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Experienced Teaching Assistants' Perceptions of a Simulated Environment for Facilitating Discussions with Individual Student Avatars from a Design Team in Conflict

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Introduction

This Complete Research paper describes the outcomes of using a simulated environment for teaching assistants (TAs) to practice managing conflicts on teams of undergraduate students engaged in a design project. Team-based projects are frequently used in engineering undergraduate courses, especially in introductory engineering courses. In addition to technical competence, team-based design projects support the development of collaboration and communication skills and engage novice engineers in higher levels of thinking [1]–[5].

While team-based design projects are widely used in first-year introductory engineering courses, implementing these team-based experiences can be logistically challenging. Introductory courses often have large class enrollments with constraints on the availability of faculty instructors, especially at large, research-focused universities [6]. Our institution uses a cadre of undergraduate TAs to mentor student teams and facilitate small group discussions in our large-enrollment (ca. 700 students) introductory engineering course with a TA-to-student ratio of 1:25 [7]. Teamwork in this course is structured around two summative interdisciplinary projects [8], [9]. We have previously identified the need to provide support to our TAs to help them address conflicts in student teams [10]. Our research project involves the development and use of a team conflict scenario within a simulated environment to help TAs better facilitate one-on-one discussions with their own students on a design teams.

Background and Motivation

To support students to work effectively on teams, it is important for instructors and/or TAs to identify and help mitigate team conflicts. Previous studies have identified "social loafing"—defined as reduced motivation, effort, or performance from individual team member(s)—as the most prevalent problem within student teams, particularly in early undergraduate years [11], [12]. Our experience is consistent with other published literature suggesting that a student may not engage within a team as expected due to logistical barriers to participation, marginalization by other team members, or disinterest in the major/project [11], [13]–[15]. Rather than "social loafing" which has negative connotations, we propose the use of the term "engagement-related conflict" when describing these instances where students are evaluated by their peers as not contributing to their team as expected.

Routine use of validated peer evaluation tools, such as Comprehensive Assessment of Team Member Effectiveness (CATME), can alert an instructor or TA to a team conflict; they can then discern the true cause of this conflict to remedy the situation [15], [16]. However, there is little guidance for instructors or TAs on how to coach individuals and teams toward more effective team behaviors when engagement-related conflict occurs. We are motivated by the need to develop a coaching program for TAs to help students who are on design teams experiencing engagement-related conflicts.

In pre-college education, simulated classrooms with student avatars are increasingly being used for professional development purposes to help educators practice challenging discussions. These simulated environments provide a safe virtual environment for educators to practice their skills [17]. Mursion® is a simulated environment in which educators or other users interact with avatars. Avatars are controlled by a highly trained human-in-the-loop called a simulation specialist (or "sim"). The sim voices and moves the avatars using hardware and the Mursion® software system. Scenario authenticity, avatar realism, and the value of the simulated experience has been examined by other work in the simulation literature [18], [19].

This study focuses on developing and field testing a simulation tool to coach teaching assistants to effectively interrogate and identify the root causes of engagement related conflict on student teams. Our participants were experienced TAs, and we first investigated their perceptions of and experiences with team conflicts prior to exposure to the simulation tool. After participating in the simulation, we explored whether the participants identified the root causes of engagement-related conflict on the student team in the simulation, what participants' perceptions were about the authenticity of the scenario, and how helpful the simulated environment would be for coaching other TAs.

Methods

Scenario

The scenario we developed describes a fictional team of five student avatars—Angela, Ciara, James, Jordan, and Stephanie—in an introductory engineering course engaged in a semester-long product design project. The scenario is situated in an authentic context using actual details of the project theme, semester timeline, and assignment topics from the introductory engineering course taught at the University of Delaware. As is typical to the course, the student avatars are described to be from different majors and are from diverse backgrounds. In the scenario, student avatars are six weeks into the semester and halfway through their design project. CATME is regularly used for peer evaluation at UD; the scenario includes CATME scores and peer-to-peer comments for this team. The CATME results were designed to suggest that three of the five team members—Ciara, Jordan, and Stephanie—may be contributing less than what is expected by some of their peers.

For the scenario, we developed detailed backstories for Ciara, Jordan, and Stephanie (the three students of focus) that impact their engagement in the team and participation in the course due to different reasons. Ciara is student who commutes and thus, is unable to participate in last-minute team meetings; this student avatar is experiencing ***logistical issues***. Jordan has missed several team meetings and discussion sessions; this student avatar no longer wants to major in engineering (***genuine disinterest***). Stephanie has an outgoing personality and has attended most team meetings; this student avatar, while interested in the course and the project, is experiencing ***marginalization*** by some team members. Angela and James are leading the project and drive the design ideas, project management, and meeting logistics. It is implied that Angela and James organize last-minute meetings, prioritizing their own convenience with meeting time and

location. These backstories were not directly shared with the study participants, but rather, used by the research team to prepare and deliver the simulation sessions. Study participants had the opportunity to learn information from these backstories as they posed questions to the students during discussions. Before recruiting participants, we obtained approval from the University of Delaware Institutional Review Board for the entire research project including all study instruments (reference number 1909500-3).

Participants

We invited a pool of undergraduate engineering students from the University of Delaware with experience serving as TAs in courses that use team-based design projects. From this pool, we recruited twelve study participants who were entering their third year (five participants) or fourth year (seven participants); six participants had previously served as TAs for the introductory engineering course at UD while others had experience serving as TAs for other team-based design courses. The study participants had a variety of intersectional identities as shown in Table 1. All participants took the introductory engineering course in their first semester at UD.

Table 1. Demographic data of study participants.

