

Work in Progress: Making Engineering Education Teams more Effective: An Exploration of a Nearly Epistemic Negotiation

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WIP: Making Engineering Education Research Teams More Effective: An Exploration of a Nearly Epistemic Negotiation

Abstract

In this work-in-progress paper, we present our initial characterization of an interdisciplinary engineering education research team's culture around the generation, expression, and application of knowledge (epistemic culture). To explore this phenomenon, we used an ethnographic case study approach, focusing on a single interdisciplinary engineering education research team. We observed six recorded team meetings that occurred across four months. For each meeting, we took fieldnotes and identified any discussion about research ideas, approaches, or questions among team members (i.e., a critical interaction). In this paper, we focus on one instance in which epistemic questions were raised but there was no true negotiation of ideas. We used Longino's critical contextual empiricism model as a lens to characterize the team's epistemic culture and gain insight into an instance that was primed for epistemic negotiation. In this paper, we present our initial characterization of the team's epistemic culture and our analysis of the instance we identified. We also discuss possible barriers to teams having epistemic negotiations.

1 Introduction

There are three certainties in life: death, taxes, and group projects. Whether working on a team leads to innovative solutions or frustration often depends more on the dynamics among team members than the project itself. These dynamics can be especially important on interdisciplinary teams where individuals may have different ways of thinking about knowledge (or epistemic beliefs) because of their disciplinary backgrounds [1, 2, 3]. For example, a more quantitative or positivist-leaning researcher may insist that findings must be generalizable in order to be useful. Meanwhile, their more qualitative, interpretivist collaborator might not be concerned about the findings being generalizable as long as they brought about a deeper understanding of the topic under investigation. These differences in thinking can create tensions that prevent teams from achieving their core goals. These tensions are often incorrectly associated with ineffective communication or project management, preventing teams from addressing the true barrier - epistemic differences (e.g., from our example: the goal of research being generalizable knowledge vs. an insightful, co-constructed meaning) [4, 5, 6].

Within the field of engineering education, working on interdisciplinary teams is essential as engineering education practice often comes from the integration of educational research, practice, and industry [7, 8, 9]. Furthermore, engineering education research, which strives to transform engineering education practice, is an interdisciplinary field that combines research methods and

theories from fields such as engineering, sociology, education, and psychology [10, 3, 11, 12]. Engineering education research is often conducted on interdisciplinary teams that include individuals from engineering and the social sciences and from different roles within a university (e.g., faculty, administration, student support staff). For engineering education research to achieve its full impact, we need to better understand how these teams come to define their approaches to generate, express, and apply knowledge (epistemic culture) and navigate differences in thinking about knowledge among team members (epistemic negotiation).

The purpose of this work-in-progress is to apply Longino's Critical Contextual Empiricism (CCE) [13] model to provide an initial exploration of an interdisciplinary engineering education research (EER) team's epistemic culture. We will first introduce the CCE model and describe how we expect each norm to present in the context of EER teams. Second, we will present our initial characterization of an interdisciplinary EER team's epistemic culture. Third, we describe a single instance where epistemic questions were raised during a team meeting without a true negotiation of ideas. Finally, we discuss our inferences about possible barriers to EER teams engaging in collaborative epistemic negotiations.

2 Theoretical Framework

We used Longino's CCE [13] model as a lens to characterize an EER team's epistemic culture and understand how this team approached an instance where epistemic questions were asked. The CCE model brings together both the cognitive and social aspects associated with knowledge production and is laid on the foundation that "scientific knowledge is produced by cognitive processes that are fundamentally social" [13, p.128]. Furthermore, Longino argues that knowledge is generated through critical interactions across multiple points of view which work to "transform the subjective to the objective" [13, p.129].

Based on these assumptions, the CCE model defines four norms of an idealized knowledge community that foster critical interactions that lead to the development of theories, methods, and ideas that are not based solely on the idiosyncratic thinking of individuals or communities. The four norms are 1) providing venues for criticism, 2) uptaking criticism, 3) recognizing public standards, and 4) maintaining tempered intellectual equality. These norms will likely not be fully satisfied by any research team, instead they serve as an ideal benchmark and provide language to describe a team's culture around knowledge generation, expression, and application.

