

Comparing Team Evaluation Software (Team+ and CATME)

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Abstract—The first-year program at Michigan Technological University emphasizes an active, collaborative learning environment. Students are grouped into teams of 3-5 students to work on class activities and projects. The success of this program relies on the students learning to work together and numerous activities in the class are designed to help build these teamwork skills. For example, teams are expected to build a team contract at the beginning of the semester and provide formative and summative feedback to each team member in the form of peer evaluations.

In the Fall of 2021, four faculty members at Michigan Technological University evaluated two different teaming systems designed to help enhance these teamwork skills: CATME and Team+. A total of 402 students, in 19 sections of our first-year engineering course participated in this study. Sections were randomly assigned to using either the CATME or Team+ tool. Eight sections (170 students) used the CATME tool and eleven sections (232 students) used Team+. We have historically used the CATME team tool in our courses for peer evaluation. Comparing peer evaluation results with Team+ is one metric we used to measure how our first-year engineering populations responded to this new teaming software. Additionally, we evaluated the impact both of these tools had on team connectedness and satisfaction as well as participation levels in team development activities throughout the semester. This paper will summarize these overall quantitative metrics as well as the reflections from students and faculty on both teaming systems.

Keywords—team development, first-year experience

I. INTRODUCTION

The first-year engineering program at Michigan Technological University consists of two main courses: ENG1101: Engineering Analysis and Problem Solving and ENG1102: Engineering Modeling and Design. These courses are designed to introduce first-year engineering students to the fundamentals of engineering: problem solving, engineering design, teaming, unit conversions, programming, 3D modeling, ethics, spatial visualization, and technical communication. Both courses are offered using a flipped classroom, in which the students complete the required reading, watch a short video explaining the course concepts, and/or complete a short activity before coming to class. Within the classroom, the students complete activities or work on projects to deepen their learning

of the concepts with the help of their instructor and their LEAP leader (a near-peer student mentor assigned to each section of students).

With one to two instructors per classroom of 120 students and one LEAP leader per 24 students, peer-to-peer learning is encouraged and enhanced by the implementation of student teams. In both courses, students are placed into a team of 3-5 students for the semester to work on the class activities and projects. Several activities throughout the semester are designed to help students work effectively in their teams. For example, at the beginning of the semester, all teams create a team contract with ground rules for their teaming behaviors for the semester. A midterm peer evaluation and reflection on their teaming experience occurs halfway through the semester and teams have an opportunity to update their team contracts to reflect any changes they wish to implement at that point in the semester. At the end of the semester, a final peer evaluation is completed by the students.

Historically, instructors have used CATME to build student teams in the beginning of the semester and to gather and share feedback between students during the semester. CATME provides instructor tools for a) assigning students to teams, b) training students to work in teams, c) identifying teams having teamwork difficulties, and d) training students to rate teamwork behaviors [1]. Importantly, CATME leverages a survey in the beginning of the semester that gives instructors the ability to identify important characteristics of students with which to build teams. The software also provides instructors with a user-friendly interface to assist in building teams by matching students with similar or dissimilar characteristics according to instructor preference. This interface allows flexibility for each instructor. Once teams are built, CATME is primarily used to collect feedback from student teams that is shared mid-way through the semester and again at the end of the semester.

The Team+ software differs from CATME in that it provides a more structured approach to maintaining teams through a collaborative dashboard that students can interact with throughout the semester. Team+ guides students during the semester through eight activities that focus on four team development stages: a) team identity, b) team roles and rules, c) performance evaluation, and d) developmental feedback [2]. These activities are done collaboratively and students can see in

real-time what their progress is for their teaming exercises. In addition, Team+ provides a platform for team building, giving students the ability to insert bios, upload photos, and communicate with each other. It does not, however, facilitate team creation, so all instructors used CATME to build student teams at the beginning of the semester.

Establishing and maintaining a positive team dynamic is essential to the success of these student teams throughout the semester. With these two very different software options available, during the Fall of 2021, both options were used by two sets of instructors in their respective sections. The goals of this study were as follows:

- Identify and compare the strengths and potential weaknesses of each platform
- Evaluate the ease of implementation and use of each system, both from an instructor and student perspective
- Compare level of student engagement with each platform
- Assess and compare team behaviors and outcomes between the two platforms.

II. STUDY METHODS

A total of 402 students, in 19 sections of ENG1101 participated in this study. These sections were taught by two teams of instructors. Sections were randomly assigned in each instructor's course to use either the CATME or Team+ tool. Eight sections (170 students) used the CATME tool and eleven sections (232 students) used Team+. This distribution is shown in Table I.

