Near-Peer Mentors' Discussions with a Student Avatar Experiencing Logistical Issues on a First-Year Design Team

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Introduction

In this Complete Research paper, we share results from our larger study of how experienced near-peer mentors (NPMs) who manage design teams facilitate one-on-one discussions with students on design teams in conflict. These design teams are part of a large (ca. 650-student) first-year undergraduate engineering design course at the University of Delaware, with 28 NPMs each mentoring approximately five five-person teams in the course. Often, students in the course report that others on a team are not contributing as much as they should to the team or engaging enough with the team. Further inquiry into this type of team conflict by NPMs is necessary. We have found that those who are perceived to be not contributing to teams might be experiencing logistical issues, marginalization, or disinterest in the major. Broadly, our work aims to explore how NPMs can use discussion to make this kind of inquiry and to suggest how NPMs may benefit from coaching to effectively intervene on team conflicts. This work is novel within the first-year engineering program space in that its aim is to support NPMs as they, in turn, support first-year students on design teams.

The focus of the present study is to examine how 12 experienced NPMs facilitated discussions with "Ciara" – one of three student avatars in a mixed-reality (MR) simulation. Prior to engaging in the MR simulation, NPMs were given peer evaluations about Ciara that suggested that she was not contributing as much to the team as she should. NPMs' discussions with Ciara had the potential to reveal that she was experiencing logistical challenges. In what follows, we share ideas from the literature and from our own observations about engagement-related conflict on design teams, and then address the use of MR simulations in educational environments.

Engagement-Related Conflict on Engineering Design Teams

Team-based work is a fundamental tenant of design thinking and the work of an engineer; it is critical that undergraduate engineering programs include team-based design projects throughout the curriculum [1]. The literature has reported on the benefits of and best practices for students engaged in team-based design projects [2-4]. Also addressed in the literature are challenges related to teamwork, especially with respect to conflicts related to interpersonal dynamics among team members [5-8]. A meta-analysis of team effectiveness identified two conflicts related to interpersonal dynamics on undergraduate engineering design teams [7]. The first is that undergraduate students struggle with trusting one another to do the work of the team. The second and most prevalent problem has to do with perceived "social loafing" among team members.

The term social loafing was coined in the psychological literature; it describes the tendency to exert less effort when working collectively (e.g., in a team) than when working individually [7, 9]. In colloquial language, the term may be used interchangeably with "slacking" and is sometimes used to suggest an intention to "free ride". We use the term "engagement-related team conflict" to describe the turmoil a team experiences when one team member suspects another is not sufficiently engaged with the team (i.e., when a team member believes another is not contributing a much as they should). We do so to challenge the colloquial terms like slackers,

free-riders, or social loafers, and the meanings they connote, i.e.: that individuals are intentionally conserving effort for personal benefit and/or expect to receive the full benefit of others' efforts. Ascribing these unseemly motives to students facing logistical difficulties, feeling marginalized, or losing interest in majoring in engineering, is presumptuous, harmful (e.g., damaging professional reputation), and limits the ability to address real problems.

Some progress has been made in addressing team conflicts related to interpersonal dynamics in engineering design teams. For example, instructors can create environments that help to improve team engagement by reducing team size and centering teamwork around complex and meaningful projects [7, 9]. Instructors can employ the use of routine peer evaluations [10], which enable the tracking of teams' health by receiving quantitative and qualitative feedback from students throughout the semester. A widely used peer evaluation tool is the Comprehensive Assessment of Team Member Effectiveness (CATME) [11, 12]. Ideally, CATME and similar tools are used as formative assessment tools, enabling instructors and NPMs to further investigate team conflicts that surface in peer evaluations. If necessary, NPMs can intervene to help resolve those conflicts and move forward productively.

Consistent with findings from the meta-analysis [7], the major source of team conflict among design teams in our first-year engineering design course is engagement-related conflict. Over several years, course instructors have observed that most of these conflicts arise from three types of underlying problems. These are logistics, marginalization, and disinterest. Logistics include issues like scheduling conflicts (e.g., a team member may consistently miss team meetings due to such challenges). Marginalization refers to individuals being positioned as outside of the dominant group [13]. Our primary use of marginalization focuses on those who have been historically minoritized in engineering education by race, ethnicity, identity as LGBTQIA+, and/or gender. Individuals may be made marginal to a team or within an engineering program with respect to these and other non-dominant identities [see 14, 15 for examples]. Finally, we have observed that in some cases of engagement-related conflict, those who appear to be disengaged from the team have lost interest in the course or the major.

The Mixed-Reality Simulation: Mursion®

The simulation system we used in our study is called Mursion®. Mursion® is an MR simulated environment that allows users to practice facilitating discussions with one or more avatars. The Mursion® system works with Zoom such that the user facilitating the discussion sees the avatar(s) on a single Zoom screen. For any Mursion® session, the avatar(s) are controlled in real time during the discussion by a single, highly trained person called an interactor or simulation specialist (sim). This person is referred to as the "human-in-the-loop" in MR simulations [16]. During the session, the user only sees the avatar(s) on the Zoom screen. The sim sees the user, the avatar(s) they operate, and a control screen.

