Understanding First-Year Engineering Students' Perceptions of AI-Generated Performance Feedback Reviews

Olivia Ryan, Virginia Polytechnic Institute and State University

Olivia Ryan is a Ph.D. student in Engineering Education at Virginia Tech. She holds a B.S. in engineering with a specialization in electrical engineering from Roger Williams University. Her research interests include developing professional skills for engineering students and understanding mathematics barriers that exist within engineering.

Ms. Katherine Drinkwater, Virginia Polytechnic Institute and State University

Katie Drinkwater is a PhD student in Engineering Education at Virginia Tech. She studies teamwork in engineering teams, engineering extracurriculars, judgment and decision-making in engineering design, and women in engineering. Her background is in Mechanical Engineering.

Susan Sajadi, Virginia Polytechnic Institute and State University

Susan Sajadi is an assistant professor at Virginia Tech in the department of engineering education. She has a BS and MS in Biomedical Engineering and a Ph.D. in Engineering Education Systems and Design from Arizona State University. Prior, she worked as an engineer in the medical device industry.

Dr. Mark Vincent Huerta, Virginia Polytechnic Institute and State University

Dr. Huerta is an Assistant Professor in the Department of Engineering Education at Virginia Tech. He earned his PhD in Engineering Education Systems & Design at Arizona State University and has a BS/MS in Biomedical Engineering. His research group explores approaches to building positive and inclusive learning environments that support the professional growth of students and faculty within engineering education contexts. His research interests include graduate student mentorship, faculty development, mental health and well-being, teamwork and group dynamics, and the design of project-based learning classes.

Understanding First-Year Engineering Students' Perceptions of AI-Generated Performance Feedback Reviews

Abstract

This empirical research, research brief paper, explores engineering students perceptions of AI-generated performance feedback reports (PFR) crafted from peer comments in a project-based learning (PBL) class. Peer feedback is an effective tool for promoting accountability and reducing social loafing among student teams. However, students are often ill-equipped to write constructive, actionable feedback that helps their peers effectively improve their teamwork behaviors. Therefore, feedback literacy has emerged as an important skill for students to develop in order to take action on the feedback they receive, and one of the key constructs of feedback literacy is *appreciating feedback.*

Our recent work has demonstrated the feasibility of utilizing generative AI to create summarized, personalized feedback reports for all students in an engineering PBL class based on written comments from their teammates. We have found that generative AI significantly improves the quality of peer feedback students receive by making it more constructive and actionable. Our broader work examines the impact of AI-summarized feedback reports on the various elements of feedback literacy by analyzing student reflection data. This research brief will focus on the *appreciating feedback* construct, specifically as it pertains to how students appreciate the use of generative AI for the summarized feedback reports.

We piloted the AI-generated feedback reports in six PBL classes as part of a larger study, and students in 2 of the classes completed reflections about the use of AI in developing the PFRs. Using a thematic analysis approach, we first analyzed the reflection data using a priori codes and then employed inductive coding to identify themes within our original codes. We found that students generally appreciated the feedback reports and expressed appreciation for the constructive and concise nature of the feedback, noting that it provided an effective and summarized way to receive feedback from their peers. However, others felt that the reports lacked the nuance present in raw peer comments and wished they could see the original comments. These findings suggest an opportunity to use generative AI as a stepping stone for developing students' feedback literacy. Furthermore, we believe that by understanding students' perceptions of AI in this context, we will gain valuable insights to further refine the integration of AI in the classroom and equip educators with the necessary tools to utilize AI effectively within the current educational landscape.

Introduction and Background

Engineering students' ability to develop teamwork skills is a key goal of engineering education, as outlined in the ABET criteria [1]. Engineering graduates have considered teamwork one of the most important skills in their work [2]. Nonetheless, employers have noted that recent engineering graduates often lack the interpersonal and professional skills necessary to succeed in a collaborative engineering workplace [3]. To develop teamwork skills during their undergraduate education, it is common for students to participate in project-based learning (PBL) courses, where they work on a team for an extended period to simulate workplace settings [4]. In

these courses, students are frequently asked to provide peer feedback since instructors cannot fully monitor each team and its members' contributions.

