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## **AC 2011-2116: ASSESSMENT OF THE CATME PEER EVALUATION TOOL EFFECTIVENESS**

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# **A Preliminary Assessment of the CATME Peer Evaluation Tool Effectiveness**

## **Abstract**

In project intensive courses student teams are used to enable completion of significant work and, hopefully, significant learning in one semester. Faculty desire to use peer evaluations and self-evaluations to assess how much each team member contributes to the overall effort and success of the project. Ideally, the evaluations and assessments will lead students to modify their behavior to improve their effectiveness on teams. This paper describes an attempt to measure progress towards the goal of leveraging peer and self-evaluations to change student behavior.

The Comprehensive Assessment of Team Member Effectiveness (CATME)<sup>1</sup> was developed using extensive university research. A web-based survey at [www.catme.org](http://www.catme.org) makes it possible to collect data on team-member effectiveness in five areas that research has shown to be important.

1. Contributing to the team's work
2. Interacting with teammates
3. Keeping the team on track
4. Expecting quality work
5. Having relevant knowledge, skills and abilities

This tool was implemented in a junior level product design class. The class is focused on a team, semester long, externally sponsored, design and build project. Students were asked to complete peer and self-evaluations two times during the semester. Students' reactions to the feedback they received from the CATME system were gauged using a survey and self-reflection tools.

More importantly, the faculty hope to use the tool to catalyze change in student behavior over time. The authors used the (CATME) software to assess junior engineering student's team effectiveness. An additional survey was used to quantify what if any effects the feedback from the CATME software had on the student's behavior.

## **Introduction**

Student team project based learning has been shown to be an effective method of helping the students to internalize the subject matter and preparing them for their professional lives<sup>2,3</sup>. However, assessing an individual contribution to the success of a team effort is difficult and time consuming. This problem is compounded when a significant part of a grade is determined by the results of a team project. Past attempts to assess a student's contribution to a team have typically involved a paper based survey administered at the end of the project. An example of one of a survey used by the authors is shown in appendix 1. This approach has two major flaws. First it is time consuming to administer and collate results. The time required may be the reason why it is administered only at the end of the project. Second this approach does not give students feedback or a chance to modify their behavior based on the feedback. As an educator the feedback and chance to modify behavior is the most important learning for a student. Employers

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expect college students to possess these skills and often complain that college graduates have not learned the team approach to problem solving<sup>4</sup>. Therefore, efforts to improve team performance must focus on the performance of individuals<sup>5</sup>.

### Course Overview

A web-based peer evaluation instrument called CATME<sup>6,7</sup> (Comprehensive Assessment of Team Member Effectiveness) was deployed in a junior level product design class at a regional, comprehensive, teaching focused university. The class was held during the fall semester of 2009. Eighteen students were enrolled in the class and the students were divided into six teams that ranged in size from two to four students. The projects are all externally sponsored and range in complexity from a bike fairing to an automated bullet sorter. The four credit class consisted of two seventy-five minute class meetings and one three hour lab session a week. The class is required for students majoring in Product Design and Manufacturing and is an approved technical elective in the Mechanical Engineering curriculum. The grading scheme for the course, shown in Table 1, illustrates the importance of the project.

Table 1. Task Weighting for the Product Design Course

Weekly Lecture and Lab Assignments, Project Progress Reports and Lecture Preparedness Quizzes	40%
First Exam	10%
Second Exam	10%
Midterm Design Review and Report	10%
Prototype Performance and Peer Reviews	15%
Final Project Report and Presentation	10%
Class Participation	5%
	100%

The following topics are typically covered in the class:

1. Design Process Overview
2. Gathering Information from the Target Market
3. House of Quality

4. Specifications
5. Function Structure Diagrams
6. Concept Generation
7. Estimation and Feasibility
8. Concept Selection
9. Project Planning
10. Math Modeling
11. Prototyping Strategy
12. Tolerance Analysis
13. Intellectual Property and Patents

## **Methodology**

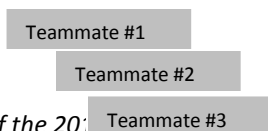
For this study the CATME survey was administered in the middle of the semester and again at the end of the semester. After the students received feedback from first survey, they were asked to compare their scoring of themselves to the scores they received from their teammates and formulate a plan to improve. Finally the students were surveyed at the end of the semester about the use of CATME.

