

Work in Progress: Using CATME in Team Development of One-Semester-Long Open-Ended First-Year Engineering Student Design Projects

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Work-In-Progress: Using CATME in Team Development of One-Semester-Long Open-Ended First-Year Engineering Student Design Projects

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Introduction

Engineering schools offer project-based courses during the first-year study. These project-based courses present student teams with real-world problems [1], develop team leadership [2] amongst student teams, analyze team performance, team abnormalities, and conflicts [3], as well as improve their teamworking skills [4]. The students also develop communication skills [5]. Those multiple project goals require the instructors to have a solid understanding of how to form and maintain healthy student teams and track individual team performance. Peer feedback helps the participants to sharpen teamwork skills via giving feedback on team members' competencies and receiving feedback on one's own competencies [6]. Peer evaluation allows the instructors to capture interactions when not present. Peer evaluation in the middle of the project also helps students to improve their team's performance [7]. CATME is a web-based tool that has been used by over one million students, which includes tools for peer evaluation, team formation, and assessing teamwork skills [8]. CATME has rater practice tools [9] and frame-of-reference [10] training to improve the quality of peer evaluation. The peer-evaluation framework includes five basic behavior dimensions: contributing to the team's work, interacting with teammates, keeping the team on track, expecting quality, and having relevant knowledge, skills, and abilities (KSAs).

In addition, CATME offers another five dimensions for instructors to have a better understanding of the individual perception of team collaboration: conflict, satisfaction, cohesiveness, interdependence, and peer influences. In detail, the dimensions of conflict, satisfaction, and cohesiveness are intended to evaluate the current team situation and avoid potential conflicts. For decades, organizational psychological scholars have investigated interpersonal conflict [11, 12]. Team conflicts generally arise from different opinions on project directions and working styles [13]. Conflict could potentially impact the team performance in a negative way [14]. Therefore, instructors should keep tracking the development of potential team conflicts. The satisfaction of individual team members is primarily related to the team structure and interaction [15]. Cohesiveness is regarded as synergy between team members [16]. Studies showed that higher cohesiveness could lead to an increase in team performance [17]. On the other hand, the dimensions of interdependence and peer influences are intended to evaluate potential leadership amongst team members (**Figure 1**). Leadership is the core of the team structure. Effective leadership is defined as paying proactive and reactive attention to the team's needs [18], which could positively impact team performance [19].

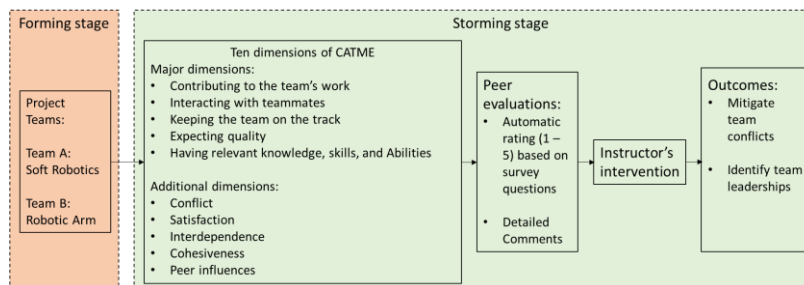


Figure 1. The theoretical tracking model helps the team development

This work-in-progress study aims to use the ten dimensions to construct the data collection model and mitigate potential team conflict and seek potential leadership for team building. The research question is: *Could CATME help to identify team conflicts and leadership in a multi-disciplinary small-size team environment?*

Experimental Methods

Twelve undergraduate students (most of them were first-year students) were split into two project teams with even student numbers. Team A aimed to build a soft robotic gripper, while Team B aimed to build a voice-activated robotic arm. During the team formation stage, Team A used an interest-driven approach to assign individual tasks, while Team B used a merit-based approach to assign individual tasks. In Team A, the students were allocated the tasks based on their own learning objectives. In Team B, the students were allocated the task based on their individual strengths. For example, a student with a computer science background was assigned to a machine-learning-related task. In April 2022, both teams were at the storming stage. All the team members took the rater practice before the peer evaluation. To investigate if CATME could provide more insightful information than conventional Google form, Team B members also took the peer evaluation in Google form. An end-of-semester survey was taken to evaluate the CATME experience (**Figure 2**).