Peer feedback is an effective tool for promoting accountability and reducing social loafing [5], [6], [7], [8]. However, some students might struggle to give honest and constructive feedback to their peers due to concerns about harming team dynamics or facing backlash from others in the group [9]. Furthermore, students are often ill-equipped to write constructive, actionable feedback that helps their peers effectively improve their teamwork behaviors [9]. Students often struggle to provide effective feedback because instructors rarely teach them explicitly how to do so [10]. In any team environment, whether in school or at work, it is common to give feedback to peers and colleagues. Therefore, feedback literacy has emerged as an important skill for students to develop in order to take action on the feedback they receive [11]. Feedback literacy refers to the capacity to make sense of feedback information and use it to enhance performance. Feedback literacy consists of multiple constructs that contribute to taking action on feedback, one of which is *appreciating feedback* [11]. Research has shown that feedback literacy is an important competency for engineering students [12] and helps students improve their own feedback behaviors [13], underscoring the importance of feedback as a teamwork skill.

To enhance the peer feedback process in engineering team settings, our recent work has demonstrated the feasibility of utilizing generative AI to generate summarized, personalized feedback reports for all students in an engineering PBL class, based on written comments from their teammates [14]. In recent years, education has begun utilizing generative AI for both research and teaching. There is an ongoing discussion among researchers and educators about how to use generative AI effectively [15], [16], [17]. Using generative AI to automate the summary and report generation process for feedback reviews enables instructors to better manage the demands of large classes, providing students with personalized, constructive, and actionable summarized feedback reports [14]. This process has also been paired with training for students to enhance their feedback writing skills for their peers [18]. Summarized feedback reports support the development of feedback literacy for engineering students by offering them examples of effective feedback that they can refer to while writing future feedback.

While generative AI offers many advantages, it also presents potential drawbacks and limitations [16], [17]. The public has mixed views on generative AI, resulting in varying levels of enthusiasm and skepticism [19]. Considering the recent emergence and increased accessibility of generative AI, there is a limited understanding of students' perceptions of generative AI in an educational context. Our broader work examines the impact of AI-summarized feedback reports on various elements of feedback literacy from analyzing student reflection data; this research brief will focus on the *appreciating feedback* construct, specifically as it pertains to how students appreciate the use of generative AI for the summarized feedback reports.

We aim to understand students' perceptions of receiving feedback in this manner; specifically, we are interested in their thoughts on the quality, value, and style of the reports. Therefore, this brief will be guided by the following research question: **What are first-year engineering students' perceptions about receiving an AI-generated feedback report about their teamwork behaviors in a project-based learning course?** These insights will help us understand how AI-generated feedback reports support or hinder students' development of feedback literacy skills.

Methods

We piloted performance feedback reviews (PFRs) in six first-year engineering PBL courses during Fall 2023. Since this is a research brief, we are not able to explain the full details of the PFR generation process, but our recent journal paper [14] provides information on the IRB approval and consent process, the de-identification process, prompt development, and an example of a PFR. The students completed reflections throughout the course about the PFRs and how their approaches to teamwork changed, which is the subject of a forthcoming paper. However, one instructor included a reflection question specifically asking students about the AI aspect of the PFRs, which we chose to share in this research brief. The students responded to this question: "Overall, what did you think about the AI-generated Feedback Reports? What are your thoughts about the reports being generated by AI?"

In total, 106 student responses were collected, and we analyzed them using two rounds of coding. The first round of coding categorized student responses into "Appreciates AI-generated feedback" and "Does not appreciate AI-generated feedback." The initial coding round allowed us to understand students' overall perceptions of the AI-generated reports. Our focus on *appreciating feedback* was informed by a theory of student feedback literacy [11] that asserts that *appreciating feedback* is a prerequisite for students to act upon it. The second round of coding utilized an inductive coding method [20] to identify themes in the data. We analyzed each quote from the first round to highlight what specifically students appreciated or did not appreciate regarding the AI-generated reports, and three themes emerged.