MR simulations have been used in education and other fields to help individuals practice facilitating challenging discussions before facing similar discussions in real on-the-job contexts. For example, outside of education, Mursion® has been used to help employees in various industries learn to have difficult discussions as leaders; to discuss issues related to diversity, equity, inclusion, and justice; and to hone their customer service skills (www.Mursion.com) [17].

Within education, MR simulations such as Mursion® and TeachLivE™, have been used in multiple ways, including to help pre-service teachers learn to manage classroom behavior, hold meaningful discussions about content with students, and engage in teacher-parent conversations [18-23]. In the context of engineering education, researchers have used Mursion® to investigate how in-service teachers facilitate engineering argumentation discussions and to investigate how pre-service teachers practice facilitating discussions with students about their brainstormed ideas, design performance, and improvement [24, 25].

One way to better understand MR simulations is to contrast them with two other types of simulations: (1) live actor simulations and (2) computer-based agent simulations (Figure 1). An example of the first type involves human actors who play standardized patients for those preparing for the medical profession [26]. These standardized patients can be queried by those preparing to be nurses or doctors about their symptoms. In contrast, computer-based agent technologies are controlled by computer algorithms [27]. The learner engages with the computer algorithms through a user platform without additional human intervention.

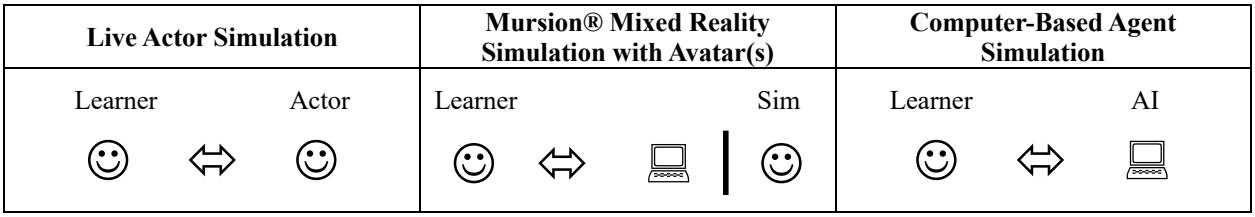

Figure 1. Three types of simulations to support learners' discussion practice.

MR simulations with avatars are like live actor simulations in that the avatars are played in real time by the sim. This provides quick and relevant responses to what the learner says. The sim also operates body language and facial expressions of the avatars. These verbal and visual avatar responses contribute to the authenticity of the simulation, especially when compared to chatting with a computer-based agent [17, 28]. In the design of the Mursion® experience, computer algorithms are used to create certain movements and expressions the sim can select for each avatar, and to generate the appearance and vocal range for each avatar.

In MR simulations, the learner sees and engages with the avatars on a screen. The learner does not see the person who is the sim; thus, the sim is shown behind a "wall" in Figure 1. This contributes to a feeling of anonymity that results in an increased willingness by the learner to interact and share as compared to interactions with real people [29, 30]. Ultimately, the goal is to prepare learners for future experiences with real individuals [31]. There is some evidence that practice within MR simulations improves pre-service teachers' abilities to facilitate similar discussions with real students [32].

To become a Mursion® sim, individuals must take a course and pass a final performance assessment for the relevant Mursion® simulated environment. There are multiple simulated classrooms used for educational discussions (e.g., the high school classroom). Each has five different avatars. During Mursion® coursework, the sim delves deep into the vocal characteristics, dispositions, and backgrounds of each avatar. The sim learns how to voice and move the avatars, hop in and out of different student avatars during a discussion, and combine

their own vocal range with technological support so that different avatars sound different. Beyond this, the sim also requires extensive practice as the avatar(s) in the context of the scenario. Being a sim is a form of improvisation, which is acting without a script but within constraints dictated by a scenario. See a detailed discussion of both Mursion® and content/scenario training for a sims to lead a science discussion by Authors [23].

Study Context

The sim for the present study is the first author, Lottero-Perdue, who is a member of the engineering education community. To our knowledge, the larger study of which the present study is a part, is the first use of Mursion® to create a college-level learning environment. The larger study involves the use of four avatars (Figure 2). One of the avatars, Nina (leftmost in Figure 2), is the host avatar whose role it is to help facilitate data collection sessions. Starting with student avatars from the Mursion® high school classroom – Ciara, Jordan, and Stephanie – we made alterations to their vocal characteristics and backstories to age them into first-year undergraduate engineering students. In our study scenario, these three student avatars are in a team along with two other students: Angela and James. Ciara is the student avatar of focus in this paper.

Figure 2. Avatars used in the present study (used with permission from Mursion®, inc.)