## **The CATME System**

The CATME system asked the students to rank themselves and their peers in the following categories:

1. Contribution to the team's work.
2. Interacting with teammates.
3. Keeping the team on track.
4. Expecting Quality Work.
5. Having related knowledge, skills and abilities.

The student input is collected using images like the one shown in figure 1.



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Description of Rating			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<ul style="list-style-type: none"> <li>• Does more or higher-quality work than expected.</li> <li>• Makes important contributions that improve the team's work.</li> <li>• Helps teammates who are having difficulty completing their work.</li> </ul>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Demonstrates behaviors described above and below.
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<ul style="list-style-type: none"> <li>• Completes a fair share of the team's work with acceptable quality.</li> <li>• Keeps commitments and completes assignments on time.</li> <li>• Helps teammates who are having difficulty when it is easy or important.</li> </ul>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Demonstrates behaviors described above and below.
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<ul style="list-style-type: none"> <li>• Does not do a fair share of the team's work. Delivers sloppy or incomplete work.</li> <li>• Misses deadlines. Is late, unprepared, or absent for team meetings.</li> <li>• Does not assist teammates. Quits if the work becomes difficult.</li> </ul>

Figure 1. CATME's graphics used to collect student input.

For data analysis purposes the highest score corresponds to a numerical rating of 5 and the lowest score corresponds to a numerical rating of 1. The CATME tool provides individualized feedback on each of the five criteria to every student. Students can see how they rated themselves, how the team rated them and the average rating for the team. The method for showing student feedback is shown in figure 2. Additional student feedback examples are shown in appendix 2.

In addition CATME provides concrete suggestions for improving their performance in each category. For example for the "Contributing to the Team's Work" criteria, CATME suggests the following behaviors to improve a student's ratings.

- Do a fair share of the team's work.
- Fulfill your responsibilities to the team.
- Come to team meetings prepared
- Complete your work in a timely manner.
- Do work that is complete and accurate.
- Make important contributions to the team's final product.
- Keep trying when faced with difficult situations.
- Offer to help teammates when it is appropriate.

## Contributing to the Team's Work

How You Rated Yourself		
How Your Teammates Rated You		
Average Rating for You and Your Team		
Description of Rating		
▶		<ul style="list-style-type: none"> <li>• Does more or higher-quality work than expected.</li> <li>• Makes important contributions that improve the team's work.</li> <li>• Helps teammates who are having difficulty completing their work.</li> </ul>
	▶	Demonstrates behaviors described above and below.
		<ul style="list-style-type: none"> <li>• Completes a fair share of the team's work with acceptable quality.</li> <li>• Keeps commitments and completes assignments on time.</li> <li>• Helps teammates who are having difficulty when it is easy or important.</li> </ul>
▶		Demonstrates behaviors described above and below.
		<ul style="list-style-type: none"> <li>• Does not do a fair share of the team's work. Delivers sloppy or incomplete work.</li> <li>• Misses deadlines. Is late, unprepared, or absent for team meetings.</li> <li>• Does not assist teammates. Quits if the work becomes difficult.</li> </ul>

Figure 2. How CATME displays student feedback.

The average for each team member for each criterion for the two times the CATME tool was used is shown in Table 2.

### Student's Responses to their Peer's Assessment

After the first students took the first CATME survey, they students were asked to respond to the questions below.

- a. Compare and contrast your self evaluation to the evaluation of your peers. Discuss any differences.
- b. How will you improve your performance in the future? The Catme.org website gives specific information on improving your performance.

Unfortunately it is hard to find meaningful data from the student's responses. No student disputed the evaluation of their peers. In addition each student dutifully copied down some strategies they planned to employ to improve their performance. A typical student's response is below.

Table 2. The average responses for each student, by each criterion for the two times the CATME tool was used.