Findings

We identified three key themes in students' reflections on the reports they received: the constructiveness, conciseness, and summarized nature of the feedback reports. In general, students viewed the reports positively, though some expressed critiques or concerns. In our first round of coding, we coded 66 instances of students appreciating the reports and 29 instances of students not appreciating the reports.

Constructive

The first theme centered around the constructiveness of the feedback reports. Students found that the feedback reports provided constructive, actionable feedback to help them improve their teamwork behavior. For example, one student said, "The AI generated feedback was very accurate and phrased in a very constructive way." This was echoed by other students who felt that the feedback report provided specific, detailed suggestions to help their teamwork behavior: "From the teamwork assignment I was surprised to see the level of detail provided by GPT within the report and its ability to create suggestions." Generally, students found that the constructiveness of the feedback reports was a major strength.

A limitation of the generated feedback reports is that their ability to provide constructive feedback relies on student peer comments. Some students did not write as detailed or robust comments as others, which became clear in the feedback reports. Some students didn't think the feedback reports were helpful because they lacked constructive feedback; for example, one student said, "However, the feedback report did not have any constructive feedback (or

non-positive feedback at all), which was not helpful." Similarly, students said they didn't find anything useful in their feedback report because it didn't provide suggestions for anything they didn't already know.

Concise

Another one of the themes centered on the conciseness of the feedback reports. All of the feedback reports summarized 3-5 peer comments and a self-reflection into a one-page letter that outlined the students' strengths, areas for improvement, and alignment of their peer feedback with their self-reflection. Students appreciated the conciseness and found the letter easy to digest; this can be illustrated by a few student reflections: (1) "I think the AI did a good job of generating feedback report that was concise but still informative and formal," (2) "Even though it was written by an AI, I could easily understand it, and it gave clear and concise feedback," and (3) "These AI generated reports are really cool and I like how there short yet descriptive so I can work on myself without having to read several pages of my teammates responses." These reflections show how students value and appreciate the conciseness of the feedback reports.

Although many students appreciated the conciseness of the feedback reports, others felt that the reports might lose nuance or details in their summary; as one student said, "I think the AI-generated Feedback Reports glaze over many important and personalized details that are included in the feedback given by teammates." Another student echoed a similar concern but recognized the potential value of these types of feedback reports."While the AI-generated reports offer useful insights, they might not capture all nuances, but they serve as a valuable starting point for self-reflection and improvement." This mixed opinion on the conciseness and utility of the reports was a common theme among students:

> I feel like the AI-generated reports are a bit vague and I can tell they are AI generated because they take the exact words from my initial post and [regurgitate] it without much change so…the delivery is not the greatest. That being said I love the concept as it is a new way of improving teamwork habits while also compiling mass of amounts of forums to give a concise and detailed/personalized report for everyone.

Summarized Nature

The final theme emerging from the student reflections was the summarized, anonymous nature of the feedback reports. Although peer evaluation systems like CATME allow instructors to release peer comments anonymously, the individual comments may still be recognizable. Therefore, summarizing the comments into one report adds a level of anonymity. Students overwhelmingly appreciated that the feedback reports were summarized and anonymous, as they provided a safe avenue for sharing and receiving feedback without worrying about hurting others' feelings. These two quotes illustrate that sentiment.

> It is so interesting that I am able to read feedback from my teammates but also keep it anonymous so it is not taken personally. I think everyone made kind and helpful comments that reassures me and I appreciate that I am able to know what they think of me so I know how to improve.

> The feedback I received was helpful and not as intimidating to receive so I think next time I won't be as scared to share how I feel about my teammates in terms of the work they put in because I like that ChatGPT is another layer and it is ultimately helpful to get this feedback.

Students also stated that they felt like they could provide negative feedback instead of focusing on just positive feedback, “I enjoyed the AI-generated feedback reports because they allowed team members to be more comfortable with giving constructive, negative feedback versus only positive feedback.”

Although students overwhelmingly appreciated the anonymous nature of the feedback reports, some students expressed that the anonymous nature removed some transparency they were hoping for among their team. One student expressed this critique.

