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Using guided reflections to increase awareness of positive engineering team member behaviors

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introduction

Team projects and assignments are commonly used in engineering technology classes, as studies have shown them to promote learning and persistence [1] as well as to satisfy ABET accreditation requirements [2]. Throughout engineering technology curricula, students are taught the skills necessary to accomplish the technical tasks required of them in the team projects and assignments, but many students lack any experience working on a high-functioning engineering team. They are told to 'work as a team' but have no paradigm of what that instruction means. This can lead to the majority of students experiencing interpersonal problems and reduced learning [3]. Recent publications have focused on remedying this through promoting psychological safety [4] or cultivating teamwork as a virtue instead of a skill [5]. This work attempts to focus on the skills of teamwork.

research methods and procedures

This paper describes efforts in the fall semester of 2024 to implement learning teamwork skills into a junior-level finite element analysis course in the MET program at Montana State University, building upon previous work [6] that used team assignments and projects to promote engagement and curiosity.

Many class periods throughout the semester used the model of reviewing the homework and concepts from the previous class, then breaking into groups to apply the newly learned technique to the ongoing group project. Next, an individual was randomly selected to present their group's findings to the class in a design review-like setting. Afterwards, students were assigned an online 'quiz' that was actually a reflection activity. They were asked about how the newly learned skill applied to the problem at hand, what the presented group did that was different from their group, what they might do differently when faced with a similar problem in the future, and how they felt their group functioned during the work time. Afterwards, the class continued with the introduction of new concepts and a homework assignment due at the next class period.

Previous efforts fell short of prompting deep reflection on the part of the students—when asked how their team functioned and presented with unlimited space to write their feelings, nearly every student would simply type "fine," or "ok," or "good." More guidance for the reflection activity was clearly needed.

The literature described methods in which guided reflection can be used to promote learning, [7-11]. Ash's and Clayton's work [10] even describes a method by which the guided reflection need not grow so large and lengthy to make it impractical as an in-class activity, it may be as simple as 4 sentences, using prompts Ash and Clayton [10] describe as:

a) What did I learn?
b) How did I learn it?
c) Why does it matter?
d) What will I do in light of it?

Having a short in-class reflection was preferred, as it is suspected that a longer, out-of-class reflection assignment would be subcontracted by the students to an LLM, whereas none has (as of yet) displayed the audacity to use an LLM to generate the text of a reflection when physically attending the class.

For the guided reflections about team functioning, the specifics of the prompting questions were crafted to highlight positive STEM team behaviors identified in research [12-13].

Students were given the opportunity to assess their strengths and weaknesses near the beginning of the semester. This self-assessment was to be used to track changes in the students' perception of the strength of their teamwork skills.

Most of the students in this class were simultaneously enrolled in either a junior-level required multi-disciplinary group project course (a pre-requisite for a two-semester capstone sequence) where the MET students work on a 4-person semester-long team project with junior students from other engineering majors, or the two-semester joint Mechanical Engineering-Mechanical Engineering Technology capstone sequence where the students work on a 4-person team project that includes a semester of design and a semester of building and testing. In the history of teaching this class, I have noted the students spend a large amount of time before and after (and sometimes during) the class complaining about the dysfunction of their engineering teams in the other classes. My naïve assumption was that the frustration of those experiences would point out to the students how much they had yet to learn about how to positively contribute to an engineering team, and the prescribed guided reflections would serve the purpose of teaching the skills to improve each student's assessment of their own teamwork skills.

results and discussion

Results of the student self-assessment were extremely surprising—all students felt they were excellent team members. The average self-assessment of teamwork skills rounded to 9 on a scale of 1 (lowest) to 10 (highest) with only one student out of 24 enrollees assessing themselves less than 8 out of 10. Clearly, the problem with all teams was somebody else. Assessing again later in the semester to see growth would not be useful; the initial assessment left no room for growth.

Instead, a more direct approach was taken—spend class time explicitly discussing the concrete examples of team member behaviors shown in the American Association of Colleges and Universities' Teamwork VALUE Rubric [13]. This change in approach meant meaningful assessment of the work must take place in the future. The revised approach was to focus on one of the five rows of the VALUE Rubric during a single class period. The students were then asked to reconstruct the levels of the VALUE Rubric in a quiz format to show they could recognize and recall facts involving teamwork (lowest level of Bloom's Taxonomy [14]). Later reflection exercises after group activities were used to evaluate whether the students understood the concepts and were applying them within their own group activities, reaching the next two level's of Bloom's Taxonomy.

conclusion

Students learning to work in teams need to be explicitly taught positive engineering team member behaviors. In the future, this will be taught and reinforced throughout the semester both

through guided reflection and more traditional assignments and activities with better-designed assessment.

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