Identity	**Category and No. (Total 12 participants)**
Age	18-22 years: 11 Older than 22: 1
Self-described gender	Male: 3 Female: 9
Member of LGBTQ+ community	Yes: 1 No: 10 Prefer not to specify: 1
Major	Mechanical Engineering: 11 Chemical & Biomolecular Engineering: 1
First generation college student	Yes: 1 No: 11
Race/Ethnicity	Asian or Asian American: 1 Hispanic or Latino: 1 White/Caucasian: 10

Data Collection Process

After consenting to the study, each participant completed all the following steps: (1) respond to a pre-simulation survey, (2) prepare for the simulation session by reading a Simulation Preparation document, (3) attend their scheduled Mursion® simulation session via Zoom, and (4) respond to a post-simulation survey immediately after the simulation session. We describe each of these steps and associated instruments in what follows.

Pre-Simulation Survey

Prior to engaging in the simulation session, all twelve participants completed a survey with questions related to their own experiences with team conflicts (as students and as TAs), training they received as TAs, and peer evaluation using CATME. The survey contained three individual yes/no questions, two blocks of yes/no questions, three Likert scale questions, and eight open-response questions. Open-response questions asked for elaboration after each individual or block of yes/no question(s) or Likert scale question. The complete survey instrument is shown in Appendix A.

Simulation Preparation Document

After completing the pre-simulation survey and approximately one week prior to facilitating their discussions, participants received the simulation preparation document. This six-page document included the purpose for the discussions, descriptions of the team and student avatars, and quantitative and qualitative CATME peer evaluation results (along with guidelines to explain CATME terminology). The document explained that the purpose for the discussions was for participants to diagnose the reason for each student avatar's disengagement from the team and to elicit from students their ideas about subsequent remedies. The descriptions of student avatars in the document (Figure 1) arose from the backstories but were much less detailed and did not include the reason for each avatar's disengagement from the team. Names, pronouns, and personality traits for these avatars were provided by Mursion®. Descriptions of student avatars provided in this document are consistent with the information that TAs for the introductory course could be expected to have about the students they mentor (e.g., attendance at TA-facilitated discussion sessions for the introductory course, which occur weekly on Fridays). All study participants had familiarity with CATME as they had previously taken the introductory engineering course and have served as TAs.

Nina (she/her/hers)	Ciara (she/her/hers)	Jordan (they/them/theirs)	Stephanie (she/her/hers)
			
Nina is your host for the discussions.	Ciara is a civil engineering major. Ciara seems polite and focused. Ciara is from a military family. Ciara commutes from a military base where her family lives. Ciara has attended all Friday discussion sessions.	Jordan is an engineering undeclared major. Jordan seems quiet and withdrawn. Jordan seems disengaged during team meetings. Jordan identifies as non-binary. Jordan has missed the last three Friday discussion sessions.	Stephanie is a mechanical engineering major. Stephanie seems very outgoing. Stephanie once asked you about what classes she could take to learn more about robotics. Stephanie has attended all Friday discussion sessions.

Figure 1. Images of student avatars and backgrounds provided to study participants in the simulation preparation document. Images courtesy of Mursion®.

Simulated Discussion Session

During the simulation session, each participant facilitated three one-on-one discussions with the student avatars Ciara, Jordan, and Stephanie to understand the nature of the conflict from their perspective. To mitigate order effects, we varied the order in which each of the twelve study participants facilitated discussions with the three student avatars. The study participants took 15 or fewer minutes for each one-on-one discussion. The host avatar, Nina, introduced the session, asked reflective questions after each discussion, and concluded the session. These activities were supported by a host script. The one-on-one student discussions were not scripted, but rather, each student avatar responded to TA questions using improvisation within the constraints of the scenario. The same sim played the host (Nina) and all students (Ciara, Jordan, and Stephanie) for all participants' discussions during this study. This sim has been certified by Mursion®, is a co-author of this study, and is a member of the engineering education community.

Post-Simulation Survey

After completing the simulation session, all twelve participants completed the post-simulation survey, which is shown in Appendix B. This instrument was used to gather data on the participants' reflections on the one-on-one discussions and team dynamics; and perceptions of the authenticity of the scenario and realism of the avatars, ease or difficulty of using the technology, and value of the scenario as a TA training experience. The survey contained a block of questions for TAs to identify the primary reason for each student's perceived lack of engagement, eight Likert scale questions, one question to order the steps they would take on after the one-on-one discussions, and eight open-response questions, which enabled participants to elaborate on their choice-based responses.

Data Analysis

We analyzed data from both pre- and post-simulation surveys using quantitative and qualitative approaches [20]–[22]. We used descriptive statistics and frequency distributions to understand the central tendency and variation in Likert scale responses. We explored how qualitative data from open-ended responses supported or extended the quantitative findings. For each open-ended item, analysis was aimed at generating themes to capture "the *possible* range of empirical meaning, actions, and processes" ([23, p.1616], emphasis in original) expressed by the participants.

Results

We summarize results from the pre- and post- simulation surveys in what follows. Overall, results indicate that participants recognized the value of the simulated environment in coaching TAs towards facilitating discussions with students experiencing engagement-related team conflicts.

Pre-Simulation Survey Findings

Personal Experiences with Team Conflicts

The pre-simulation survey included several questions where participants reported experiences with team conflicts from both a student and TA perspective (questions A.1 to A.4, & A.8 to A.10 from Appendix A). Figure 2 shows participant reports of experiencing substantial conflict as a student on a design team, observing team conflicts in a team they were mentoring as a TA, and helping to resolve a team conflict (questions A.1 to A.3). Seven participants reported personally working on a student design team that experienced substantial interpersonal conflict. Each of these participants reported another student (not themselves) as the source of the team conflict. Examples of team conflicts included poor communication, missed meetings, scheduling conflicts, and perceptions of poor-quality work and/or lack of effort.

