastes the reflection responses into the tool of choice, along with a prompt describing how the analysis should be conducted.

Table 2: A prompt for summarizing reflection data

I am going to give you a list of student responses to the prompt "*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.*" After I give you the responses, please analyse them to provide themes. Focus on 3-5 top themes, and make sure each theme is distinct. For each theme include the proportion of matching responses, and some supporting quotes from the responses. Make sure none of the quotes include profanity.

Table 2 provides an example prompt that is tailored to summarising responses to the “highlights” reflection question described previously but can be trivially adapted. Some key points are:

1. It tells the large language model (LLM) about the question that collected responses address. Many student responses are extremely terse and can be difficult to decipher without this context.
2. It specifically requests a thematic analysis. Without this instruction the LLM may instead respond with recommendations for students or recommendations for the teacher. While this may be a valid use, we felt it best to let the data speak for itself and allow the teacher and students to decide how to respond to it.
3. It quantifies the number of themes that should be returned. Without this instruction the LLM tended to be very granular and present themes that were difficult to distinguish from each other and are too time-consuming to decipher when sharing during class-time.
4. It specifically requests that the prevalence of each theme be quantified, and for supporting quotes to be provided. This gives allows each theme to be quickly interrogated and validated (one can conduct quick searches to verify that each quote is present in the original data).
5. It requests that the quotes be free of profanity. The “lowlights” reflection question may occasionally capture heated responses. The summary may be shared live during class time and need to be appropriate for a public and inclusive learning environment.

This summarization approach is model agnostic, so any LLM that the reader has access to will likely be suitable. One factor to consider when selecting an LLM is that they can only retain a certain amount of text in memory at one time. LLMs will truncate and ignore any input that exceeds this context window, and often do so without informing the user. Practitioners with large cohorts or particularly verbose reflections should verify that their chosen LLM has a sufficiently large context window, or develop alternative strategies such as randomly sampling or processing their data in multiple batches.

Closing the loop

Once the summaries are generated using the approach described above, they are ready to be presented and discussed with students to acknowledge patterns in student experiences, prompt discussion around common themes, and validate both positive and negative sentiments expressed by the cohort. This is an extremely efficient process even at a large scale. For maximum efficiency and transparency, the entire process (collecting student responses, summarizing them using AI, and discussing the results) can be conducted live during class time.

Methodological Approach

This paper is presented as a reflective account of teaching practice rather than a research study. The work described here was conducted as part of regular subject delivery in two large university-level subjects, and no ethics approval was sought for the collection or analysis of student data. As such, this paper does not report on student-generated data directly, nor does it include formal evaluation of student outcomes. Instead, we document and reflect on the implementation of a structured reflective activity and the use of GenAI tools to rapidly summarise student responses at scale. Our observations are based on our experiences as teaching staff, and on informal interactions with students during and after the activity. This practitioner perspective aims to offer a model that

can be adopted and adapted by other educators, particularly those teaching large cohorts where manual reflection synthesis is impractical.

Case study 1: Studio-Based Subject

41059 Mechanical Design Fundamentals Studio 1 (MDFS1) is the first studio experience for mechanical and mechatronic engineering students at the University of Technology Sydney. The subject has an annual size ~400 students, with a larger spring semester (~280). The subject is student centred and lets students work through the engineering design process to construct a robot for the Warman Design and Build Challenge, teaching students how to tackle complex engineering problems in a pro-active and reflective nature (Lidfors Lindqvist et al., 2023, 2024) .The 12-week semester is divided into 3-week sprints, modelled after the agile framework in engineering projects. These sprints are formative in nature, meaning students submit or present work for feedback instead of marks, with a focus on dialogic feedback (Carless 2012) and feedback literacy (Carless and Boud, 2018). The feedback-driven sprints were designed to foster reflection-in-action during activities and reflection-on action afterward, promoting continuous learning and improvement (Schön, 1983). Due to the open-ended learning environment in the studio, the guided reflection tool is used to develop empowered, confident and self-motivated learners.

Implementation approach

Responses were summarised either post session or immediately after submission using a GPT-based large language model. Within 10–15 minutes, the model extracted key themes and representative student quotes. To close the feedback loop, the AI-generated summary was either processed and presented live in front of the class or formatted into a concise presentation slides and presented in the following session. This not only open conversation about shared challenges and learning strategies, but validated the learning experience by creating a sense of belonging.

Example reflection report

Table 3 provides an example of what the captured data of student reflections may look like when feed forward to students via an in-class presentation. This can be accompanied by the instructor giving suggestions and examples, to help students either transfer others good practice/experience or support where there may be a lack of understanding or stressors.

Table 3: An example of how GenAI summarised outcomes were presented to students in class.