TABLE I. STUDY ASSIGNMENTS FOR TEAMING SOFTWARE

Instructor Team	CATME			Team+		
	# of Sections	# of Students	# of Teams	# of Sections	# of Students	# of Teams
Team 1	4	80	20	6	119	30
Team 2	4	90	24	5	113	30

To address our study goals, we used student and faculty feedback on each platform to compare the strengths, weaknesses, and ease of implementation. Additionally, we looked at completion rates on the different activities to assess student engagement, participation, and use. Finally, to assess the effectiveness and differences in student experiences, students were administered the Teaming Effectiveness and Satisfaction Survey which contains the Online Student Connected Survey (OSCS) [3] and the Team Effectiveness Questionnaire [4] as a pre-post survey. While this survey was intended to measure student connectedness in online programs, in this instance, the survey was modified to measure the students' connectedness in their first-year engineering classroom. The OSCS consists of 25 items in four subscales: comfort, community, facilitation, and interaction and collaboration [3]. The comfort scale evaluates how comfortable a student is with communicating in class and asking for help. The community scale looks at how close students feel they are

to their classmates. The facilitation scale measures how well the instructor promotes collaboration between students. Finally, the interaction and collaboration scale measures how well the students actually collaborate and share information with others in class. Each subscale is measured on a five-point Likert scale (5 = strongly agree, 1 = strongly disagree) and the subscale items are summed to create an overall subscale score for comparison. The maximum score for each category is as follows: Comfort (40), Community (30), Facilitation (30), and Collaboration and Interaction (25) [3].

The Team Effectiveness Questionnaire consists of 56 questions separated into eight subscales: purpose and goals, roles, team processes, team relationships, intergroup relations, passion and commitment, and skills and learning [4]. Each subscale is measured on a six-point Likert scale (6 = strongly agree, 1 = strongly disagree) and the average value of each subscale is used as an overall subscale score for comparison with the sum of all eight factors providing an overall Team Effectiveness Score [4].

In addition to the Teaming Effectiveness and Satisfaction Survey, the students were asked to reflect on their experiences with the particular teaming software in a post-only survey at the end of the semester. The questions for the post survey are listed below. The questions in the first list were administered to all students and the second list were given to the Team+ students only.

Both teaming software:

- The assignments helped us develop our team identity.
- The assignments helped us establish how we work.
- The assignments helped me to identify a way to meaningfully contribute to my team.
- The assignments helped us identify positive team behaviors.
- The assignments helped us identify negative team behaviors.
- The assignments helped us identify and manage team conflicts.
- Peer evaluations helped me provide meaningful feedback to my teammates.
- Peer evaluations provided me with valuable feedback from my teammates.
- The week 8 and 9 assignments helped our team make changes that improved the team experience for the remainder of the semester.
- I made use of the [teaming] videos to give effective feedback.
- Comments on your experience using [teaming software].

Team+ only:

- I made use of the Team+ videos to learn more about my personality type.

- I made use of the Team+ videos to learn about different team styles.
- I made use of the Team+ videos to learn more about how to work in teams.
- I made use of the Team+ videos to help manage team conflict.

It is important to note that the week 8 and 9 assignments were different for each teaming software. During week 8 of the semester, the students who used the CATME software completed a midterm peer evaluation where they evaluated themselves and their teammates on the CATME five dimensions of teaming (Contributing to the Team's Work, Interacting with Teammates, Keeping the Team on Track, Expecting Quality, and Having Relevant Knowledge, Skills, and Abilities) [1] and provided written comments to each team member. This was followed by a reflection on these peer comments and revision of their semester team contract in week 9. For the Team+ students, they completed the Keep, Stop, Start Exercise week 8. This exercise has the team work together to identify the specific behaviors that are helping the team that they should keep, behaviors that could help the team that they should start, and behaviors that are hindering them that they should stop [2]. This is followed by a midterm peer evaluation where they evaluated themselves and their teammates on the Team+ five dimensions of teaming (Acting Responsibly to the Team, Creating a Positive Team Climate, Making a Collaborative Effort, Managing Conflict Inclusively and Constructively, and Monitoring Individual and Team Performance) [2].

III. RESULTS

To begin, we will discuss student participation by looking at the completion rates of the CATME and Team+ activities. Then we will discuss the survey results to look at the differences in team effectiveness and team connectedness. Finally, we will discuss the student and faculty responses on the strengths and weaknesses of each teaming software.