Team/Student	Contribution to the team		Interacting with team		Team on track		Expecting Quality		Related k, s and a.	
	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.	Oct.	Nov.
Team 1A	3.8	3.2	3.5	3.2	3.8	3.2	4.0	3.2	3.5	3.8
Team 1B	3.8	3.8	3.0	2.8	3.5	3.8	4.2	3.8	4.0	3.5
Team 1C	4.0	4.2	3.2	3.2	3.2	3.5	3.5	3.5	4.2	4.0
Team 1D	3.8	3.8	3.5	3.0	3.5	3.8	3.8	3.5	3.5	3.5
Team 2 A	4.7	4.3	4.7	4.7	4.3	5.0	4.3	4.7	4.7	5.0
Team 2 B	4.7	4.7	4.7	4.3	4.0	4.3	4.7	4.3	4.3	4.7
Team 2 C	5.0	4.3	4.7	4.7	4.3	5.0	4.7	4.7	4.7	4.7
Team 3 A	4.0	3.5	3.7	3.0	4.3	4.0	4.3	3.0	4.0	5.0
Team 3 B	4.0	4.5	3.7	3.0	4.3	4.0	4.0	4.0	4.3	5.0
Team 3 C	3.7	4.0	3.7	3.0	4.3	4.0	4.0	3.0	3.7	5.0
Team 4 A	5.0	5.0	4.3	4.0	4.7	4.5	4.0	4.0	4.3	5.0
Team 4 B	5.0	4.0	4.7	3.5	3.3	3.5	4.0	4.5	3.7	4.0
Team 4 C	3.3	3.5	3.3	3.0	2.0	3.0	2.7	3.5	3.0	3.5
Team 5 A	4.7	4.3	4.0	4.0	4.3	4.3	4.3	4.7	4.7	4.0
Team 5 B	3.7	3.3	4.0	4.0	3.7	3.7	3.7	3.7	3.7	3.7
Team 5 C	4.3	4.0	4.3	4.0	4.3	4.3	4.3	4.3	4.3	4.0
Team 6 A	4.0	4.5	4.0	4.5	4.5	4.0	4.0	4.5	4.5	5.0
Team 6 B	4.0	4.5	4.0	4.5	4.0	4.0	4.0	5.0	4.5	4.5

My group rated me higher than I rated myself in regards to work contribution. I always try to contribute a fair share of work and more, but I am never quite sure what my group thinks of me in regards to workload. I interact with my teammates slightly worse than I thought I did. Not poorly, but slightly less than they said I thought I did. This may be because sometimes I am blunt and am quick to point out problems. My teammates said that I keep the team on track more than I thought I did. I like organization and I like to see improvements made; this may be the cause of this. I thought that I motivated the team more than I do, but the team says that I motivate the team slightly less than I do. I try to keep morale high and motivate the group to work hard nonetheless. My group and I agreed that I have a fair amount of technical knowledge and background for this project, and I believe this is fairly accurate.

My group said that I contribute a fair amount plus extra to the group. I don't think I will make any changes to this. My teammates said that I interacted fairly well with them, but I could use improvement. I will try to listen more and not criticize other ideas. I keep the team on track fairly well and this area does not

need improvement in my opinion. I will continue what I have been doing. As far as expecting quality, my score was very high. I still feel that the quality we are churning out is lower than it should be. I will try to maintain this level of quality that I expect nonetheless and not subside. My prior knowledge for this project is fairly high for this project so I don't think I need to do any relearning for this project. I will continue to refer to my notes from other classes to continue this though.

The questions do not appear to have provoked much reflection by the students.

### **Results of student survey regarding CATME**

The students were given an end of semester survey in order to estimate the effectiveness of the CATME tool from their perspective. Twelve students responded. A Likert scale was used. 1= Strongly Disagree, 2= Disagree, 3= Neither Agree nor Disagree, 4= Agree, 5= Strongly Agree

The following series of questions were used.

- 1) The feedback I received from my peers through the CATME surveys was accurate.
- 2) I changed my behavior based on the feedback I received from my peers through the CATME surveys.
- 3) My teammates changed their behavior based on the feedback they received from the CATME surveys.
- 4) The CATME Survey results improved my performance on the team.
- 5) The CATME survey results improved the team's ability to function. (2 Person Teams select N/A.)
- 6) The results from the CATME survey were easily understood.
- 7) I would recommend using the CATME surveys in future course offerings.