Highlights **Successful Prototyping:** Enjoyed building low-fidelity prototypes and seeing their designs come to life and the hands-on learning **Skill Development:** The progress in SolidWorks and learning new design techniques. **Creative Collaboration**: Positive teamwork experiences where ideas were shared freely in a judgment-free environment. **Effective Feedback Application:** Mentor feedback was valuable and used to make meaningful improvements to project/artefacts. **Positive Engagement**: The in-person interactions with tutors and the constructive guidance received. **Design Successes**: Achieving design milestones, such as fitting assemblies correctly or overcoming technical challenges, were rewarding moments
Lowlights **Team Dynamics Issues:** Struggles with communication and uneven contribution from group members affected project progress. **Time Management Challenges:** Balance workload and manage time effectively, especially with multiple deadlines and other subjects. **Technical Difficulties:** Problems with Citrix, disrupted workflow and caused frustration. **Unclear Submission Expectation:** Miscommunication about assignment requirements led to confusion and stress during presentations. **Design Struggles:** Difficulty understanding certain concepts, such as free body diagrams or AS1100 standards, made some tasks more challenging.

Feedback Gaps: Some students felt the feedback on DE1 was vague and lacked depth, making it hard to identify specific areas for improvement.

Aha-Moment
Creative Breakthroughs: Moments of inspiration, when change in design opened up new possibilities for the project.
Prototyping Insights: Realising the value of low-fidelity prototypes to identify issues early and iterate on design concepts effectively.
New Understanding of Tools: SolidWorks and CAD design, including advanced features like mates, configurations, and exploded views.
Learning Efficiency: Recognising simpler approaches to complex tasks, like understanding the engineering analysis or structuring time more effectively.
Integration Success: Seeing individual components come together smoothly during assembly reinforced the importance of cohesive design and teamwork.
Application of Feedback: Moments where feedback directly led to design improvements, helping connect theory with practical application.

Case study 2: Introductory Programming Subject

48023 Programming Fundamentals runs twice a year with a typical cohort of ~300 students, the vast majority of whom are brand new to tertiary education. As a transition subject it plays a crucial role in helping students adjust to the academic expectations, learning styles, and independence required at university. To further complicate matters, 48203 is one of two introductory programming subjects offered by UTS. It's sister subject 41039 is aimed squarely at aspiring software engineers and computer scientists, while 48023 instead attracts a cohort for whom programming will be an auxiliary skill rather than a core competency. As a result, students in the subject frequently struggle with low motivation and a poor sense of belonging. Programming as a discipline is very granular and gated, meaning that there are many individual concepts and skills that students need to learn, and they are strongly dependent on each other (Robins et al. 2003). Hence, the subject is taught in a highly prescriptive fashion, with a new sets of reading, practice and assessed tasks released each week.

Implementation approach

In this subject the reflection activity was conducted asynchronously, meaning that students were free to answer the reflection questions in their own time. The questions were embedded directly into the learning management system, immediately after the weekly set of assessed coding challenges. These weekly tasks were due on Sunday evening each week, and a weekly lecture was livestreamed the following morning. Immediately prior to the lecture, the lecturer would download all of the student responses to each question and paste them into the LLM along with the prompt shown in Table 2. The resulting themes would be presented and discussed during the lecture.

Example reflection report

Table 4 provides excerpts from an AI generated report that was presented and discussed with students during one of the weekly lectures. In the original report each theme would be accompanied by multiple supporting quotes from the data; these have been excluded because we have not secured ethical consent to publish them.

Table 4: A truncated example of summarized themes from case study 2 (with quotes excluded)

Highlights
Mastery of Encapsulation & OOP Concepts (~40%): Students frequently highlighted success in understanding and applying encapsulation (e.g., private/public variables, getters/setters) and broader object-oriented programming (OOP) principles, often tied to the Tamagotchi project.
Hands-On Coding & Practical Application (~30%): Many students emphasized the value of active coding tasks (e.g., Tamagotchi challenges, debugging) and how practical exercises solidified their learning.

Collaborative Learning & Peer Support (~15%): Positive interactions with peers (e.g., pair programming, lab partners) and instructors were cited as key motivators.

Lowlights
Difficulty with Encapsulation & OOP Concepts (~30%): Many students struggled with understanding and applying encapsulation, constructors, and class design
Challenges with Focus & Engagement (~20%): Students reported losing focus during long coding tasks, abstract explanations, or repetitive exercises.
Preference for Hands-On Learning (~12%): Many emphasized needing more practical examples, visual aids, or collaborative work.

Aha-moment
Breakthroughs in Understanding Encapsulation & OOP (35%): Many respondents highlighted "a-ha" moments related to encapsulation, constructors, and object-oriented design.
Effective Learning Strategies: Breaking Down Problems (30%): A recurring theme was the value of incremental problem-solving, pseudocoding, and testing small parts.
Debugging and Syntax Realizations (20%): Many shared moments where fixing small errors (e.g., typos, static usage, or method logic) led to breakthroughs.

Reflections and Lessons Learned

Having implemented the reflection activity and automated summarisation process across two distinct teaching contexts, we found it valuable to engage in our own reflective practice using the same framework we asked of our students. In this section, we present a set of Highlights, Lowlights and Aha-Moments from the teaching team's perspective, offering an honest account of what worked well, what proved challenging, and the key insights we gained along the way. These reflections aim to provide practical guidance for others considering a similar approach, while also illustrating the broader pedagogical impact of surfacing and responding to student voice at scale.