Venues for criticism include forums where methods, ideas, assumptions, and reasoning can be evaluated and critiqued by the community. In the context of EER teams, these venues could be formal (e.g. an advisory board meeting or peer review process) or informal (e.g. a hallway conversation or sidebar conversation during a meeting). They might be internal, only including group members, or external to the group. The modes of communication in a venue may be spoken (e.g. a meeting or phone call) or written (e.g. an email or peer review). Additionally, the venue could have varied degrees of collaboration involved in the critical activities (e.g. a team discussion regarding the solution to a problem vs a team delegating tasks to be completed). We anticipate that these venue characteristics could impact the nature of questions posed, the amount of space provided for epistemic discourse, and individual willingness to engage in critical interactions.

Longino states that it is not enough for critiques to be posed and discussed, there should be an

uptake of criticism that allows theories, beliefs, and ideas to change over time, making criticism a constructive practice [13]. We anticipate that uptake of criticism could occur on a spectrum within an EER team. On one end, criticism could simply be dismissed outright or ignored. On the other, the criticism could be acknowledged, thoroughly evaluated, and used in the transformation of beliefs and methods. This transformation may not always look like a change in beliefs or approach, instead it could be a solidification of already existing ideas alongside a change in how these ideas are communicated.

Public standards within a knowledge generating community are established guiding principles, ideals, and goals which are used to evaluate knowledge, theories, and outcomes [13]. We expect standards adopted by an EER team could be related to data quality/validation, disciplinary norms, research ethics, stakeholder requirements, or standards specifically applicable to that team. While within an idealized knowledge generating community, the standards would be shared among all members of the team, we anticipate that on EER teams there may be certain standards that are not shared across the team or present in different ways from one individual to another. We anticipate that the public standards adopted by an EER team or members of an EER team will influence which critical activities are enacted, prioritized, or engaged with.

Equality of intellectual authority requires diversity of perspectives and discourse where ideas, approaches, and theories are exposed to the broadest range of criticism [13]. We expect there are several factors which could influence the tempered equality within an EER team such as disciplinary bias, demographic bias (gender, race, ethnicity, etc.), seniority or type of position, background experience, or other interpersonal power dynamics. Two examples of this might be qualitative research methods being considered less rigorous than quantitative approaches or a full professor's opinions being given more weight than that of a graduate student.

These four CCE norms will likely not be fully satisfied by any research team, instead they serve as an ideal benchmark and provide language to describe a team's culture around knowledge generation, expression, and application.

3 Methods

This work-in-progress paper documents our initial data collection and analysis within the first phase of a multi-phase study that seeks to explore how individuals and teams working on interdisciplinary engineering education projects negotiate differences in thinking about knowledge, a type of critical interaction. The first phase of the project takes an ethnographic case study approach to deeply explore the epistemic culture of interdisciplinary engineering education research teams.

For this work, we focused on a single research team (Team X) and the recordings of their team meetings that occurred from December 2019 through April 2020. Team X has researchers from engineering, engineering education, and psychology. They are working on a project that seeks to integrate engineering education research and practice. It is important to note that most of Team X's meetings we observed occurred as the COVID-19 pandemic was beginning and higher education institutions moved instruction online.

To ensure our observations of the team meetings stayed focused on the goals of our study, we

worked as a team to clearly define the social reality under investigation (SRUI). To support this process, we virtually participated in a recorded ProQual Institute workshop [14] and created visual representations of the social reality. We spent a series of research group meetings discussing our pictorial systems maps and combining them into a single representation and understanding of the SRUI. We defined the SRUI as interactions among team members that are centered around differences in thinking about knowledge. From this understanding, we developed a fieldnotes template that we used to conduct our observations of Team X's meetings. More details about these methods can be found in Boyd and colleagues [15].

For this work-in-progress, we observed and took fieldnotes on six team meetings. In these fieldnotes, we characterized individual team members' roles in the group, their willingness to participate, how the team handled decision making, and how the team worked through epistemic differences. We generated fieldnotes for each observation in teams of two and then discussed the fieldnotes as a whole research group. These discussions as a group contributed to our understanding of Team X's overall epistemic culture and were documented within memos that are included in the fieldnotes.

As part of taking fieldnotes, we identified instances of critical interactions as defined in Section 2. For this study, we specifically sought out critical interactions in which team members discussed research goals and purpose, presented ideas or epistemic questions about the research process (methods, analysis, validation, truth/falsehood), and reached research decisions. We identified three instances and each of us watched these segments of the team meetings. One of these instances was clearly centered around differences in thinking about knowledge - this is the instance we present in this paper.

