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Using Reflection to Promote Teamwork Understanding in Engineering Design Education

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Purpose With teams almost ubiquitous in industry and increasingly the norm in engineering design classes, our study aimed at seeing whether reflective exercises can help students better understand the nature of high performing teams and how to leverage their own strengths—and manage conflicts--as members of an effective team. In particular, we wanted to see how students' understanding of successful teams evolves over time and whether their growing understanding can help us evaluate our instructional approach and learn how best to teach teamwork in relation to design.

Background The study context was a two-quarter, project-centered, team-based introduction to user-centered design—Engineering Design and Communication (EDC)--that is co-taught by faculty from engineering and communication and thus integrates communication and teamwork instruction into the design experience[1]. Teamwork instruction and coaching were part of the original course design, since faculty assumed that team experience alone is insufficient to help students acquire the teamwork competency needed to succeed in engineering. Following Schon's and Kolb's ideas about reflective practice and experiential learning [2, 3], students had several opportunities in the course to reflect on their team's achievements and performance [4]. Thus their concrete design experiences were combined with reflection and abstraction so that their ideas could evolve as they underwent a holistic adaptive learning process. Previous research [4] based on pre- and post-course memos about students' team experiences suggested that students were indeed gaining awareness of the characteristics of effective teams that have been identified in the literature [5], such as dividing the work equally, benefiting from team members' diverse strengths, and communicating regularly. However, findings also pointed to gaps that instructors considered important, such as failing to realize that "true teams" identify and work toward a shared, measurable performance goal. In addition, since the memos were very open-ended, they were difficult to code.

Method After taking steps to improve teamwork instruction in the following year, we planned a more structured assessment to explore student learning. Just before the course and at the end of their first quarter, students were given a reflective assessment to complete online: "Identify and discuss the factors that contribute to successful team performance." In answering the question for the second time, students were able to see their original answer. Thus, they could see that the response was designed as an ungraded reflective answer, not a test. Approximately 96% of students completed the pre assignment and approximately 79% completed the post. For analysis, we randomly selected 75 paired responses (approximately 25% of the data). Two readers blind-coded the responses, looking for the same essential characteristics of successful teams that we used in the earlier study and that are widely identified in the literature.

Findings In the ten categories that were tracked, positive changes occurred in seven areas, where the post score was higher than the pre score. We used these scores not as a measure of "right" and "wrong" ideas about teamwork but rather as guides to analyze student responses in specific areas. From this examination, we concluded the following:

- While students do not often refer specifically to a "true team,"—a term commonly found in the teamwork literature—many show an excellent understanding of a "true" or "high performing" team in language that demonstrates an understanding of the concept. Responses show an understanding of synergy—how a well functioning team of individuals working together can accomplish more than any one of them could accomplish alone—along with a focus on a shared goal or common purpose. This connection was lacking in the 2003 study.
- Although the numbers in some categories do not change much, or may even decrease, the content indicates considerable growth in understanding teamwork and the nature of teams. This shows up in the greater specificity and elaboration of many post responses,
- As students discuss key ideas about communication, open-mindedness, and respect, they connect them to essential design activities. Some students came into the course connecting high performing teams with creativity and innovation, but others gained this insight as the course proceeded.
- Decreased scores related to some teamwork traits, like communication, may be a limitation of the study, since students tended to replace a broad term like communication with specific communication activities that they discussed in the post responses in terms of other skills such as project management. Ironically, despite the lower score, student responses suggest a more nuanced and sophisticated understanding of some of these concepts.

Conclusion Opportunities for reflection on teamwork appear to have a useful place in design courses in the engineering curriculum. However, further work needs to be done to explore the relationship between this growth in teamwork and the students' performance in design.

References

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