> Unfortunately, I think the AI makes it hard to form a strong bond within the team through transparency. If team members are willing to work with one another then they should also expect criticism if they fall behind in a certain area, or at the very least they can talk about what went wrong.

The students who didn’t like the feedback reports had similar issues and wanted to see the original comments from their teammates instead of the summarized comments.

Implications and Discussion

As this work demonstrates, generative AI is a valuable tool that can be effectively utilized in engineering education. It can help automate instructor processes to provide students with constructive, concise, and summarized feedback, enabling them to improve their teamwork skills. Summarizing feedback is a valuable use case because it helps students develop the teamwork skills essential for engineers in the workplace [2]. Generally, students had positive perceptions of generative AI being utilized in this way; however, some students raised concerns about losing nuance in the summary and wishing they could see the raw comments themselves. Our recent work evaluating the PFRs found that AI accurately summarizes and also enhances peer feedback; however, some students may feel like the reports lack nuance, which likely stems from the lack of detail in the raw comments [14].

These findings suggest an opportunity to use generative AI as a stepping stone for developing students’ feedback literacy behaviors. The system we have developed provides concise summaries that students can use to enhance their feedback skills; ultimately, the goal is for students to be able to write feedback that can be directly shared with their peers. Therefore, modeling what constructive feedback looks like through the performance feedback reports is one way students can improve their ability to write feedback. However, this should not be the only way students are taught to improve their feedback skills. We have also shown the importance of incorporating an intervention in writing feedback into PBL courses [18]. Instructors can consider how peer evaluations are scaffolded within their class and across the curriculum to help support students' feedback literacy development.

Furthermore, understanding student perceptions of generative AI in the classroom provides insight into how to effectively implement these tools while ensuring they are used appropriately.

Generally, it has been found that students have positive perceptions of generative AI to help with teaching and learning support, but have concerns about privacy and accuracy [21], [22], which aligns with our findings. For educators interested in incorporating generative AI into the classroom, we encourage them to solicit feedback to gauge students' perceptions of AI in the classroom and identify areas for improvement in its use for both educators and students. By gathering and analyzing student feedback, educators can refine AI applications to better align with their goals and increase overall acceptance of AI technologies. Ultimately, leveraging student perceptions not only enhances the efficacy of generative AI in the classroom but also prepares students to engage thoughtfully with AI technologies in their future professional and personal lives.

References

[1] "Criteria for Accrediting Engineering Programs, 2022 – 2023 | ABET." Accessed: Sep. 29, 2022. [Online]. Available: https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2022-2023/

[2] H. J. Passow, "Which ABET Competencies Do Engineering Graduates Find Most Important in their Work?," *J. Eng. Educ.*, vol. 101, no. 1, pp. 95–118, 2012, doi: 10.1002/j.2168-9830.2012.tb00043.x.

[3] National Academy of Engineering, *Understanding the Educational and Career Pathways of Engineers*. Washington, D.C.: National Academies Press, 2018, p. 25284. doi: 10.17226/25284.

[4] C. L. Dym, A. M. Agogino, O. Eris, D. D. Frey, and L. J. Leifer, "Engineering Design Thinking, Teaching, and Learning," *J. Eng. Educ.*, vol. 94, no. 1, pp. 103–120, 2005, doi: 10.1002/j.2168-9830.2005.tb00832.x.

[5] C. M. Brooks and J. L. Ammons, "Free Riding in Group Projects and the Effects of Timing, Frequency, and Specificity of Criteria in Peer Assessments," *J. Educ. Bus.*, vol. 78, no. 5, pp. 268–272, May 2003, doi: 10.1080/08832320309598613.

[6] D. Hall and S. Buzwell, "The problem of free-riding in group projects: Looking beyond social loafing as reason for non-contribution," *Act. Learn. High. Educ.*, vol. 14, no. 1, pp. 37–49, Mar. 2013, doi: 10.1177/1469787412467123.

[7] S. G. Harkins and J. M. Jackson, "The Role of Evaluation in Eliminating Social Loafing," *Pers. Soc. Psychol. Bull.*, vol. 11, no. 4, pp. 457–465, Dec. 1985, doi: 10.1177/0146167285114011.