Our initial analysis of this instance was conducted in multiple parts. First, we all watched the instance and recorded our initial impressions. Second, each author was assigned a single norm from Longino's CCE model [13] to use as a lens to understand how the norm presented in the instance. Third, we met as a group to discuss our individual analyses of each norm. Finally, we met with an external member to our research group to share our initial analysis and get feedback. Based on these discussions and our overall understanding of the team's epistemic culture, we used the CCE norms to infer why an epistemic negotiation did not occur on an EER team.

This study was reviewed and approved by our Institutional Review Board. All participant names included in this paper are pseudonyms. We shared the direct quotes and our results section with the participants to get their feedback and ensure that they were comfortable with our representation of their conversations. These processes served to protect our participants' identities and provide a means of member checking [16].

4 Results

In the following subsections, we present our initial characterization of Team X's epistemic culture focusing on the four norms of CCE. Then we describe our initial analysis of the instance in which epistemic questions were raised.

4.1 Initial Characterization of Team X's Epistemic Culture

The six team meetings we observed were focused on project progress and tasks (venue for criticism). These meetings were lead by the Principle Investigator, Lucas, who set a quick pace for these meetings, going through tasks defined by the team to get status updates and determine if additional resources (e.g., time, people) were needed. During these meetings, we observed little dialogue among team members about how the tasks would be completed (uptake for criticism). When questions were asked, the team tended to make quick decisions and move to the next point of discussion. Based on the project management focus of the meetings and quick decisions during meetings, it is clear that the team values productivity and has adopted it as a public standard within the group. While there was an obvious leader for the meetings, all team members brought up questions and concerns in an organic manner (tempered equality). Additionally, despite many of the team members being at the same institution, the team held all of their meetings virtually to ensure that all members of the team were able to participate equally (tempered equality).

4.2 A Nearly Epistemic Negotiation

The instance we present below occurred a few weeks before the end of the spring 2020 semester. Multiple members of Team X were wrapping up teaching classes that they had rapidly transitioned to online instruction. The team members were all working remotely and experiencing exhaustion. During the meeting, Team X assessed how much of their original semester goals could be accomplished before the summer. At one point in the meeting, Team X noted that a series of classroom observations had not yet been completed, which was a task assigned to Wyatt. Team X's Principle Investigator (PI), Lucas, initiated a larger discussion by asking what the group could do to support Wyatt. This question led to the discussion included below between Lucas, Wyatt and a third team member, Hudson.

Hudson: "So, Wyatt? Wyatt what I was recommending was, given the fact that the constraint on the project has changed by going online, can we [mark complete] saying that almost a majority of the people have already been observed, maybe not 100 percent but at least [mark complete] on that one and say yes, that's done and ... if we need to go back, we can add additional observations potentially in the fall semester."

Wyatt: "I would say, yeah, absolutely and we're going to do more observations anyhow. But I think given everything that went down, yes, we can say that the classroom observations are done."

Lucas: "So, are we thinking at all about trying to make observations of this online instruction somehow or is that just something we just have to talk about?"

Wyatt: "I think we are, but right now I was looking at the schedule ... I don't know if there is enough bandwidth to get any good observations of online done. During that time period between I don't have my undergraduate student anymore, he's not able to do anymore observations, so I'm kind of soloing it right now. So I don't think I'm gonna be able to get anybody get those classrooms observed or recorded."

Hudson: "Also another thing that I would like to bring up is. Let's pray to god and cross our fingers that we don't have to do any more online, so this would be an anomaly

rather than a thing. Adding this into the whole data that is collected may actually generate a lot of noise, so I would suggest we don't do anything online. That's my personal opinion."

Wyatt: "So from the data standpoint, we wrote this as a case study because our N is so small, so there's no real noise that can happen within a case study. So I'm not as worried about that. My question that I keep coming back to is what is the added value of collecting data on the classroom observations? Are we actually going to analyze them? And if we do, what are we doing that for? I'd rather capture all of that in the interviews than I would in a classroom observation and just kind of take them for granted that it's reflective of what they actually did."

Lucas: "Yeah. And again... there's plenty of time to do other classroom observations, presumably someday go back to bricks and mortar face-to-face delivery. That you know, even though the project started, a lot of classes are going to continue as normal as without any kind of modifications and stuff. So for this, given that situation, is everybody comfortable [marking this task as complete]?"

Following the conversation, the group agreed to mark the classroom observation task complete.