The Engagement-Related Conflict Scenario

Kavanaugh [33], Bondie and Dede [21] described a scenario for MR simulations used in pre-service teacher education as being "rooted in a frequently occurring complex dilemma observed in student learning that revolved around interactions with the teacher as the vehicle for learning" (p. 234). The scenario we developed is rooted in the frequently occurring conflict in design teams where one or more team members perceive others as not doing enough on the team. The teacher in this case is the NPM who supervises the team and has an opportunity to investigate what might undergird this perception – informing NPMs about if and how to intervene to help resolve the conflict. The conflict within the scenario as well as the CATME scores and comments are all fictitious but based upon the research team's experiences with design teams, team conflicts, and CATME.

We prepared two sets of materials for the scenario: 1) the NPM-facing materials that the NPM receives to prepare for the discussion, and 2) the sim-facing materials that the sim uses and that help to constrain their improvisations. Using these materials is essential to the design of MR

simulation work [28, 34]. The development process for these materials occurred via an iterative process of improvement and testing, as recommended in the MR simulation literature [21].

NPM-Facing Scenario Materials

All NPM participants were provided scenario materials in a six-page document to help them prepare for the simulation session. The NPMs did not receive any training or additional information to prepare for their discussions. The first page orients NPMs to the design team, basic nature of the conflict the team is experiencing, goal of the discussions they will facilitate, and summary of information to which they have access in the rest of the document to use as they prepare. The document specifies that during the simulation session, NPMs will have the opportunity to have three one-on-one discussions with Ciara, Jordan, and Stephanie, respectively. NPMs are advised that their goal is to understand the perspective of each student avatar with whom they have a one-on-one discussion rather than to give advice or fix the problem. NPMs are asked to use the provided student information, CATME data, and student comments to prepare for the discussions. Additionally, NPMs are informed that a student who others suspect is not doing their part for the team may be (a) having logistical issues that make it difficult for them to contribute to the team, (b) feeling marginalized by the team, or (c) lacking interest in the project or in engineering.

The second page of the NPM-facing materials provided images of each of the student avatars (similar to Figure 2), their pronouns, and short descriptive statements about each student. Note that student avatar pronouns and some of these descriptive statements came from the backstories and dispositions of the students provided by Mursion® (e.g., that Ciara is polite and focused and comes from a military family). For our scenario, we added that Ciara is a civil engineering major and commutes from a military base where she lives with her family.

The final four pages of the NPM-facing materials summarize the five CATME Teamwork Dimensions, show the team's peer-to-peer ratings for each of the Dimensions, and provide peer-to-peer comments about each of the five team members. Ciara received low CATME scores from the team. Peer comments conveyed that Ciara is not coming to all team meetings and that this might be because she is a commuter. Ciara's comments included that she has a lot to contribute, contributes when she can, and wishes the team had assigned roles.

Sim-Facing Scenario Materials

The sim-facing materials assist the sim in knowing how to respond in character consistently as each of the students to NPM questions during the discussions. Two major components of sim-facing materials are narrative backstories for each student and sample responses. Ciara's narrative backstory included information about her family life, relevant experiences prior to entering college, and her experiences thus far this semester.

We devised a two-page document of sample responses for each of the three student avatars for how they would respond to several questions, as well as how they might elaborate if probed for additional information. Table 1 provides examples of sample initial and follow-up responses that Ciara might provide with respect to questions about whether she is interested in the class/major, is experiencing logistical difficulties, or is being marginalized.

Table 1. Sample Responses for Ciara regarding Logistics, Marginalization, and Interest.

Topic	Initial Response	Follow-up Responses
Interest	Yes, I'm interested.	I know that civil engineering is the major for me. I really like my classes. I like the design project and want our product to work.
Logistics	Yes.	James and Angela ... set up meetings at the last minute when it's convenient for them and I'm driving home or at home. They don't stick to our team norms. They change the plans and meet when it's convenient for them and expect others to show up, too. They meet in the dorms. I don't feel comfortable there. I thought we said we would meet in one of the engineering buildings.
Marginalization	Not really.	They mostly treat me differently because I am not like them since I'm military and I don't live here on campus.

Note that these sample responses help guide the sim's responses but do not need to be used as a script or in a particular order. As described in work by Mikeska, Howell, and Straub [19], while sims have access to prompts like these sample responses, the prompts do not represent "a set of scripts or strict contingency moves" but are rather guidelines, setting parameters for the sim to make "judgments in the moment as the interaction unfolds" (pp. 139-140).

The sim also had access to the team norms document the team created at the beginning of the semester. One norm was that the team would set up the following week's team meeting on the Friday prior, enabling all team members' scheduling constraints to be considered. Another was that the team would meet in a public place on campus like one of the engineering buildings.