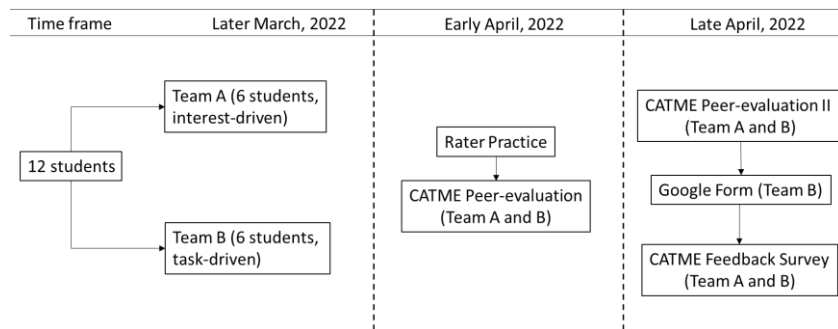


Figure 2. Survey strategy used in this study

Results and Discussion

CATME Peer Evaluation Results for Team Conflicts and Leadership

The average peer rating for Team A and B was above 3.9 across the five dimensions of CIKEH: contributing to the team’s work (C); interacting with teammates (I); keeping the team on track (K); expecting quality (E), and having relevant knowledge, skills, and abilities (H). Having a score of 3.0 means above-average performance and 4.0 means acceptable performance. Besides quantitative evaluation, all the team members gave comments to each other. A closer look at comments revealed some potential conflicts (**Table 1**).

Table 1. Selected comments at the early storming stage

Team A Comments
Member 1 commented on Member 2: “I do not see her in the virtual meetings either, so I do not know what she contributes.”
Member 4 commented on Member 5: “I think he can communicate more and be more present in meetings to know what’s going on.”

Member 4 commented on Member 6: “He can communicate better but is doing an overall good job in the group.”
Team B Comments
Member 2 commented on Member 1: “I think she could contribute a lot more.”
Member 2 commented on Member 1: “I just wish she was more present during meetings.”
Member 6 commented on Member 2: “He seems very busy, although I do not communicate with him often.”

In Team A, Member 4 commented on Member 6 that “He can communicate better but is doing an overall good job in the group.” After an invention from the instructor via setting up a one-on-one meeting with member 6, Member 4 commented on Member 6 again, “He was able to perform up to standard.”

Figure 3 includes scores of other dimensions. Taking Team A as an example, the team conflicts decreased from 1.22 to 1.07 at the late storming stage after the instructors’ intervention. In the late team storming stage, Member 4 of Team A was rated by peers to be above average (4.60) in the dimension of interdependence, while Member 5 of Team B was rated above average (2.77) in the dimension of peer influence. Those above-average scores show traits of potential leadership for both students. Later in the team elections, both students were elected by their peers to be the leaders.

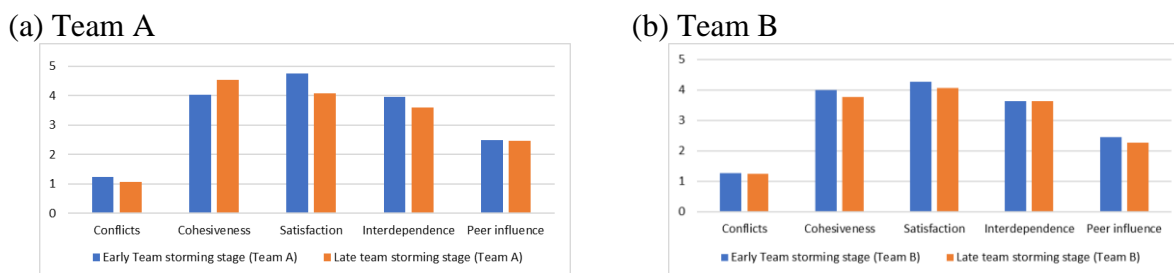


Figure 3. Average scores for conflicts, cohesiveness, satisfaction, interdependence, and peer influence for Team A and Team B at early and late storming stages.

In the conventional google form, the team members just need to provide one general score for peer evaluation. Two additional questions were designed to evaluate team interaction: “Please list the tasks you have completed so far.” as well as “Do you feel like you are being treated unfairly on your team? If so, please elaborate.” The end-of-semester survey shows some students were in favor of Google form, probably due to its simplicity. Overall, 50% of students agreed with the statement that CATME helped them with team development.

Conclusion

This preliminary study demonstrates the feasibility of using CATME to identify potential conflicts as well as leadership in small-class projects. The results show the quantitative scores of are helpful for identifying leadership while individual comments are beneficial for identifying potential conflicts. Based on the feedback from CATME, the instructor could apply a variety of interventions to prevent further development of conflicts. The inventions include one-on-one virtual or in-person meetings, group meetings, redistributing of team tasks, and shifting group activity to a more agreeable time slot.

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