Board 17: Work in Progress: Promoting Equitable Team Dynamics in a Senior Biomedical Engineering Design Course

Dr. Jennifer H Choi, University of California, Davis

Jennifer Choi is currently an Associate Professor of Teaching in the Department of Biomedical Engineering (BME) at UC Davis. In addition to teaching core undergraduate courses, Jennifer is aimed at integrating engineering design principles and hands-on experiences throughout the curriculum. She has interests in engineering education, and curricular innovation. Prior to joining UC Davis, Jennifer taught in the BME Department at Rutgers University, and was a postdoctoral fellow at Advanced Technologies and Regenerative Medicine, LLC. She received her doctoral degree in Biomedical Engineering from Tufts University, M.S. degree from Syracuse University, and B.S. degree from Cornell University.

Work in Progress: Promoting Equitable Team Dynamics in a Senior Biomedical Engineering Design Course

Introduction

Team-based engineering design projects are common mechanisms to promote hands-on engagement with the engineering design process. Team-based projects are often implemented in both introductory and senior level courses in the undergraduate engineering curriculum. Navigating the complex team dynamics that occur at both curricular stages, however, can often be challenging. Student population, course structure, project scope, timeline, and course workload are just a few factors that may influence how effective students are as team members and what strategies instructors may use to promote healthy team dynamics.

Previously, the implementation of an equity minded strategy for promoting healthy team dynamics was explored in an introductory biomedical engineering (BME) course [1]. The use of asset-based activities throughout the course provided introductory students with a mechanism to share about their individual assets with their teammates and complete their team-based design project through the lens of team member assets and interests. Student feedback was previously reported, in which introductory students felt the asset-based activities were very useful and had a significant positive impact on their team dynamics and productivity [1]. Following the positive feedback received in the introductory course, the same equity-minded approach was implemented in a senior BME capstone design course. This Works-in-Progress explores the implementation and preliminary impact of asset-based activities in a senior BME capstone design course.

Methods

Description of Asset-based activities: Individual asset maps, team-based asset charts, and asset-based cover sheets were incorporated into our year-long BME capstone senior design course, in which students engage with the engineering design process through a team-based design project (Figure 1). Each student generated an individual asset map during week 1 of the course. Asset maps provided students with the opportunity to highlight their experiences, acquired skills and desired areas for growth through a constructed web of connected text [2]. Students were encouraged to utilize a freely available mind mapping software, www.bubbl.us, to create their maps. Students noted their assets in various areas including: team and project skills, personal background and culture, clubs/organizations/sports, technical expertise, passions and interests, relevant experiences, related coursework and jobs, and creativity. Once teams were self-formed by week 2, each team member shared their asset map with their teammates in class. During the same class session, teams also produced team-based asset charts which listed all team-based assignments in the course and assigned members to specific parts based on their assets and/or desire to grow in a particular asset. Likewise, teams completed a team culture chart in which culture goals, actions and warning signs could be discussed and articulated [3]. Student teams then submitted project applications in week 3, which required teams to articulate their rationale for their top seven project choices based on team interests, experiences, and skills. For each major written team assignment thereafter, teams were also required to include an asset-based cover sheet, which highlighted each team member's contribution and related assets [2].

Peer Evaluation: Four times throughout the senior design course, students evaluated themselves and their teammates using the CATME peer evaluation tool. In this online peer evaluation tool, students rated their peers' behaviors (1 to 5) in each of the following areas: Contributing to team, Interactions with team, Keeping team on track, Expecting quality, and Having knowledge, skills and assets. Ratings from the first peer evaluation in two offerings of the course in which asset-based activities were incorporated were compared to aggregated ratings from the three previous course offerings and subsequent offering in which asset-based activities were not included.

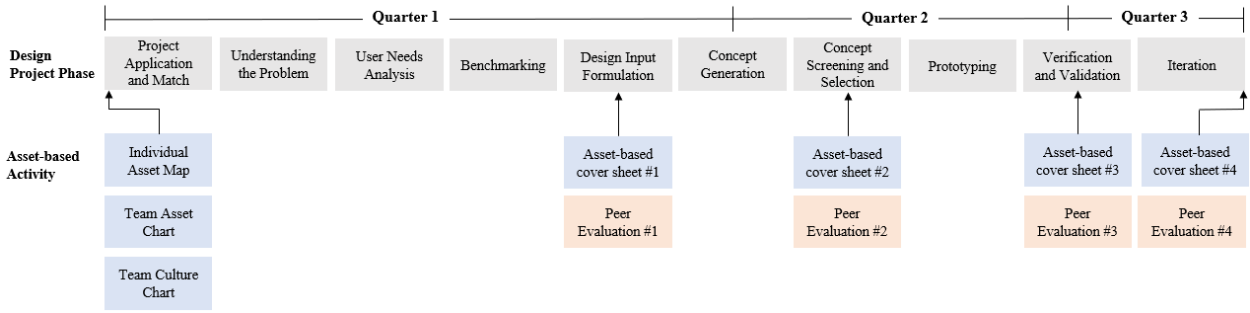

Figure 1. Timeline of asset-based activities and CATME peer evaluations implemented in year-long BME capstone senior design course.

Student Feedback: While formal student feedback on asset-based activities was not collected, course evaluation comments were assessed.