Study Methods

Two research questions drove this qualitative study: 1) How do the NPMs in this study inquire about whether Ciara is experiencing logistical challenges, marginalization, or disinterest in the class or major? and 2) In what ways did the NPMs in this study provide support or encouragement to Ciara during the discussion? Twelve undergraduate engineering majors with experience as NPMs mentoring student design teams in one or more design-based courses participated in the study. Note that this sample size, 12, is well within the recommended range for studies of this nature. Unlike quantitative research, which depends on large sample sizes to make generalizable claims, qualitative research uses small samples sizes to understand unique experiences within specific contexts.

The 12 participants had been NPMs for one (10 participants) or more (2 participants) design-based courses. They included those who identified as female (9), male (3), Asian or Asian American (1), Hispanic or Latino (1), White/Caucasian (1), members of the LGBTQ+ community (1), and first-generation college students (1). The participants were entering their third (5) or fourth year (7). All participants had familiarity with using CATME.

Each participant signed up for a one video recorded Mursion® session. We provided NPM-facing materials to each study participants one week prior to engaging in their simulation session. During the session, they facilitated a one-on-one discussion with Ciara and two other avatars in varying order. All student avatars were played by the sim for the study, as was the host

avatar, Nina, who introduced the session and each of the discussions. Discussions with each avatar were between 6 and 15 minutes. We also gathered survey data prior to and after the session; this is not a part of the present study but is available in our prior work [35]. After de-identifying the data and assigning pseudonyms to all participants, we generated transcripts for each discussion using Rev.com and reviewed those for accuracy before analysis.

We collaboratively and iteratively coded all the transcripts using strategies for analyzing discussion transcripts developed in our prior work [36, 37]. We applied codes to NPM turns within the transcript; a turn is a block of text having one or more sentences/phrases followed by a response from the student avatar. The first two authors, Lottero-Perdue and Malladi, coded four of the transcripts together and each coded four transcripts independently. We reviewed one another's independent coding, met to reconcile differences, developed emergent codes as necessary to describe the data, and then returned to the double-coded transcripts to ensure consistency in coding across all the transcripts.

The present study discusses results from analysis of the 12 transcripts of NPMs' discussions with Ciara. We coded each NPM turn for whether it elicited or probed Ciara with respect to logistics, marginalization, or disinterest. Eliciting and probing were two discussion moves that we used from literature on eliciting student knowledge [38]. Here, eliciting suggests that the NPM asks a question that has not been addressed by Ciara so far, whereas probing suggests that Ciara shares some information about a topic that the NPM follows-up on through additional questioning.

We used subcodes to further describe how NPMs elicited or probed about logistics and for the supportive statements they used. Unlike a priori codes for logistics, marginalization, and interest, these subcodes were emergent in our analysis. Where relevant, we applied more than one subcode to a given turn. We used qualitative content analysis to characterize the range of eliciting/probing questions and supportive statements across participants [39].

Results for Research Question 1: Logistics, Marginalization, and Interest

Table 2 summarizes our coding for eliciting or probing NPM turns that inquired about challenges related to logistics, marginalization, or interest. The total number of turns of each type are also shown as a means of comparison. Evident in the table is that all 12 participants asked questions about logistics, each posing between 2 and 11 questions. Fewer participants asked about marginalization or interest; those who did posed fewer questions about these topics.

Logistics

When we designed the scenario, we aimed for NPMs to discover that while Ciara's team members suggested that she was not contributing as much as she should to the team, Ciara was primarily experiencing issues related to logistics. Although these issues were related to her status as student who commutes, they were caused by some team members who lived on campus not abiding by team norms. The entire team had set those norms about how, when, and where they would schedule meetings. Team members often re-scheduled meetings with little warning, with Ciara planning to attend the originally scheduled meeting but not being able to make the re-

scheduled meeting (e.g., because she was already on the way home). They would also reschedule meetings in dormitories rather than public spaces.

As shown in Table 2, all 12 participants asked at least two questions regarding logistics. The nature of those questions ranged across participants. Subcodes for logistics included questions that asked about commuting, team norms, meeting scheduling, video conferencing, and meeting location. Some subcodes were applied to the same (often compound) question.

Table 2. NPM Turns with inquiries about Logistics, Marginalization, and Interest.

NPM Participant	Logistics	Marginalization	Interest	Total Turns
Number of Turns				
Blake	5	1	0	21
Cameron	4	2	0	26
Courtney	4	0	1	30
Dallas	11	1	1	38
Frankie	9	0	1	36
Greer	5	2	0	28
Hunter	2	0	0	33
Jason	2	0	0	23
Justice	4	0	0	23
Kai	2	0	0	24
Lennox	2	0	0	16
Sam	2	0	0	20
Total	*52*	*6*	*3*	*318*
Number (Percentage) of Participants (n=12)				
	12 (100%)	4 (33%)	3 (25%)	

Note: All participant names shown are pseudonyms.