A. Student Participation

Tables II and III show the participation of individuals and teams in the various activities related to the CATME and Team+ software respectively. For students who completed the CATME survey, we've also included the traditional teaming activities used in ENG1101 such as the team contract, individual reflection on peer evaluation, and revised team contract as the Team+ software has similar activities built into the software package. For example, the team contract for CATME students provides a similar role as the Team Rules and Roles activities in Team+. Additionally, the individual reflection on peer evaluation serves a similar role as the Keep, Stop, Start Activity in Team+.

The team building assignment for each software package was a little different. The students who completed the CATME assignment were instructed to create a slide that contained a team name, motto, mascot, and a team picture somewhere on campus. For the students who used the Team+, students were also asked to create this team slide, but the team name, motto, and mascot discussion was facilitated through Team+ and was completed after each individual shared their photos,

biographical information, and completed self-assessments on communication, listening, and conflict managements styles in the personal profile and team styles activities.

Several of the assignments for the CATME students were team based (indicated with an asterisk in the tables below) and the completion rate is reported as the number of teams who completed the assignment instead of by number of students. For these activities (e.g., team building, team contract, revised team contract), it is impossible to tell which individual(s) on the team contributed to these assignments. With the CATME peer evaluation software, it is clear which individuals completed the peer evaluation assignments. Additionally, in Team+, the individual participation in the software is tracked and easily reportable.

As shown in Tables II and III, the students in general seem to have the most participation on the first teaming activities, is lowest mid-semester, and then increases toward the end of the semester. The lowest participation in the CATME group (Table II) is the midterm reflections and revised team contract, with a 90.6% completion rate. In the Team+ group (Table III), it appears that the Teaming Keep, Start, Stop Exercise had the lowest participation at 90.9%. This also occurred at the midpoint in the semester. Overall, it appears that there was more individual participation in the Team+ activities than the CATME activities or team activities completed by CATME students in ENG1101.

TABLE II. STUDENT PARTICIPATION IN SEMESTER TEAMING ACTIVITIES (CATME)

Activity	% Completion
Team Building ^a	100.0
Team Contract	97.7
CATME Midterm Evaluation	94.1
Individual Reflection on Peer Evaluation	90.6
Revised Team Contract	90.9
CATME End of Term Evaluation	91.2

^aDenotes Team Activity (cannot tell individual contribution)

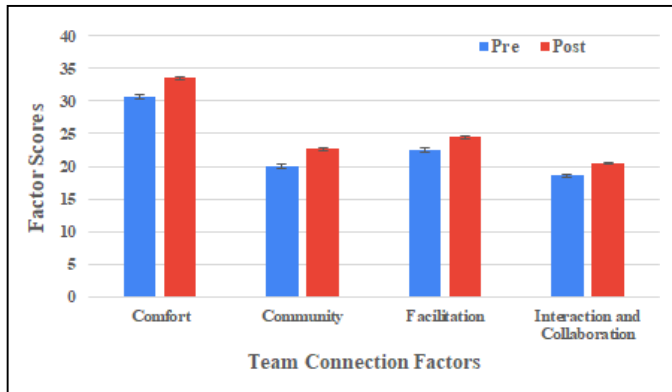
TABLE III. STUDENT PARTICIPATION IN SEMESTER TEAMING ACTIVITIES (TEAM+)

Activity	% Completion
Personal Profile	100.0
Team Styles	100.0
Team Identity Building ^a	98.3
Team Rules	99.1
Team Roles	96.6
Teaming Keep, Start, Stop Exercise	90.9
Mid-Semester Self/Peer Evaluation and Developmental Feedback	97.0
End of Term - Team Evaluation	96.6

^aDenotes Team Activity (cannot tell individual contribution)

B. Teaming Effectiveness and Connectedness

The Teaming Effectiveness and Connected survey was assigned as homework to all students in the study sections and a total of 348 students completed both the pre and post Teaming Effectiveness and Connectedness survey (85.7% response rate).



We used a one-way repeated measures ANOVA to compare the differences within and between the teaming groups. Within the groups there were significant differences between the pre and post survey results ($p < 0.001$) on the OSCS questions as shown in Fig. 1. This indicates that the students in both groups are increasing their comfort level, feelings of community with their classmates, and their ability to communicate and collaborate with their teammates over the course of the semester. Additionally, it appears that the faculty have increased their facilitation of collaborative activities for the students over the semester.

Fig. 1. Changes in OSCS Teaming Factors over the Semester (n = 348)

There were significant differences between the teaming groups on the pretest scores at the beginning of the semesters, so these differences were controlled for in the analysis of pre-post differences between groups. There are significant differences between the teaming groups on the community, facilitation, and interaction and collaboration subscales as shown in Table IV. It appears that students in the Team+ group showed larger community development over the course of the semester with their classmates than the students in the CATME group. Additionally, the Team+ group showed a larger increase in their ability to communicate and collaborate with their teammates and the students perceived a higher difference in faculty facilitation of collaborative activities for the students over the semester in the Team+ group. There were no significant differences shown in the comfort subscale between the groups, so while there were significant differences over time, neither teaming software appeared to improve students comfort level with their classmates over the other.