This study protocol (ID 1705553-2) was reviewed and determined exempt by the institution's Institutional Review Board.

Results and Discussion

A comparison of CATME Peer Evaluation #1 ratings collected from six offerings across three course structures of the senior design course is shown in Figure 2. The Pre bar represents aggregated data from the 3 offerings before asset activities were implemented. The Asset Activity bar represents the peer evaluations collected from the two offerings with asset activities. Lastly, the Post bar represents peer ratings from the latest offering where asset activities were not included. Interestingly, peer evaluation ratings for Interacting with teammates, Keeping team on track, Expecting quality and Having related knowledge, skills and abilities were significantly higher ($p<0.05$) in course offerings with included asset-based activities compared to both before and after activities were implemented. Peer ratings for Contributing to the team, however, were significantly higher when asset activities were included only when compared to the course offerings before activities were implemented. This suggests that the asset-based activities may have played a significant role in increasing students' ability to work effectively in a team.

End of course evaluations following asset-based activity integration, however, revealed that some students felt that there was too much emphasis on team building. For example, one student stated, *"I think we spent too much time team building in Fall. A lot of us already knew each other and we spent so much time together that even if we didn't, we would have gotten close."* Similarly, another agreed stating, *"There was too much team building in fall quarter. It was*

redundant as most of us already knew each other very well due to BIM classes and friend groups." For context, by the first day of class, 70% of the students in this class already had formed teams, which suggests that many students had developed working relationships with their peers prior to their senior year. Other comments corroborated this sentiment, however also felt that it came at a cost of the project timeline: *"It would be nice to do less team building in the beginning and shift the timeline forward faster."*

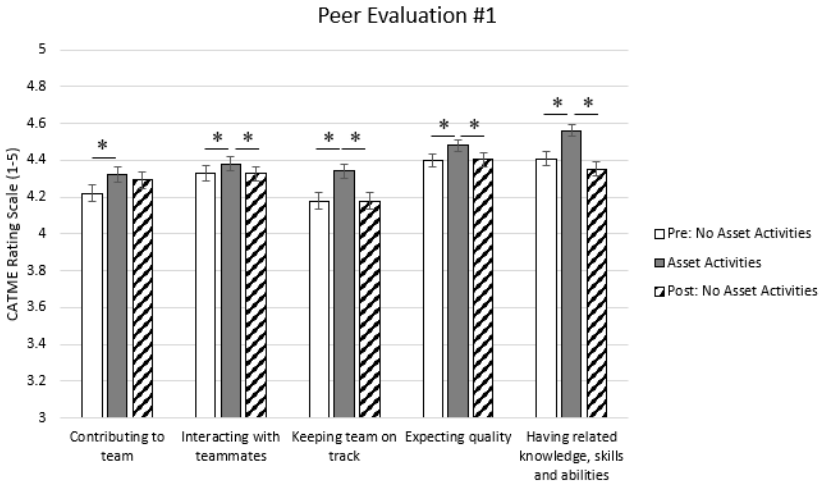

Figure 2. Comparison of mean CATME Peer Evaluation #1 ratings for BME capstone design course from course offerings before asset-based activities were included (Pre: No Asset Activities, n=364), after activities were included (Post: No Asset Activities, n=425), and during the two course offerings in which asset-based activities were implemented (Asset Activities, n=457). *Statistical significance ($p<0.05$, t-test).

Importantly, asset-based activities were implemented for the first time during the first iteration of a restructured senior design course, where the BME senior design course transitioned from a 2-quarter to 3-quarter long course. The additional quarter allowed for more time at the start of the quarter for team building and asset-based activities but was also intended to provide more time for prototype testing and iteration. As a result of the additional time, Peer Evaluation #1 was conducted after teams had been working together for 4 more weeks than when it was conducted during the previous 2-quarter structure. One speculation is that the additional time provided teams with more opportunity to experience working together, contributing to the significantly higher peer evaluation ratings. Furthermore, in the following 3-quarter offering when asset-based activities were not included, the course timeline was shifted such that Peer Evaluation #1 occurred at the same time as those offerings that did not include asset activities (Pre). As shown in Figure 2, evaluation ratings were at a similar level to ratings in the offerings prior to asset activities (Pre), also suggesting that the additional time may have contributed synergistically with asset-based activities to achieve higher peer evaluation ratings.

Future plans to collect additional feedback will deepen our understanding of the impact and value of asset-based activities on *all* students in our senior level team-based design course. Additionally, further studies are needed to investigate how to effectively scaffold the undergraduate curriculum with equity-minded team dynamics instruction.

References

[1] Choi, J. H. (2021, July), *Work in Progress: Promoting Equitable Team Dynamics in an Introductory Biomedical Engineering Course* Paper presented at 2021 ASEE Virtual Annual Conference Content Access, Virtual Conference. https://peer.asee.org/38191.
[2] Stoddard, E. L., & Pfeifer, G. (2018, April), *Working Toward More Equitable Team Dynamics: Mapping Student Assets to Minimize Stereotyping and Task Assignment Bias* Paper presented at 2018 CoNECD - The Collaborative Network for Engineering and Computing Diversity Conference, Crystal City, Virginia. https://jee.org/29598.
[3] Ralt, D. and Wall, J. "Intentional Teamwork." *Student Guide to Biodesign,* Version 2, Stanford University, 2021, biodesignguide.stanford.edu.