Nine NPMs collectively asked 16 questions about commuting. Our commuting subcode captured instances in which NPMs either asked about if Ciara was a commuter and what that was like, or if Ciara's commuting was the cause of her missing meetings. NPM Blake asked both types of questions, asking in sequence: *"You're a commuter, right?"*, *"Where do you commute from?"*, and *"Do you do that every day?"* NPM Blake's final question about commuting inquired: *"Some of your teammates said that you haven't been meeting some of your meetings, is the commute part of the reason why?"* Note that this question suggests that Ciara's commuting itself is problematic – rather than exploring whether the team's inclusion of Ciara as a commuter is at issue. Altogether, six NPMs posed a similar question. Ciara's responses to these questions were like how she responded to NPM Blake:

> *Ciara: Um, I would say not… yes, the commute means that I'm unable to make a last minute meeting, but we established in the beginning of this semester through our norms – which I have right here if you want me to read any of them of for you – But through our norms, we decided that during the Friday discussions, we would set up a time to meet the following week. If we stuck to that, then I would be able to make those meetings because that would take into account my schedule."*

Nine NPMs asked a total of 12 questions about the norms that the team put in place at the beginning of the semester, which included norms for how meeting scheduling would occur and where and when teams would meet. For example, NPM Cameron asked *"In terms of your team norms, like how are the meetings supposed to be set up?*" In NPM Sam's discussion with Ciara, Sam followed up with Ciara's comment that the team was not following norms by asking: *"And therefore, is that a reason, like, are you missing some [meetings] due to that reason of the changes?"* Three NPMs asked Ciara about norms with respect to meeting location. This included NPM Greer who confirmed with Ciara that *"the team is meeting um in somebody's dorm instead of uh in an open area where you said they were going to."* Relatedly, six NPMs asked a total of 22 questions about meeting scheduling with respect to time and how that affected Ciara, but that were not in direct reference to norms around scheduling. NPM Frankie asked seven of those questions, for example asking *"So, when has everyone been deciding the meetings?"* and *"Um, the meetings that you have been able to attend, are those the ones that are prescheduled?"*

Three NPMs, each asking a single question, asked if the team used Zoom in cases where the meeting occurred when the team met but Ciara was already home. For example, NPM Cameron asked: *"When they do change it last minute, do they offer you a way to Zoom in or connect remotely even if you can't be there physically?"* Additionally, a unique question in this logistics category was whether team members followed up with Ciara after a meeting that she missed *"to tell you what happened – give you like a little rough draft or summary"* of what happened.

Marginalization

Four out of 12 NPMs asked if Ciara was feeling marginalized on her team. Three NPMs asked about whether Ciara felt included in her team. For example, we coded both of NPM Cameron's comments in the following exchange as questions about marginalization:

NPM Cameron:	*Okay. Yeah, I can understand. Um, when you are at the meetings, uh, do you feel included?*
Ciara:	*Uh, I do, I do a little bit. I mean, I, I feel like they include me as a person. But they don't take into account, um, you know, I, I just, I don't feel comfortable ... I don't feel comfortable in the dorms, and we, we said we were gonna meet somewhere else anyway. So, I guess I don't think they understand what it's like to be a commuter.*
NPM Cameron:	*Okay. Yeah, I can understand that. Um, have they done anything that made you feel uncomfortable then? If you're not comfortable with the dorms, or just in general?*

NPM Blake took a different approach – asking if Ciara's teammates saw her full potential. This was after Blake commented that Blake saw on Ciara's CATME comments that she wanted there to be more specific roles on the team and to describe those. After Ciara described how doing so would be clearer, the following exchange occurred:

Ciara:	*... and I have a lot to contribute, but they've made it hard.*
NPM Blake:	*That makes sense. Yeah. Do you feel like your other teammates see your full potential in being able to, uh, contribute to the team?*

Ciara: *I'm not sure … I don't feel that they disrespect me as a person, but I think they don't understand maybe … what it's like to be a commuter. Um, not that it's – I don't think me being a commuter is the problem actually. I think the problem is not following the norms.*

No other NPMs asked Ciara questions about marginalization directly, perhaps assuming that the logistical issues were the main problem. Although not as directly about marginalization, we also observed NPM Jason's inquiry that opened the door for Ciara to explain how her lack of access to dormitories was potentially marginalizing.

Ciara: *Yes. There have been three ... team meetings, so far that I've missed … that occur at a time when I can't be there. And they … have their meetings at a location where I'm just not comfortable. But that's another issue.*

NPM Jason: *Okay. Would you want to talk about that or no? It's totally fine if you don't.*

Ciara: *Well, it's just that they, you know, so it's Angela and James that tend to be the ones that, they live in the same dormitory.*

NPM Jason: *Mm-hmm.*

Ciara: *And they often will see each other, I guess, and decide, "You know what? Let's just meet now." And they meet in their dorm … because it's convenient for them. But I don't know, I don't have a key to the dorm. … I'd rather we do what we said in our team norms, which was to meet in [one of the engineering buildings] … I feel more comfortable there.*