Table 3 summarizes the student's responses.



Table 3. End of Semester Student Evaluation of the CATME surveys.

Question	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Average
1 -Accurate	3	5	3	1	0	3.8
2- My Behavior	2	3	3	4	0	3.3
3- Teammates	0	6	3	3	0	3.3
4- My Performance	0	5	5	2	0	3.3
5- Team Performance	0	3	6	2	0	3.1
6- Understanding	3	7	0	2	0	3.9
7- Recommendation	1	4	2	3	2	2.9

Observations:

1. 66% (8/12) felt the ratings of their peers accurately assessed their contributions to the team.
2. 42% (5/12) of the students reported modifying their behavior as a result of the feedback provided by their teammates and 50% of the students believed that their teammates modified their behavior as a result of the feedback.
3. Only 25% (3/12) believed that the use of the CATME system improved the functioning of the team and, worse, only 42% (5/12) of the students recommended using the CATME system in future offerings of the course.

The most important finding of this survey is that 42% (5/12) of the students changed their behavior based on the feedback they received. This is a significant improvement over the old system, a summative peer review, that did not give the students an opportunity to modify their behavior. Moreover, In past offerings of this course, the instructor has always had to intervene to diffuse inter-team conflicts. This semester this was not required and the data points to a possible reason for this harmony. The majority of the students believed that their peers accurately assessed their contribution and that their peers modified their behavior as a result of the feedback. This may indicate that the CATME system provided an effective means for students to communicate their expectations to students who were judged lacking.

Disappointingly, only 25% of the students recommended that the CATME system be used in the future. Some students complained about the time required to fill out the survey. In addition some students expressed the feelings that improving their team skills was not as important as the technical skills taught in the class. In the future the instructor needs to highlight the importance

of team skills in the practice of engineering. In addition the instructors could emphasize the importance of using peer feedback to improve personal performance. Finally, more engaging reflection questions may help students commit to improving their performance.

### **Conclusions and Future Work**

This small deployment of the CATME system has shown some promising results that merit further investigation. To this end the authors plan to use the CATME tool in the senior capstone design experience. Not only is the capstone experience spread over two semesters but the sixty to seventy students participate in the course every year. With good fortune the longer format and the larger number of students will allow for a meaningful analysis of the effectiveness of the CATM tool.

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## Appendix 1 Peer Evaluation Form

Your Name \_\_\_\_\_

Team Name: \_\_\_\_\_

Rank order the members of your group including yourself from 1 to four. You may use any system you like – please explain. Remember in the world of work as you become managers and lead engineers you have to evaluate people and only a few can be meritorious or excellent.

You may add any qualifiers you like such as 1-3 are almost tied 4-5 are a close second and you are wondering if six is still in the class.

Peer evaluations will be held in strict confidence.

Name	Rank Order	Team member's major contributions and any special comments

Please explain your reasons for your ordering and comments on the rank ordering in general:

Comments on the group in general:

Would you like to work with the people on this team again? Was the work divided evenly? Would you recommend any of your team mates to your boss?

Please describe your contributions to the team's effort:

## Appendix 2 Additional Student Feedback from the CATME

### Interacting with Teammates

How You Rated Yourself		
How Your Teammates Rated You		
Average Rating for You and Your Team		
Description of Rating		
		<ul style="list-style-type: none"> <li>Asks teammates for feedback and uses their suggestions to improve.</li> <li>Provides encouragement or enthusiasm to the team.</li> <li>Makes sure teammates stay informed and understand each other.</li> <li>Asks for and shows an interest in teammates' ideas and contributions.</li> </ul>
▶	▶	Demonstrates behaviors described above and below.
	▶	<ul style="list-style-type: none"> <li>Respects and responds to feedback from teammates.</li> <li>Participates fully in team activities.</li> <li>Communicates clearly. Shares information with teammates.</li> <li>Listens to teammates and respects their contributions.</li> </ul>
		Demonstrates behaviors described above and below.
		<ul style="list-style-type: none"> <li>Is defensive. Will not accept help or advice from teammates.</li> <li>Complains, makes excuses, or does not interact with teammates.</li> <li>Takes actions that affect teammates without their input. Does not share information.</li> <li>Interrupts, ignores, bosses, or makes fun of teammates.</li> </ul>

system.