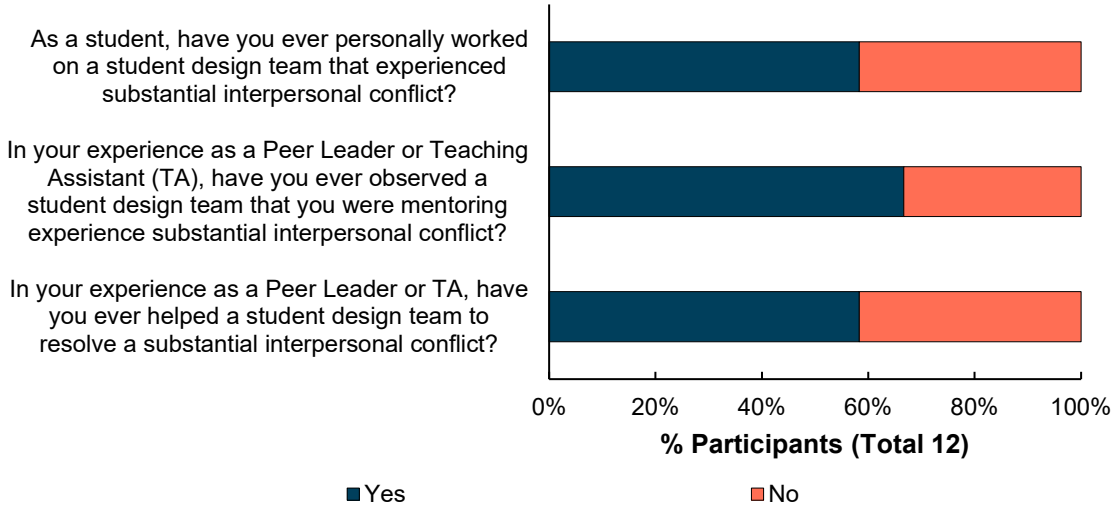

Figure 2. Personal experiences with team conflicts reported by study participants prior to engaging in the simulation session.

While only seven participants reported experiencing substantial team conflict as a student (Figure 2), all participants suspected a peer of not contributing as much as they should have (question A.8). Nine participants confronted this peer and reported this issue using peer-review processes like CATME. Of these nine, four participants additionally raised their concern with their TA or professor. One participant only reported the issue directly to their TA or professor without confronting the peer or using the peer-review process. Four participants recalled a time when they did not contribute as much as they should have; none of the participants have experienced what it is like to be told that they were not contributing.

Participants gave a variety of plausible reasons for a student not contributing as expected (question A.9). These included having (1) college transition issues with inadequate communication and time-management skills to adjust to heavy workloads and team-based design projects, (2) trusting other team members to complete the tasks even if they do not do their fair share, (3) disparities in priorities due to family issues, health concerns, extra-curricular

obligations, or lack of interest, or (4) being marginalized by a team member who discriminated against or dominated others.

In their roles as TAs, ten participants suspected that a student in a team they were supervising was not contributing as much as they should to the team (question A.8). Several participants reported experience with talking to students they suspected as not sufficiently contributing (nine participants), being excluded or marginalized by others (five participants), dominating the team (four participants); or to a team about ensuring that every member had the opportunity to make a meaningful contribution to the project (four participants). Two participants reported experience with all the above. In their written responses about conflicts they observed as a TA, participants described incidents in which some members of the team claimed others had not contributed sufficient effort or work to the team (question A.2.i). These included polarizing descriptions such as "one person d[id] all of the work" or "groupmates did nothing". One TA's response included a description of a dominant member that "kept running over everyone". Other responses provided specific issues that contributed to team conflict, including missed meetings, dissolution of team (after drop date), and accommodations for disabilities.

Participants were evenly split between "somewhat comfortable" and "very comfortable" with mentoring student teams experiencing conflict (question A.4). In helping student teams resolve team conflicts, many participants reported that they worked with the whole team to find a solution through team meetings and project management strategies (question A.3.i). Participants also reported using a variety of techniques to try to motivate team member(s) to change their behavior including highlighting project deadlines or grades, having one-on-one conversations, and using compassionate language. They offered a variety of strategies for addressing team conflict reports (question A.10), including reaching out to students of concern; holding one-on-one or team meetings; investigating reports of conflicts by observing group dynamics and considering alternative explanations; offering reminders of grades, due dates, and office hours; reviewing team norms/expectations; coaching teams to mitigate conflict; and planning interventions with a lead TA or professor.

Prior Training Received

More than half of the participants indicated they had no formal training related to addressing team conflict (question A.5 from Appendix A). Some recalled general training for TAs that focused on course-specific issues (e.g., content, grading policies). Half of the participants indicated they relied heavily on just-in-time training from peers, experienced TAs, and/or professors when team conflicts arose. Some participants indicated that they drew on their personal experiences with conflicts or other general leadership training.

Perceptions of using CATME for Peer Evaluation

The pre-simulation survey also included two questions related to using CATME for peer evaluation (questions A.11 & A.12 from Appendix A). Only half the participants indicated that CATME is helpful in identifying students who are not contributing as expected to the team (responding either "somewhat helpful" or "very helpful" to question A.11). In describing how

they use CATME to address team conflicts (question A.12), several participants reported that they use the comments as resources and review CATME score trends within a team or over time when they see low ratings. One participant described looking for flags raised by the CATME instrument for "Exceptional Conditions" (e.g., low performer, overconfident, etc.) [24]. A few participants expressed concerns with CATME—believing that low ratings may be related to personal differences or that low ratings and/or negative peer-to-peer comments are provided only when the problem is well-established.

Post-Simulation Survey Findings

Reflections from One-on-one Discussions with Student Avatars

The post-simulation survey contained several questions to gather data on whether participants were able to identify the reason for engagement-related conflict for each student avatar and participant perceptions about the next steps they could take (section B.1 of Appendix B).