We noticed several instances in which Ciara mentioned her discomfort with the meetings occurring in the dormitory without NPMs probing further to learn more about this challenge or find out from Ciara why this was problematic. For example, NPM Courtney agreed with Ciara with the norm about meeting in engineering buildings but did not otherwise respond to Ciara's statement that *"I'm not really comfortable there."* Similarly, NPM Dallas did not probe about Ciara's discomfort, responding instead with: *"Yeah and dorms, a lot of times, can be really crowded with people and it's very distracting with the living and academic space in one. So, I think that that like those choices of study spaces [in the engineering buildings] are good."*

Interest

Three out of 12 participants directly asked about Ciara's interest in being an engineering major or in course. At the beginning of the discussion, NPM Frankie asked: *"And you like [the course] so far?"* to which Ciara responded *"Yeah. It's okay. I mean, I think the project is interesting."* Similarly, NPM Dallas was able to check for interest at the beginning of the discussion:

NPM Dallas: *And I see you're civil engineering?*

Ciara: *Yes. I'm [in] civil engineering.*

NPM Dallas: *That's nice, why did you pick that one?*

NPM Courtney inquired about interest towards the end of the discussion with Ciara, asking: *"Um, how are you enjoying the project? Do you like it, though?"* Other NPMs may have

discerned from other questions that Ciara was not disinterested in the course or engineering. For example, early in the discussion, NPM Greer asked about a capstone course that Ciara had taken in high school and that she mentioned in her CATME report. Ciara shared that she "liked that project" – an engineering project – very much. For other NPMs, Ciara's expressions that she has a desire to contribute to the team but has trouble doing so due to logistical issue likely suggested her inherent interest in the project and course.

Results for Research Question 2: Supportive Statements

All but one participant (92%) offered supportive statements to Ciara. We further coded NPMs' supportive statements into seven subcodes that we have ordered by frequency in Table 3. These are: assuring, agreeing, offering help, encouraging, sympathizing, empathizing, and praising. In this section, we draw our examples from NPM Dallas, who was the only NPM to employ all these supportive moves during the discussion with Ciara. Dallas was also the only NPM to attend to logistics, marginalization, and interest in the discussion.

Table 3. Frequency of Supportive Subcodes within each NPM's Supportive Turns.

	Assuring	Agreeing	Offering Help	Encouraging	Sympathizing	Empathizing	Praising	Total Supportive Subcodes	Total Supportive Turns
Blake	5	0	1	0	4	1	0	11	7
Cameron	3	1	1	1	1	0	0	7	5
Courtney	2	2	0	0	0	0	0	4	4
Dallas	4	3	2	8	1	1	2	21	16
Frankie	2	0	1	1	0	0	0	4	3
Greer	0	0	0	0	0	0	0	0	0
Hunter	0	3	1	2	3	0	0	9	8
Jason	4	2	1	3	0	0	0	11[a]	7
Justice	8	1	0	0	0	1	0	10	10
Kai	3	5	3	3	5	0	1	20	11
Lennox	2	1	2	0	2	1	1	10 [a]	6
Sam	3	3	2	2	0	0	0	10	5
Total	36	21	14	20	16	4	4	*117*	*82*
Number (Percentage) of All Participants (n=12)									
Total	10 (83%)	9 (75%)	9 (75%)	7 (58%)	6 (50%)	4 (33%)	3 (25%)		

Note: Each of these NPMs also had a supporting subcode we coded as "other" not shown here.

Assuring was when the NPMs told Ciara that they heard or understood what she shared with them. This included *"I understand"* or *"that makes sense"* or even *"that's fair ..."* depending on the context. It also included instances where NPM says that they will take what Ciara has shared

with them into consideration to determine next steps to resolve the team conflict. **Agreeing** occurred when the NPM indicated that they agreed with an idea or perspective that Ciara shared. **Offering help** was typically, but not always, provided near the end of the discussion, and included turns where the NPM shared that they can be a resource or help the team or Ciara move forward in a positive way. **Encouraging** included words of encouragement to Ciara regarding her success on the team or in the future (e.g., *"don't worry"*, *"it'll be okay"*) and encouragement of Ciara's contributions in the discussion. We also coded instances of the NPM **empathizing** or **sympathizing** with Ciara, with empathizing being based on a shared experience and sympathizing involving comments on how Ciara must have felt (without suggestions that the NPM had felt this way). **Praising** was directed towards Ciara or the team (e.g., *"you're doing a great job!"*). Encouraging and praising were similar, yet we reserved encouraging for comments that seemed to serve the purpose of encouraging further discussion or action and praising for praise of Ciara or the team as people, students, or team members.

Examples of Supportive Subcodes from NPM Dallas's Transcript

In this first excerpt from the beginning of the discussion, Ciara explains why she chose civil engineering after NPM Dallas asks about Ciara's interest in civil engineering (see excerpt shared previously). What follows are several supportive subcodes shown in bold at the end of Dallas's turns. We also show logistics and marginalization coding in bold italics.