TABLE IV. TEAM CONNECTIONS BETWEEN GROUPS BY SUBSCALE

Measure	CATME		Team+		F (1,345)	η^2
	M	SD	M	SD		
Community	22.61	4.66	23.17	4.86	24.44 ^c	0.066
Facilitation	24.48	4.48	25.05	3.82	24.33 ^c	0.066

Measure	CATME		Team+		F (1,345)	η^2
	M	SD	M	SD		
Interaction and Collaboration	20.49	3.44	20.78	3.34	9.69 ^b	0.027

^b $p < 0.05$

^c $p < 0.01$

While the Team Effectiveness Questionnaire focused on eight subscales related to teaming, only one subscale showed significant differences over time: team relationships ($F(1,346) = 5.380$, $p = 0.021$, $\eta^2 = 0.015$). No other significant differences were found over time or between groups. The questions in this subscale relate towards specific team behavioral characteristics such as appreciation of capabilities, effective listening, open communication, trust, help with problem solving, conflict resolution, and cooperation. The changes in the team relationships seem to indicate growth in these areas over time between teammates, which is a positive outcome and demonstrates growth in teaming skills over the course of the semester.

C. Teaming Post Survey

In addition to the pre/post survey, students were asked to reflect on their experiences with the teaming software they used in an end of the semester assignment. The quantitative survey results are shown in Table V. A total of 335 students completed the survey (83.3% response rate). In general, neither tool received overwhelmingly positive reviews. We used an independent samples t-test to compare the results of the post survey between teaming software groups. Only two questions showed significant differences between groups: “the assignments helped us develop our team identity” and “the assignments helped me to identify a way to meaningfully contribute to my team” ($p < 0.05$). In both of these cases, the students in the Team+ teaming group showed higher agreement.

TABLE V. TEAMING POST SURVEY RESULTS

Questions	% Agreement	
	CATME (n = 143)	Team+ (n = 192)
The assignments helped us develop our team identity.	36.4	50.5
The assignments helped us establish how we work.	54.6	57.3
The assignments helped me to identify a way to meaningfully contribute to my team.	45.5	54.7
The assignments helped us identify positive team behaviors.	58.7	63.0
The assignments helped us identify negative team behaviors.	55.9	53.1
The assignments helped us identify and manage team conflicts.	42.0	33.9
Peer evaluations helped me provide meaningful feedback to my teammates.	51.1	52.6
Peer evaluations provided me with valuable feedback from my teammates.	50.0	51.6
The week 8 and 9 assignments helped our team make changes that improved the team experience for the remainder of the semester.	39.2	49.0
I made use of the [teaming] videos to give effective feedback.	23.8	21.9

Questions	% Agreement	
	CATME (n = 143)	Team+ (n = 192)
I made use of the Team+ videos to learn more about my personality type.		24.0
I made use of the Team+ videos to learn about different team styles.		25.0
I made use of the Team+ videos to learn more about how to work in teams.		24.5
I made use of the Team+ videos to help manage team conflict.		22.9

D. Faculty and Student Comments

In this last section, we focus on comments from the instructors and students involved in this study. Faculty feedback is summarized below followed by open comments from students on the Teaming Post Survey on the teaming software they worked with over the semester.

From the faculty point of view, Team+ provides an excellent platform for teaming engagement. Compared to CATME, Team+ has a much better interface for students to interact and share feedback. The software is truly a platform for engagement rather than simply a tool to provide feedback. Additionally, the language used to solicit feedback is simple, straightforward, and non-intimidating for first year undergraduate students. It appears that students find it approachable and easy to respond to. The Team+ approach seems to engage students on a level that is inviting rather than technical, making it easier to implement.

Additionally, the Team+ faculty dashboard provides an easy way to monitor the progress of each team in any section. As the graphic layout is simple and understandable, faculty can easily determine how well each individual team member is contributing through a single click. In addition, exporting data is a simple task, making analysis and grading easy. Compared with CATME, Team+ is a much friendlier interface to learn and is as intuitive as any social media platform, which makes it an attractive option for student engagement and faculty implementation.

Team+ is ideally suited for asynchronous online classes. It requires students to individually submit responses to the Team+ platform and then post comments to the discussion board. Once the team reaches an agreement, one of the team members post their team decisions. We gave students time in class to work through the Team+ activities together. While most of the team members submitted their responses and comments to the Team+ platform, several did not, preferring to just talk about their responses rather than posting their responses on Team+. In the future, I would recommend having students submit their individual comments/responses prior to class and then give them time during a synchronous class to discuss and reflect on the individual posts and require one student to submit a summary of their discussion.