Identifying primary reason for conflict: All twelve study participants were able to identify the primary reason that Ciara (logistical issues) and Jordan (genuine disinterest) seemed disengaged from teamwork (question B.1.1). However, three participants misidentified the primary reason for Stephanie as experiencing logistical issues instead of marginalization. Indeed, Stephanie was experiencing some logistical issues, however, her most significant concerns were about feeling marginalized. Participants unanimously agreed that the one-on-one discussions provided useful information to help the team move forward in a productive way (question B.1.2).

Identifying next steps: Most study participants expressed that their next step would be to speak to Angela and/or James—the student avatars that were not a part of the one-on-one discussions (questions B.1.3 & B.1.6.1). Motivation to speak to Angela/James either stemmed from a need to know the reason why they held last-minute project meetings or from a desire to conduct a fair process by speaking with all team members. After speaking with Angela and/or James, all but one participant indicated that they would talk to the team as a group. The remaining one participant indicated that they would observe what the team/students do next before talking to the team. After facilitating a conversation with the whole team, other next steps suggested by participants include asking the team to share any remaining concerns without the TA's presence; requesting access to the next submission via Google Docs to monitor progress and distribution of work; following up with the students via email, additional one-on-one meetings, or weekly check-ins; seeking help from other TAs and the professor; and repeating the process as needed.

All twelve participants indicated that they would be "very comfortable" (nine participants) or "somewhat comfortable" (three participants) having a follow-up discussion with the whole team to address and remedy the team conflict (question B.1.4). Participants shared a variety of outcomes they hope to obtain from the team discussion (question B 1.5.1). Predominant outcomes were to create consensus for a new meeting schedule and to give each team member an opportunity to voice their concerns and preferences. Other participants shared outcomes related to reinforcing team norms, equitable work distribution, or responsibility. One participant

advocated for specific ideas shared by the student avatars Ciara and Stephanie during the simulation session.

In sharing their strategies to achieve these outcomes (question B.1.5.2), almost every participant indicated they would, at some point, offer advice to the team. These remarks include being understanding of one-another, revising team norms, rescheduling meetings, or re-allocating work. Many indicated a desire to solicit engagement from every person in the team meeting. Some were interested in making space for each person to express themselves; others wanted targeted input from everyone (e.g., availability for meetings). Just over half indicated that they would use questioning as a technique during the meeting. One participant suggested "re-asking" questions from one-on-one discussions that allow team members to explain their perspective and avoid TA's inadvertent disclosure of confidential information. Others indicated they would give explanations, including their current understanding of the situation or institutional policies.

Authenticity of Scenario and Realism of Conflicts

In the post-simulation survey, we gathered data on participant perceptions of how authentic they felt the scenario was and how typical they found the presented conflicts to be (section B.2 of Appendix B). Likert scale responses to the questions related to authenticity of the scenario are shown in Figure 3. Participants found the conflicts in the team of student avatars to be "very realistic" (nine participants) or "somewhat realistic" (three participants) (question B.2.1). In explaining their choices (question B.2.2), participants who described the scenario as "very realistic" noted familiarity with these sources of conflict—citing their experience with students who have faced logistical barriers, loss of interest, or marginalization while working on teams. Comments from two participants who described the scenario as "somewhat realistic" centered on the student avatar Stephanie. One participant believed that Stephanie could have managed her role in the team conflict if she genuinely had ideas to contribute. Another participant noted that in their experience, students do not self-report marginalization.

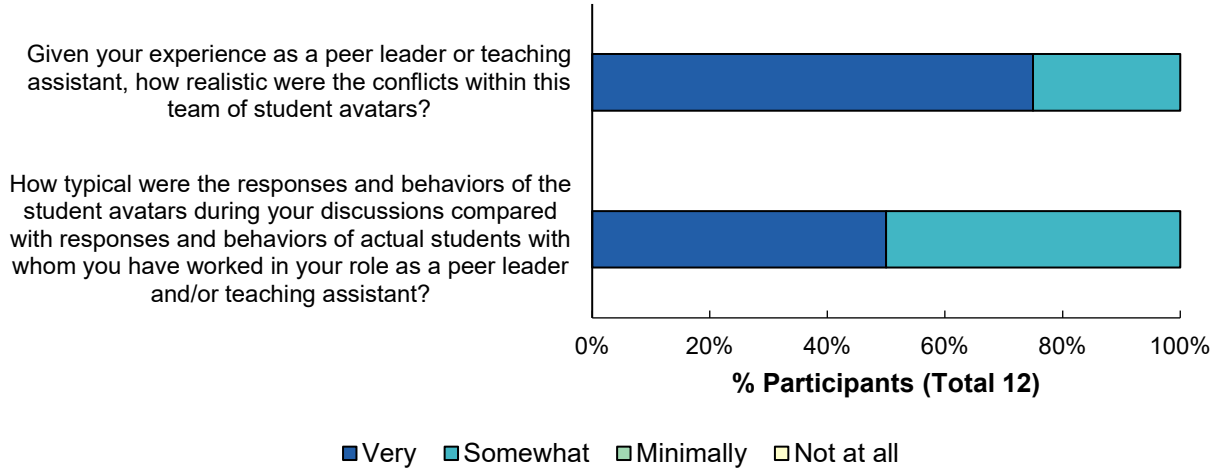

Figure 3. Likert scale responses from study participants regarding the realism of conflicts expressed by student avatars and typicality of student avatar responses and behaviors during their simulation session.

Participants were evenly split in their descriptions of the responses and behaviors of the student avatars as "very typical" vs. "somewhat typical" (Figure 3, question B.2.3). There is some evidence that the study participants made distinctions between realistic team conflicts and typical response/behaviors of the study avatars. In their explanations (question B.2.4), participants who described the student avatars as "very typical" noted parallels between the student avatars and their personal experience. While some participants thought that the responses from student avatars were natural, some others felt like the student avatars were quicker to open up than real students would and that responses were leading the discussion in a certain direction.