Ciara:	*Well, um, I think that there're a lot of really interesting things that, that civil engineers can do, and I want to work for um, the US Army and be a civil engineer for them. I did some work for them over the summer, but I really think it would be neat to, I don't know, help the Army Corps of engineers or something.*
NPM Dallas:	*Yeah, that's so cool. And I remember you telling me you're from a military family, too.* **[Encouraging]**
Ciara:	*[indicates yes]*
NPM Dallas:	*So, you're following after your parents. That's really cool.* **[Encouraging]**
Ciara:	*Yes … My brother, too.*
NPM Dallas:	*Oh wow, so all of you? That's great. Um, how far away do you live? I mean, if your family is in the military, you must, you must have to drive a little bit, right?* **[*Logistics*, Encouraging]**
Ciara:	*Yes … It's about 25 minutes, depending, like if traffic is good … to, to get from campus to home.*
NPM Dallas:	*And you have your own car and everything?* **[*Logistics*]**.
Ciara:	*I do sort of, but I do have to share it with my mom and my dad sometimes. Depending on what's happening.*
NPM Dallas:	*I understand. I had to share a car with my brother for a year. It was so hard. Really was.* **[Assuring, Empathizing]**
Ciara:	*Yeah, sometimes two people need it at the same time and it's difficult.*
NPM Dallas:	*Does that ever affect your class? Like have you ever not made it to class because of that?* **[*Logistics*]**

Ciara: *Oh, no … I always prioritize class. Class is really important to me to make it on time. And to, to be there. So that's a priority. But it's hard for me to do anything at the last minute because I might have to get home and let my mom use the car. You know, those kinds of things.*

NPM Dallas: *Yeah. Right. I've seen you, like your attendance in discussion is great. Like, it's perfect. I see you haven't missed any. Um, so tell me about your team. Right? You guys have just turned in a milestone. You just did CATME. I'm sure you know your teammates by now. Um, so tell me like, tell me how the vibes are. Is everyone getting along?* **[Praising]**

Ciara: *Well, I, I think people are getting along … I don't think... Hmm. I think that they don't think that I'm contributing as much as I should.*

NPM Dallas: *Oh no. What makes you think that? Have they said anything to you, or do they exclude you from any discussions?* ***[Marginalization]***

Later in the discussion, Dallas responded to Ciara after she shared the team's norms.

NPM Dallas: *… I think that deciding to plan meetings and attending the scheduled meetings is good, but we, have you brought up to them that you know, when they schedule these unplanned meetings super abruptly that affects you?* **[*Logistics*, Agreeing]**

Ciara: *Yes, I, I've said to them like, I'll get on GroupMe, and you know, I'll say I can't come, I've got to get home and my mom needs the car and you know, I can't come to the meeting, and you know, you know, why don't we follow our team norms. But it keeps happening…*

NPM Dallas: *Yeah, that's really unfair. I can understand why you're frustrated. Is there any, like, what suggestions would you give to them if they were receptive? Like what would you say to them if you, if you could, if they were more receptive to what you said? Like how do you think we can improve the effectiveness of these team meetings?* **[Agreeing, Assuring, Sympathizing]**

At two points towards the end of the discussion, Dallas offered help to Ciara.

NPM Dallas: *Yeah. Is there anything else that you want to let me know about any team dynamics or anything that I can do as your TA to help?* **[Offering Help]**

Ciara: *Really, what I've already shared with you is, are the big things that are of concern to me right now. It's just, you know, making it so that everyone can possibly come to the meetings and contribute.*

NPM Dallas: *Yeah.*

Ciara: *But other than that, I don't feel like there are other issues. I think once I can make the meetings, I can do the work.*

NPM Dallas: *Yes. Well hopefully we'll get you contributing soon, and we can get meetings that work for everyone in a comfortable space at an agreed upon time so everyone can plan their work schedules. And I know you mentioned Stephanie with work, too, and you with the commute. Like, we should definitely be able to find a time for everyone to meet. We can definitely stick to that.* **[Encouraging]**

Ciara: *Yes …*

NPM Dallas: *Would you, would that make you a lot happier of a teammate if we reevaluated the team norms and stuck to them?*

Ciara: *Yes … It would. It would be a lot better, and I think it would be helpful for the whole team.*

NPM Dallas: *I agree because it sounds like if only two people are contributing, you know, you said they're like doing most of the work because they are just in close proximity to each other and that's not really like the quality of work that we want. We want everyone to have the chance to learn and to work together and draw on those strengths. So-*

Ciara: *Yes,*

NPM Dallas: *... I'm sure we can find a solution to this.* **[Encouraging]**

Ciara: *Great.*

NPM Dallas: *But thank you so much for letting me know your perspective and what's going on. And if there's anything else that you ever want to update me on, just let me know.* **[Offering Help]**

As mentioned previously, Dallas' discussion contained all the supportive subcodes as well as prompts to inquire about whether Ciara was experiencing logistical issues, being marginalized, or was disinterested in the major or course. As shown in Table 3, there was a range, however, with some NPMs using fewer supportive subcodes – and – as shown in Table 2, some NPMs not directly attending to either interest or marginalization in their discussions.