Highlights from an Educator Perspective

One of the most significant benefits we observed was the ability to "close the loop" on student feedback in a meaningful and timely manner. The summarised reflections gave us immediate and actionable insight into what students were finding helpful, confusing, or demotivating, often revealing issues before formal assessments or feedback mechanisms would have. The highlights, lowlights and aha-moments activity proved particularly well-suited to capturing actionable student feedback.

The highlights question was useful for confirming what was working well. For example, in case study 1 a frequent highlight is the physical prototyping embedded throughout the subject, but also the effective engagement with teaching staff and outcomes of applying feedback into their work. In case study 2 students frequently praised the use of gamified assessment (Milne 2024) and pair programming (Salleh et al. 2010) to make laboratory classes more engaging.

The lowlights question revealed areas where intervention and greater support was needed. For example, the coordinator in case study 1 was prompted to provide targeted supplementary resources after multiple students highlighted confusion around the assessment criteria. Similarly in case study 2 many students expressed confusion about a specific but commonly encountered error message, and the coordinator was able to dedicate a section of the lecture to explaining it.

The lowlights question was also helpful in revealing unrealistic expectations that needed to be recalibrated. For example, in case study 1 many students expressed frustration about formative assessments "not counting" towards assessment. The coordinator took this feedback as an opportunity to reinforce the rationale behind feedback-driven learning and assessment fidelity

(Sadler, 2010) to help students develop more realistic expectations of the subject and university-level learning more broadly. Similarly in case study 2, when multiple students complained about the lack of explanatory material in lab classes, the coordinator was able to reinforce that these classes followed a flipped-learning approach and that it was the students' responsibility to prepare for them.

The aha-moments offered insight into whether students were engaging in surface or deep learning and highlighted metacognitive strategies that exemplified the latter. For example in case study 1, many students reflected on how the provide feedback directly led to design improvements, helping connect theory with practical application. This suggest they are not only recipients of feedback, but actively engaging and improving their understanding through self-regulation. In case study 2 many students independently discovered useful strategies for tackling programming challenges efficiently, such as planning ahead with pseudocode, and taking an incremental approach to coding by running and testing code after each small change. The coordinator capitalized on this by developing new resources that focused on helping students develop and apply algorithmic thinking (Futschek 2006), an important skill that the subject had previously overlooked. Quotes from the reflection data were directly incorporated into these new resources.

Lowlights from an Educator Perspective

Some reflections, particularly in the "lowlights" category, included strong emotions or critical feedback. Careful diplomacy was required to present these appropriately without diminishing their seriousness, and resilience was required from teaching staff to avoid taking offence. However even the most strongly worded feedback was generally legitimate, and the rare bits of feedback that felt unfair were still worth hearing out. As mentioned previously, this process allowed such feedback to be aired, addressed and pushed back on in an open way that helped to calibrate expectations. Another issue, experienced in case study 2, was that the activity started extremely well but risked becoming repetitive and performative as the teaching session progressed. The weekly cadence employed was too granular and had overstayed its welcome by the end of the 12-week teaching session. Whereas in case study 1, where it was embedded at the start of each 3-week sprint only, generally had positive reception. Some students even adopted the scaffold to give an holistic overview of their experience in their final presentation. Repetition was most problematic when it involved legitimate criticism that was not practical to address within the current teaching session. For example in case study 2 it became evident that many students found it difficult to focus during the weekly lectures and would have been better served by bite-sized recordings that were specific to each topic. This feedback is difficult to argue with given the growing evidence supporting micro-learning (Senandheera et al. 2024) but could not be addressed in a timely way.

Aha moments from an Educator Perspective

The most significant unexpected insight that emerged during the implementation of the reflective activity was a shift in how we, as educators, understood the purpose of reflection. Initially, we had framed reflection as a largely individual exercise, something students would do privately to make sense of their own learning experiences. However, when the summarised reflections were shared back with the class, a powerful shift occurred. Students began to see that their peers were facing similar challenges, grappling with the same concepts, and celebrating similar wins. This collective recognition of shared struggles and triumphs fostered a stronger sense of belonging and normalised the ups and downs of the learning process. In this way, the reflective activity unexpectedly became a social learning tool, one that didn't just promote self-awareness, but also empathy, connection, and community within the cohort.

Conclusions and future work

The highlights, lowlights, and aha-moments reflection activity, combined with GenAI tools for real-time summarisation, proved to be a practical and impactful strategy for surfacing student voice at scale. By embedding structured reflection and timely feedback loops into two very different teaching contexts, we were able to foster more responsive teaching, encourage metacognitive awareness, and strengthen students' sense of belonging. While the activity was originally designed to support

student learning, it also became a powerful tool for educator reflection and course improvement. However, the process was not without its challenges. Repetition and feedback fatigue emerged as risks over time, and some critical insights could not be addressed within the session they were raised. These limitations suggest a need for refinement in cadence and integration, potentially through more targeted or adaptive reflection prompts. Looking ahead, future work may involve exploring more scalable ways to automate the collection and summarisation process, integrating these insights with learning analytics, and formally evaluating the impact on student outcomes. We also see potential in extending this model to support co-creation and continuous curriculum improvement across diverse disciplines and learning environments.

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