Ease/Difficulty with Simulation Session

Likert scale responses to questions related to the ease or difficulty with the simulation technology and the one-on-one discussions with student avatars are shown in Figure 4 (questions from section B.3 of Appendix B). 11 out 12 participants rated the simulation technology as "easy" to use; one of these participants noted that it felt like a "normal Zoom meeting" (question B.3.1). In explaining their response (question B.3.2), the one remaining participant who rated the technology as "somewhat easy" noted they had personal technological issues at the beginning of session, after which there were no further challenges. A few participants noted that they expected to engage with a real person when they joined the session instead of the host avatar Nina.

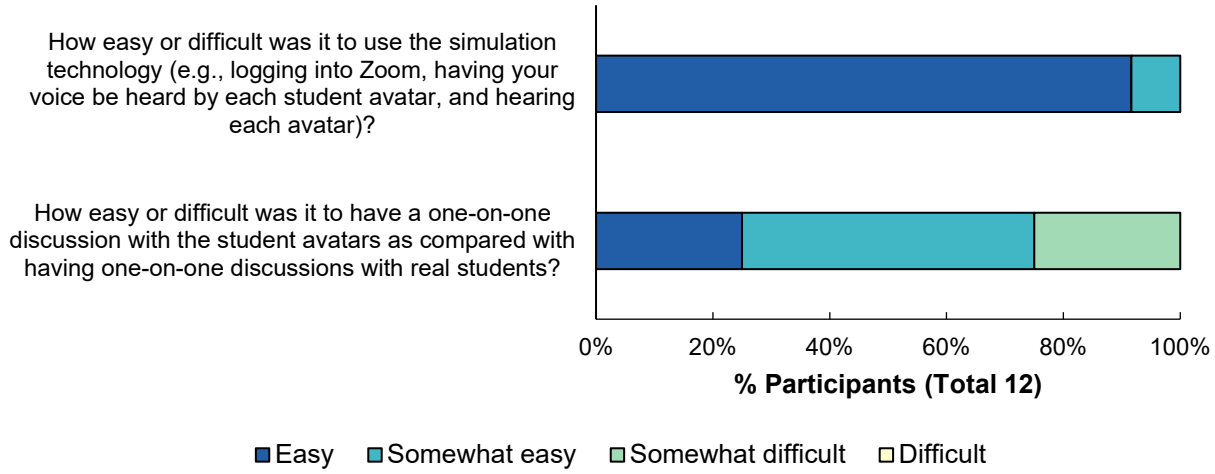

Figure 4. Likert scale responses from study participants regarding the ease or difficulty with the simulation technology and the discussions with student avatars during their simulation session.

Half of the participants reported that they found it "somewhat easy" to have discussion with student avatars as compared with real students (question B.3.3). The remaining participants found it either "somewhat difficult" or "easy". A sample of open-ended responses from participants explaining their description of the ease/difficulty in having discussions with student avatars (question B.3.4) are quoted below.

Easy

"The avatars showed genuine emotions that I would expect of freshmen in college. They were able to give real time responses and even showed body language."

"Sometimes discussions with real people are harder because they don't always give answers you are looking for that help get to the root of the problem."

Somewhat Easy

"Meeting with the avatars was fairly easy, however, since they were pretty quick to share their experiences whereas real students may not open up as fast. I also felt a bit more comfortable knowing the avatars were not real students with real implications from this project."

"Having discussions in person is always easier because you can gauge body language a lot easier, but overall, it was pretty easy to communicate with the avatars."

"With real student I would have weeks to be able to get to know the students, where in this simulation I was speaking to the students for the first time even with their CATME scores."

Somewhat Difficult

"I think it would be a little more easier in real life as it is easier to talk in person and it was a little awkward talking to an avatar than to a real person. The first person I talked to was more difficult but as I talked to more of them it became easier"

"Knowing you are in a simulation removes some of the emotion and care from the discussion."

In general, participants showed an awareness that stakes are higher when discussing team conflicts with real students as compared with the simulation session. Some participants noted initial discomfort with having discussions with student avatars in a simulated environment that eased during their session. Some others noted difficulty in having no prior connections to the student avatars while in real life they would have had time to get to know their students. Some participants also noted that verbal and nonverbal communication would be easier in person with real students.

Value as a Training Experience

In the final section of the post-simulation survey, we gathered data on how participants perceived the value of the simulation experience as a practice tool for TAs (section B.4 of Appendix B). Regarding the helpfulness of the one-on-one discussions with student avatars as practice for TAs (question B.4.3), half of the participants indicated that they believe simulations would be "very helpful" practice for those learning to become TAs. Of the remaining participants, most indicated that this training would be "somewhat helpful"; one participant indicated that it would be "minimally helpful". In their open-ended responses (question B.4.4), participants noted that the simulation session was a realistic and low-stakes way to get feedback. They also noted that the simulation session provided a learning experience on how to ask questions to understand a student's perspective. Participants who expressed concern about the simulation session noted that first-time TAs would need additional guidance before engaging in a similar one-on-one discussion. Sample responses are shown below.

Benefits of the simulation

"I think that having this discussion gave me a good idea of what kinds of questions I should be asking to understand different sides of one story. It also made me understand how important it is to speak to each student one-on-one instead only going off of what the CATME reviews"

"It felt very realistic, and in a training setting, I could receive feedback on how I did without any real stakes at hand"

Concerns about first-time TAs

"People that are TAs for the first time probably don't have a good idea of what to expect at all, so putting them through this simulation would just be overwhelming."

Limitations of the simulation

"It is helpful in that it provides experience and training, however it is still nothing like the real thing."