While there are many advantages to Team+, there are several advantages of CATME from the faculty perspective. The Team-Maker makes it easy to assign a large number of students to teams using instructor chosen criteria (e.g. schedule, gender, skills, or instructor created criteria). While CATME is not as intuitive as Team+, the instructional resources provide any needed support. Another advantage of CATME is that it

flags teams that have unusual ratings (e.g. low/high performer, under/over confident team member, clique), which helps to identify which teams may be struggling and gives an indication as to what challenges they may be facing. CATME has a feature that gives students an opportunity to practice rating fictional team members. This can help students focus on providing accurate feedback to their team members. Additionally, CATME provides an opportunity for student ratings and comments to be shared anonymously with their teammates which will hopefully result in more honest feedback from the opportunities for formative feedback. Additionally, CATME calculates an adjustment factor that can be used to adjust grades for individuals on the team with and without their self-evaluations.

Student feedback on the different teaming software was reported in the Teaming Post survey and is summarized in Table VI. The feedback comments were coded as positive, neutral, or negative in three general themes: helpfulness of software, useability of software, and student enjoyment of the software. The comments were very different for each teaming software. For comments on the CATME software, the students were split on how helpful they found it. Students who found the software helpful thought it was effective in providing feedback to their teammates. Students who did not find it helpful thought that their teams were already discussing issues and having open communication so CATME did not provide them with any extra insight into their teaming experience. In terms of useability and student enjoyment, many students had negative comments that discussed their frustration with the user interface, unclear instructions within the tool, and difficulty with the required practice evaluation for peer evaluation.

With regard to the Team+ instrument, the comments were once again split on helpfulness. The majority of negative comments focused on only using the software for the assignments that were given and that students were unclear as to the value of the software and again felt that the discussions they had on Team+ could easily happen in person. It is also clear from the comments that students were unaware of the resources available within the Team+ software to help with team building. The useability and student enjoyment themes received more positive comments from students as the students found the interface very user friendly, easy to use, and liked that they could customize their team page.

TABLE VI. TEAMING POST SURVEY DISTRIBUTION OF STUDENT COMMENTS

Category	% of Comments					
	CATME			Team+		
	Negative	Neutral	Positive	Negative	Neutral	Positive
Helpfulness	30.8	8.8	23.1	29.0	1.5	16.0
Useability	33.0	1.1	3.3	1.5	0.8	12.2
Student Enjoyment	19.8	4.4	2.2	4.6	1.5	8.4

IV. CONCLUSIONS

We had four main goals of the study. The first two goals were to identify and compare the strengths and potential weaknesses of each platform and evaluate the ease of implementation and use of each system from the faculty and student perspective. Reviewing faculty and student experiences indicated that the Team+ strengths included an easy to use faculty and student interface, clear monitoring of individual participation, and has facilitated activities that work through the team building and assessment process. Weaknesses to Team+ include the inability to create teams and a difficulty to implement many of the activities in a synchronous environment as students completed the discussions in-person rather than in the software package. The CATME software has robust team making abilities and easy identification of teams which may need instructional intervention. This software is not as user-friendly for students, which caused a great deal of frustration with the instrument.

For the third goal, we compared the level of student engagement with each platform. Overall, it appears that there was more individual participation in the Team+ activities than the team activities completed by the students in the CATME group. Finally, for our last goal, we assessed and compared the team behaviors and outcomes between the two platforms. In both groups, the teams increased their comfort level, feelings of community with their classmates, and their ability to communicate and collaborate with their teammates over the course of the semester with students in the Team+ group showing larger gains in the latter two categories. Additionally, it appears that the students in the Team+ group felt that the assignments helped them develop their team identity and find a

way to contribute to their team more than the students in the CATME group.

With both software packages, the students questioned the necessity of using the software at all. It appears that many students had a good experience in their teams and did not feel the need for the external reflection or evaluation of teaming. This indicates a need for transparency on the part of the instructor so students are clear on the value of these assignments, how to integrate them into the development of their teams, and make the most of the tools that are available for struggling teams. For future ENG1101 classes, we plan to use the best features of both. Teams will be created using the CATME Team-Maker functionality, while we will use the Team+ software to facilitate team identity creation and team development throughout the semester. To make this more effective in our class and address some of the comments by students, we plan to have students complete the asynchronous parts as part of preparation for class so that the meaningful discussions can take place within the class period.

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