Discussion and Conclusion

This work has significance in that it builds on our previous work in which we have used the Mursion® simulated environment to study NPMs' discussions with students who are experiencing engagement-related conflict in design teams [35]. Specifically, this study enabled us to explore the ways in which experienced NPMs inquired about whether Ciara was experiencing logistical problems; was marginalized by her team; or was disinterested in the project, course, or major. These inquiries included the NPMs eliciting responses from Ciara or probing responses Ciara provided [38]. In response to our first research question, we found that all 12 NPMs asked questions about logistics, with some asking more than others. From our former study, all 12 NPMs identified logistics as the primary challenge for Ciara [35]. Just one third of the NPMs directly explored whether Ciara was being marginalized. We see this as a line of questioning that we could encourage NPMs to pursue in similar discussions with students.

One outcome of our study is that we expanded our initial view of marginalization. While we did not write the scenario to suggest that Ciara was being marginalized, the sim (first author) found that Ciara needed to push back against those who suggested in their logistics-related questioning that Ciara's status as a commuter was the problem. Rather, the problem was with the team not following norms that would enable her to participate fully. This led our team to consider Ciara's status as a commuter as a potentially marginalized position on a team of students who otherwise lived on campus; this is another non-dominant identity to consider [14, 15].

We also learned that few NPMs directly asked whether Ciara was interested in the project, course, or program. Although context clues from Ciara's CATME self-report and the discussion itself may have alluded to her interest, we would suggest to NPMs that it is worthwhile to ask about interest directly. This is not only to rule it out or identify it as a reason for perceived disengagement, but to learn about the interests and motivations of students NPMs supervise.

All but one of the NPMs used supportive statements in their discussions with Ciara, with NPM Dallas doing so in 16 of 38 discussion turns and NPM Kai doing so in 11 of 24 discussion turns (see Tables 2 and 3). Others used supportive statements less frequently. We see the supportive subcodes – assuring, agreeing, offering help, encouraging, sympathizing, empathizing, and praising – as being useful for NPMs to employ in their discussions, albeit with caveats. For example, while assuring seems universally positive, indicating that the NPM is following what the student is sharing, whether agreeing is necessarily helpful depends on the context. In the transcripts we analyzed, agreeing did not seem problematic (e.g., NPM Dallas agreeing that the team changing meetings last minute was unfair to Ciara). However, there could be instances in which agreeing may be problematic. We will continue to examine this and other supportive subcodes for their utility in our future work.

Regarding study limitations, given the qualitative nature of this study, the results are tied to the context in which the study was conducted. We encourage those interested in using a similar approach to carefully consider the likelihood that adaptation would be necessary for use in a dissimilar context. Further, we used a convenience sample that may not be representative of all NPMs who have served as an NPM for one or more first year engineering design courses. Another limitation is that while the sim aimed to be consistent across NPMs there may be some inconsistencies in how the sim responded as Ciara across NPMs. The sim-facing materials helped with consistency but could not prevent against human error by the sim.

Our future work is multifaceted. It includes a similar examination of how NPMs in the present study engaged with the other two avatars in the scenario, Stephanie and Jordan. We also aim to analyze data from a similar study of NPMs who had just begun their experience as NPMs. We are in the process of analyzing these data and comparing them to the experienced NPMs. Additionally, work that we have proposed to a funding agency includes improving or expanding our scenarios in consultation with a group of experts in diversity, inclusion, equity, and justice. This will help us to ensure that as we create scenarios and use them in part to help NPMs identify and address issue of marginalization, we do so in a way that does not propagate stereotypes or is unjust. We may have NPMs also engage with the other avatars in our scenario, Angela and James. Angela uses she/her pronouns and James uses he/him pronouns; based on their Mursion® images and profiles, they present as BIPOC. We also aim to use our findings to develop professional learning opportunities to help future cohorts of NPMs learn to resolve engagement-related conflict. Finally, we are interested in how such learning opportunities translate into improved mentoring of student design teams by NPMs.

Of course, we are not alone in our interest in improving first-year engineering design experiences for students. We encourage others to continue to examine how NPMs, graduate teaching assistants, or instructors can learn to use the information contained within CATME reports as a starting point for discussions with students and to reconcile team conflict.

Acknowledgments

The University of Delaware General University Grant and Towson University Faculty Development & Research Committee Award provided funding for this work. We thank Renee Stewart Brown for her help in navigating the UD IRB review process. We also thank Olivia Tadlock, undergraduate research assistant at UD, for her help in conducting the literature review and providing feedback on the draft paper. We are grateful to two anonymous reviewers for their detailed feedback that helped us to improve the final draft of this paper.

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