Figure 5 shows participant perceptions of how helpful they found different sections of the simulation preparation document (question B.4.5). In general, the study participants found the description of the purpose of the discussion sessions and information about the student avatars to be helpful. Responses to the helpfulness of CATME scores were bimodal. Seven participants found the CATME scores to be only "somewhat helpful", while three participants indicated that CATME scores were "very helpful". More than half the participants found guidelines on how to interpret CATME data to be "very helpful" or "helpful"; three participants found them to be "somewhat helpful" or "not at all helpful". Even though participants varied in their responses to the helpfulness of CATME scores and guidelines to interpret CATME scores, they unanimously agreed that peer-to-peer CATME comments were "very helpful".

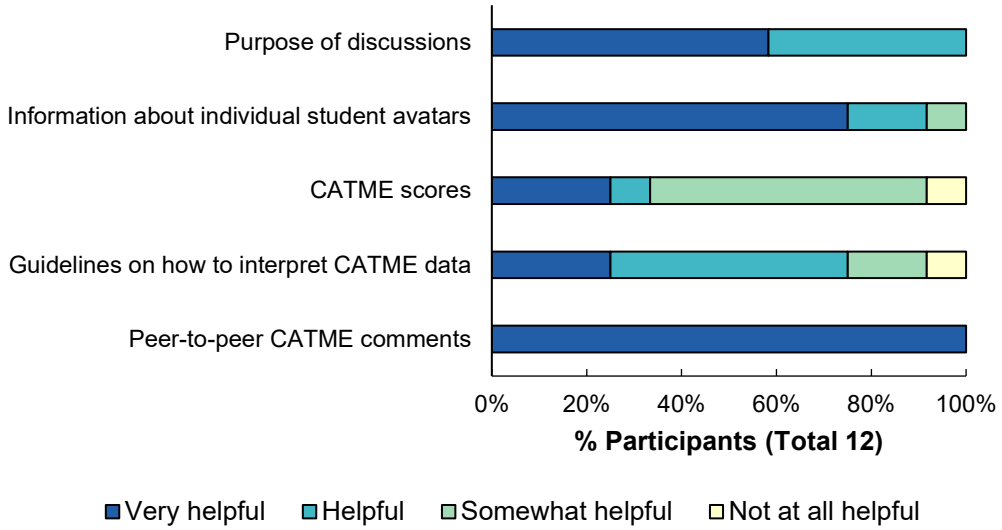

Figure 5. Likert scale responses from study participants about the helpfulness of different components of the simulation preparation document that they received prior to their simulation session to prepare for facilitating one-on-one discussions.

Sample comments from open text responses on the helpfulness of different sections of the simulation preparation document are as follows (question B.4.6). These comments show that the background information and profiles of the student avatars were helpful for study participants to prepare for the simulation session and understand the team dynamics. Many participants indicated that they found CATME scores to have limited usefulness. Participant comments suggest that they found that CATME scores may indicate a problem, but do not define what the problem is. Many participants also highlighted the CATME peer-to-peer comments to be the most important information in the simulation preparation document.

General Comments on Simulation Preparation Document

"The provided documents allowed me to take notes about the students before meeting with them. This helped me understand their situations and better questions to ask"

Purpose of the discussions

"The section outlining the purpose of the discussion helped me navigate the one-on-one talks."

Information about individual student avatars

"The student profiles were extremely helpful in giving me context of this group and what the members are like. If I didn't have those profiles i [sic] would basically have to learn what the students are like while doing the interview which would compromise the purpose of the interview."

"…the information about the individual student was only really helpful for Ciara and that she was a commuter."

CATME scores

"I think the CATME scores in general do not mean much -- the main thing that matters is if they are rated low relative to their teammates or are overrating themselves compared to their teammates."

"I think that the CATME scores are only really helpful in realizing that there is team conflict in the first place"

Peer-to-peer CATME comments

"The student comments provided context for the catme [sic] scores and helped me better understand the student's personalities"

"Reading the comments is always the most important thing for me because it gives me a better idea of the situation than the numbers."

Comparing Pre- & Post-Simulation Responses

In both pre- and post-simulation surveys, we asked participants about their perceptions of the importance of TAs receiving training to learn how to address team conflicts; Likert scale responses are shown in Figure 6. Pre-simulation, all participants responded that it is important to receive training to deal with student team dynamics and interpersonal conflict (evenly split between "somewhat important" and "very important" in response to question A.6). The

percentage of participants who believed TA training to be "very important" rose to 75% in the post-simulation survey with three participants rating the training as more important than they did in the pre-simulation survey (question B.4.1). One participant rated TA training as less important in the post-simulation survey than they did in the pre-simulation survey.

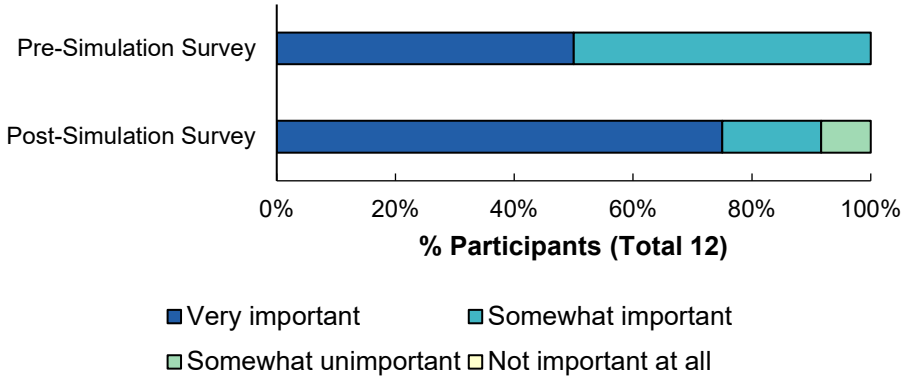

Figure 6. Likert scale responses about the importance of TAs receiving training to learn how to address team conflicts from study participants before and after engaging in the simulation session.