### Research suggests the following behaviors will improve your ratings in this area:

- Communicate effectively.
- Facilitate effective communication in the team.
- Exchange information with teammates in a timely manner.
- Provide encouragement to other team members.
- Express enthusiasm about working as a team.
- Hear what teammates have to say about issues that affect the team.
- Get team input on important matters before going ahead.
- Accept feedback about strengths and weaknesses from teammates.
- Use teammates' feedback to improve performance.
- Let other team members help when it is necessary.

## Keeping the Team on Track

How You Rated Yourself		How Your Teammates Rated You		Average Rating for You and Your Team		Description of Rating	
							<ul style="list-style-type: none"> <li>• Watches conditions affecting the team and monitors the team's progress.</li> <li>• Makes sure that teammates are making appropriate progress.</li> <li>• Gives teammates specific, timely, and constructive feedback.</li> </ul>
							Demonstrates behaviors described above and below.
▶			▶				<ul style="list-style-type: none"> <li>• Notices changes that influence the team's success.</li> <li>• Knows what everyone on the team should be doing and notices problems.</li> <li>• Alerts teammates or suggests solutions when the team's success is threatened.</li> </ul>
							Demonstrates behaviors described above and below.
	▶						<ul style="list-style-type: none"> <li>• Is unaware of whether the team is meeting its goals.</li> <li>• Does not pay attention to teammates' progress.</li> <li>• Avoids discussing team problems, even when they are obvious.</li> </ul>

**Research suggests the following behaviors will improve your ratings in this area:**

- Stay aware of fellow team members' progress.
- Assess whether the team is making progress as expected.
- Stay aware of external factors that influence team performance.
- Provide constructive feedback to others on the team.
- Motivate others on the team to do their best.
- Make sure that everyone on the team understands important information.
- Help the team to plan and organize its work.

## Expecting Quality

How You Rated Yourself		How Your Teammates Rated You	
		Average Rating for You and Your Team	
		Description of Rating	
			<ul style="list-style-type: none"> <li>• Motivates the team to do excellent work.</li> <li>• Cares that the team does outstanding work, even if there is no additional reward.</li> <li>• Believes that the team can do excellent work.</li> </ul>
		▶	Demonstrates behaviors described above and below.
▶			<ul style="list-style-type: none"> <li>• Encourages the team to do good work that meets all requirements.</li> <li>• Wants the team to perform well enough to earn all available rewards.</li> <li>• Believes that the team can fully meet its responsibilities.</li> </ul>
	▶		Demonstrates behaviors described above and below.
			<ul style="list-style-type: none"> <li>• Satisfied even if the team does not meet assigned standards.</li> <li>• Wants the team to avoid work, even if it hurts the team.</li> <li>• Doubts that the team can meet its requirements.</li> </ul>

**Research suggests the following behaviors will improve your ratings in this area:**

- Expect the team to succeed.
- Believe that the team can produce high-quality work.
- Believe that the team should achieve high standards.
- Care that the team produces high-quality work.

## Having Related Knowledge, Skills, and Abilities

How You Rated Yourself		How Your Teammates Rated You	
		Average Rating for You and Your Team	
		Description of Rating	
			<ul style="list-style-type: none"> <li>• Demonstrates the knowledge, skills, and abilities to do excellent work.</li> <li>• Acquires new knowledge or skills to improve the team's performance.</li> <li>• Able to perform the role of any team member if necessary.</li> </ul>
		▶	Demonstrates behaviors described above and below.
▶	▶		<ul style="list-style-type: none"> <li>• Demonstrates sufficient knowledge, skills, and abilities to contribute to the team's work.</li> <li>• Acquires knowledge or skills as needed to meet requirements.</li> <li>• Able to perform some of the tasks normally done by other team members.</li> </ul>
			Demonstrates behaviors described above and below.
			<ul style="list-style-type: none"> <li>• Missing basic qualifications needed to be a member of the team.</li> <li>• Unable or unwilling to develop knowledge or skills to contribute to the team.</li> <li>• Unable to perform any of the duties of other team members.</li> </ul>