[8] K. H. Price, D. A. Harrison, and J. H. Gavin, "Withholding inputs in team contexts: Member composition, interaction processes, evaluation structure, and social loafing," *J. Appl. Psychol.*, vol. 91, no. 6, pp. 1375–1384, 2006, doi: 10.1037/0021-9010.91.6.1375.

[9] A. Burgess *et al.*, "Peer review in team-based learning: influencing feedback literacy," *BMC Med. Educ.*, vol. 21, no. 1, p. 426, Aug. 2021, doi: 10.1186/s12909-021-02821-6.

[10] N. E. Winstone, R. A. Nash, M. Parker, and J. Rowntree, "Supporting Learners' Agentic Engagement With Feedback: A Systematic Review and a Taxonomy of Recipience Processes," *Educ. Psychol.*, vol. 52, no. 1, pp. 17–37, Jan. 2017, doi: 10.1080/00461520.2016.1207538.

[11] D. Carless and D. Boud, "The development of student feedback literacy: enabling uptake of feedback," *Assess. Eval. High. Educ.*, vol. 43, no. 8, pp. 1315–1325, Nov. 2018, doi: 10.1080/02602938.2018.1463354.

[12] K. Coppens, L. Van den Broeck, N. Winstone, and G. Langie, "Capturing student feedback literacy using reflective logs," *Eur. J. Eng. Educ.*, vol. 48, no. 4, pp. 653–666, Jul. 2023, doi: 10.1080/03043797.2023.2185501.

[13] P. Dawson, Z. Yan, A. Lipnevich, J. Tai, D. Boud, and P. Mahoney, "Measuring what learners do in feedback: the feedback literacy behaviour scale," *Assess. Eval. High. Educ.*, vol. 49, no. 3, pp. 348–362, Apr. 2024, doi: 10.1080/02602938.2023.2240983.

[14] S. Sajadi, M. Huerta, O. Ryan, and K. Drinkwater, "Harnessing Generative AI to Enhance Feedback Quality in Peer Evaluations within Project-Based Learning Contexts," *Int. J. Eng. Educ.*, 2024.

[15] A. Johri, A. S. Katz, J. Qadir, and A. Hingle, "Generative artificial intelligence and engineering education," *J. Eng. Educ.*, vol. 112, no. 3, pp. 572–577, 2023, doi:

10.1002/jee.20537.
[16] J. Su (苏嘉红) and W. Yang (杨伟鹏), “Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education,” *ECNU Rev. Educ.*, vol. 6, no. 3, pp. 355–366, Aug. 2023, doi: 10.1177/20965311231168423.
[17] D. Baidoo-Anu and L. O. Ansah, “Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning,” *J. AI*, vol. 7, no. 1, Art. no. 1, Dec. 2023, doi: 10.61969/jai.1337500.
[18] K. Drinkwater, O. Ryan, S. Sajadi, M. Huerta, and M. Fisher, “Improving Peer Feedback in Project-Based Learning Contexts: An Investigation into a First-Year Engineering Intervention,” in *2024 ASEE Annual Conference & Exposition*, Jun. 2024.
[19] M. F. and A. Tyson, “What the data says about Americans’ views of artificial intelligence,” Pew Research Center. Accessed: Jan. 02, 2025. [Online]. Available: https://www.pewresearch.org/short-reads/2023/11/21/what-the-data-says-about-americans-views-of-artificial-intelligence/
[20] J. Saldaña, *The coding manual for qualitative researchers*, 2nd ed. Los Angeles: SAGE, 2013.
[21] C. K. Y. Chan and W. Hu, “Students’ voices on generative AI: perceptions, benefits, and challenges in higher education,” *Int. J. Educ. Technol. High. Educ.*, vol. 20, no. 1, p. 43, Jul. 2023, doi: 10.1186/s41239-023-00411-8.
[22] V. V. Ravi Kumar and R. Raman, “Student Perceptions on Artificial Intelligence (AI) in higher education,” in *2022 IEEE Integrated STEM Education Conference (ISEC)*, Mar. 2022, pp. 450–454. doi: 10.1109/ISEC54952.2022.10025165.