In responding to the kind of training that they think TAs should receive to support their student teams in the pre-simulation survey (question A.7), most participants advocated for training that addressed common conflicts and/or conflict resolution strategies. Many specifically suggested that scenarios and sample responses would be helpful. Some responses requested information on how to get just-in-time support or judge when a conflict needs to be brought to the attention of the professor.

In the post-simulation survey, we asked participants to explain their Likert scale response about the importance of TAs receiving training for team conflicts (question B.4.2). Some participants recognized personal benefits from training or using simulation environment for training. Others named reasons for the importance of training, viz., team conflicts were common, issues can arise from insufficient training, and mitigation of team conflicts aids student success. The one participant who rated training as less important than they did in the pre-simulation survey suggested that they believe training is less important for TAs with prior training on addressing conflicts.

Discussion and Conclusion

All twelve study participants were undergraduate engineering majors who were experienced in serving as TAs for courses where student teams engage in multi-week design projects. They were all familiar with working in and/or mentoring teams where one or more students were suspected of not contributing their fair share to the project. Most participants noted that they did not receive any formal training as TAs to manage team conflicts. While all participants reported comfort with mentoring student teams experiencing conflict before engaging in the simulation session, they recognized the importance of TAs receiving training to deal with team conflicts.

After completing their simulation session, all study participants found the one-on-one discussions with student avatars in the simulated environment to be realistic and the technology to be easy to use. They reported that the responses and behaviors of the student avatars were typical compared with actual students with whom they have worked in their role as TAs. It is evident that participants perceived discussion in the simulated environment to have lower stakes and recognized the value of such one-on-one discussions with student avatars to be helpful experiences for TAs to learn to manage team conflicts.

After engaging in one-on-one discussions, most participants were able to correctly identify the primary cause for conflict for each of the student avatars. However, identifying marginalization may be a challenge for some study participants. All participants indicated that they were comfortable facilitating a subsequent discussion with the entire team. They were able to provide concrete examples of strategies and techniques that could be used to follow-up with individual students and the team to ensure their continued success.

Perceptions by study participants reported in both pre- and post- simulation surveys suggest that TAs may need additional training to using and interpreting CATME peer-evaluation scores to investigate team conflicts. All participants found peer-to-peer comments valuable in giving them insight into team dynamics.

Future Directions for Research

This work supports our ongoing efforts to build a portfolio of coaching strategies to address issues stemming from interpersonal team dynamics in design teams. We have analyzed the transcripts of the 36 one-on-one discussions that were gathered in this study (3 discussions each from the 12 participants) to characterize the differences in how the TAs facilitated the discussions. We plan to publish these results soon. We are currently analyzing results from conducting a similar study with a group of novice TAs who were mentoring student teams for the first time. We are comparing how these novice TAs engaged in the simulation session compared with the experienced TAs described in this study. We plan to create additional scenarios for one-on-one and team discussions in the simulated environment. Additionally, we plan to study how best to integrate these simulation sessions into workshops where TAs could learn from examples of effective and ineffective strategies when engaging in one-on-one or team discussions. Finally, we plan to research how these interventions could lead to improved self-efficacy among TAs and improved student outcomes in team-based design courses.

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Appendix A
Pre-Simulation Survey Instrument

A.1. As a student, have you ever personally ***worked on a student design team*** that experienced substantial interpersonal conflict?

Yes [continue to question 1.1.i]
No

A.1.i. Describe one example of such a conflict and how it was resolved, if at all. [Text Response]

In your experience as a Peer Leader or Teaching Assistant (TA), have you ever ***observed a student design team*** that you were mentoring experience substantial interpersonal conflict?

a. Yes [continue to question 1.2.i]
b. No

A.2.i. Describe one example of an interpersonal conflict that you observed in a team you were mentoring as a Peer Leader/TA [Text Response]

A.3. In your experience as a Peer Leader or TA, have you ever ***helped a student design team*** to resolve a substantial interpersonal conflict?

a. Yes [continue to question A.3.i]
b. No

A.3.i. Describe what you knew about the conflict and how you helped the team. [Text Response].

A.4. How comfortable and/or prepared did you feel as a Peer Leader or TA mentoring student teams experiencing conflict?

Not at all comfortable
Minimally comfortable
Somewhat comfortable
Very comfortable

A.5. As a Peer Leader or TA, explain the nature of any training, coaching, or support that you received, if any, on how to mentor student teams that were experiencing conflict?
[Text Response]

A.6. In your opinion, how important is it for Peer Leaders and TAs to receive training on how to deal with difficult student team dynamics and interpersonal conflict?

Not important at all
Somewhat unimportant
Somewhat important
Very important

A.7. What kind of training do you think that Peer Leaders and TAs should receive to be prepared to support student teams that are experiencing conflict? [Text response]

A.8. Please indicate whether you have ever been in one of the situations described below.

When I was an undergraduate engineering student working on a team design project

	Yes	**No**
I worked with a teammate that I thought was not contributing as much as they should have.		
I confronted a teammate that I thought was not contributing as much as they should have.		
I reported a teammate that I thought was not contributing as much as they should using the usual peer-review processes (e.g. CATME).		
I reported a teammate that I thought was not contributing as much as they should directly to a Peer Leader/TA/Professor (e.g., face-to-face, email, etc.).		
I did not always contribute as much as I could have.		
Someone (e.g., teammate, Peer Leader/TA, professor) told me that I was not contributing as much as I should have.		

In my role as a Peer Leader or TA,

	Yes	**No**
I suspected that a student was not contributing as much as they should to the team.		
I talked to a student that I suspected was not contributing as much as they should.		
I talked to a student that I suspected was being excluded or marginalized by others.		
I talked to a student that I suspected was dominating the team.		
I talked to a team about ensuring that every member had the opportunity to make a meaningful contribution to the project.		

A.9. In your opinion and experience, what are some reasons a student might not be contributing as expected to a team project? [Text Response]

A.10. In your opinion and experience, what is the best way for a Peer Leader or TA to respond to a team or individual when there is some evidence that some team member(s) are not contributing as expected to the team? [Text Response]

A.11. In your opinion, how helpful is CATME in identifying students who are not contributing as expected to the team?

Not Helpful at All
Somewhat Unhelpful
Somewhat Helpful
Very Helpful

A.12. As a Peer Leader or TA, describe how you use feedback from CATME to address team conflicts related to perceptions of some team member(s) are not contributing as expected. [Text Response]

Appendix B

Post-Simulation Survey Instrument

Section B.1. Reflections from One-on-one Discussions

B.1.1. These are some reasons that team members might not seem as engaged in teamwork:

a. Genuine disinterest (e.g., not interested in being an engineering major)
b. Logistical issues (e.g., difficulty making meeting times and locations)
c. Marginalization by team members (i.e., being treated differently by other team members due to aspect(s) of the student's identity)

Given what you learned from your discussion, what would you say is most likely to be the **primary reason** for each student (from their perspective)?
[Check one choice per row.]

	Genuine Disinterest	Logistical Issues	Marginalization
Ciara	□	□	□
Jordan	□	□	□
Stephanie	□	□	□

B.1.2. To what extent do you agree or disagree with the following statement?

My one-on-one discussions with the student avatars provided information that I could use to help the team move forward in a productive way.

Disagree
Somewhat disagree
Somewhat agree
Agree

B.1.3. What else would you want to know from the team members (Ciara, Stephanie, Jordan, Angela, and/or James) to feel more informed? [Text Response]

B.1.4. Let's say that your professor asks you to follow up by having a discussion with the whole team (with Ciara, Stephanie, Jordan, Angela, and/or James) to address and remedy the team conflict. How comfortable would you be in facilitating this team discussion? [Select one]

Not at all comfortable
Minimally comfortable
Somewhat comfortable
Very comfortable

B.1.5.1. What do you hope would be the important outcomes of this discussion? Please be more specific than the big idea of addressing team conflict. [Text Response]

B.1.5.2. How would you facilitate this discussion to achieve these outcomes? You may describe questions that you would ask, information you would share, and/or approaches you would take. [Text Response]

B.1.6.1. Now let's say your professor leaves it completely up to you to decide what to do next. What are you most likely to do before the next assignment/CATME due date?
Select what you would do first, second, third, etc. Note that you can choose to NOT do one or more of these options.

	Do first	Do second	Do third	Do fourth	Would not do
Talk to Angela one-on-one					
Talk to James one-on-one					
Talk to the team as a group					
Observe what the team/students do next					

B.1.6.2. List anything else you would do in addition to the given options above. Indicate when you would do this/these additional things (before/after one of your selected choices above). [Text Response]

B.1.6.3. Please explain your responses to what you would/would not do and their respective ordering (given choices as well as your own additional ones, if any). [Text Response]

Section B.2. Authenticity of the Scenario

B.2.1. Given your experience as a peer leader or teaching assistant, **how realistic were the conflicts** within this team of student avatars? [Select one]

Not at all realistic
Minimally realistic
Somewhat realistic
Very realistic

B.2.2. Please explain your response from the previous question about the realism of the conflict within this team of student avatars. [Text Response]

B.2.3. **How typical were the responses and behaviors** of the student avatars during your discussions compared with responses and behaviors of actual students with whom you have worked in your role as a peer leader and/or teaching assistant? [Select one]

Not at all typical
Minimally typical
Somewhat typical
Very typical

B.2.4. Please explain your response from the previous question about the responses and behaviors of the student avatars. [Text Response]

Section B.3. Ease/Difficulty with Simulation Session

B.3.1. How easy or difficult was it to use the simulation technology (e.g., logging into Zoom, having your voice be heard by each student avatar, and hearing each avatar)? [Select one]

Very Difficult
Somewhat difficult
Somewhat easy
Very easy

B.3.2. Please explain any difficulties you had with the technology. [Text Response]

B.3.3. How easy or difficult was it to have a one-on-one discussion with the student avatars as compared with having one-on-one discussions with real students?

Difficult
Somewhat difficult
Somewhat easy
Very easy

B.3.4. Please explain your response from the previous question about ease or difficulty in having one-on-one discussions with student avatars as compared to real students. [Text Response]

Section B.4. Value as a Training Experience

B.4.1. How important do you believe it is for peer leaders or teaching assistants to receive training to learn how to address team conflicts?

Not important at all
Somewhat unimportant
Somewhat important
Very important

B.4.2. Please explain your response above about the importance of peer leaders or teaching assistants receiving training to learn how to address team conflicts. [Text Response]

B.4.3. To what extent would having one-on-one discussions with the student avatars (like those you had today) be helpful practice for those learning to become peer leaders or teaching assistants?

Not at all helpful
Minimally helpful
Somewhat helpful
Very helpful

B.4.4. Please explain your response from the previous question about the helpfulness (or not) of one-on-one discussions like the one you facilitated today. [Text Response]

B.4.5. How helpful did you find the following components of the Simulation Preparation Document?
Please reference your Simulation Preparation Document when answering these questions.

	Not at all helpful	Somewhat helpful	Helpful	Very helpful
Information about the purpose of the discussions with Ciara, Stephanie, and Jordan on Page 1				
Information about the individual student avatars on Page 2				
CATME scores on Page 3				
Guidelines about how to interpret the CATME data on Page 3				
Student comments on Pages 4-6				

B.4.6. Please explain your above responses about the helpfulness of these components of the Simulation Preparation Document and provide any additional feedback you have about the document. [Text Response]