We identified this instance as a nearly epistemic negotiation because while two epistemic questions were asked, 1) from Hudson: "does including the online classroom observations add noise to the data set?" and 2) from Wyatt: "is there any value added by doing the classroom observations that cannot be accomplished by doing interviews?", a true negotiation of differences in thinking about knowledge did not occur. These questions were posed but not fully answered by the team. Individuals shared their own ideas about the questions but there was not a discussion of these ideas to reach a consensus. The team did make the decision to mark the task as complete but it did not seem to be because of agreed upon epistemic reasons.

CCE Norm - Venues for Criticism

The venue surrounding the instance above can be characterized as an informal discussion within a formal meeting that only included members of Team X (internal in nature). The meeting was centered around discussing project tasks and progress with a goal of marking tasks as complete. Based on our observation of this full meeting and the other five meetings, all members of the team seem willing to participate in this type of venue. These characteristics established a venue where everyone was willing to participate but not one with the explicit purpose of epistemic discourse. Instead, the primary purpose of the venue was to discuss progress on project tasks. This focus of the venue on project management may have contributed to Team X not fully engaging with the epistemic questions posed in this particular meeting and instead focusing on the logistics of project management.

CCE Norm - Public Standards

From our observation of the instance, we inferred four possible public standards set by Team X or held by members of Team X: 1) quality of data, 2) ensuring that research activities are value-added, 3) productivity, and 4) well-being. In this instance, Hudson brought up the initial concern about the data quality and Wyatt responded that it would not be an issue given the type of study. There was limited dialogue across the team regarding this standard. Instead, another standard is immediately

posed by Wyatt - ensuring that research activities are valued-added. The group does not engage with this standard after the question is posed. Based on our observation of this instance alone, it is unclear if other members of Team X hold these two standards and if they have been adopted as public standards on Team X.

The third standard, productivity, is directly connected to the structure and focus of Team X's meetings. All of the team meetings we observed were intentionally designed around project management. There was a general focus on getting tasks done and providing any needed resources to support the efforts. In this instance, the standard of productivity seems overlaid with a standard of well-being. In this particular meeting, Lucas begins by stating "let's be generous with ourselves" in terms of task completion. This statement has a tone of support that is directed back towards the team. In addition to reiterating the team's standard around productivity, it also suggests the need to consider well-being given the larger context of a global pandemic. These particular inferences come both from our observations of the meeting as well as member checking feedback we received from the team.

In this instance, we see Hudson and Wyatt individually raise violations of the first two standards, data quality and value-added tasks, as reasons to mark the classroom observations complete. However, we do not see other members of the team engage with the standards or use them as reasons to support marking the observations complete. It is possible that the combination of the standard of productivity and well-being contributed to Team X's lack of engagement with the epistemic questions posed regarding the standards of data quality and task value.

CCE Norm - Tempered Equality

From this instance, we cannot infer much regarding tempered equality. The team members directly involved in the discussion use professional language and posture towards one another. There does not seem to be any hesitation in sharing ideas or listening to one another. We observed similar behaviors across our observations of other team meetings.

CCE Norm - Uptake of Criticism

In response to the discussion between Hudson and Wyatt, Lucas asks if the team is going to do observations of online instruction. This question is an example of a criticism because it gently challenges the initial statements made by Wyatt and Hudson to mark the observations complete. Lucas' question leads to further discussion among the team. Both Hudson and Wyatt responded to this criticism with their reasons for why the observations should have been marked complete and raised two epistemic questions: 1) from Hudson: "does including the online classroom observations add noise to the data set?" and 2) from Wyatt: "is there any value added by doing the classroom observations that cannot be accomplished by doing interviews?"

Hudson's and Wyatt's statements and questions represent a critical interaction; however, there was minimal direct discussion of their specific statements. Hudson's concern that the "problem constraints had changed," which would lead to the online observations adding noise to the data was addressed by Wyatt stating that noise is not a problem in case study research. While it is true that there is not "noise" in the more quantitative sense of data quality, the concern about the impact of data collected within a vastly different context than the proposed case study may have been worth discussing as a team. Additionally, Wyatt's concern that continuing the observations would

not add value to the research project was not addressed at all. In the end, the team arrived at a final decision, marking the classroom observations as complete rather than conducting observations, for three disconnected reasons: including the online observations could add noise to the dataset, there is very little added value in continuing the observations, and additional observations can be done at a later date if necessary. Because of the lack of discussion and seemingly disconnected reasons, it is not apparent that there was an uptake of criticism. In the observation, we do not see evidence of a change in ideas, approaches, or beliefs or a reasoned rebuttal of either critique.

5 Discussion of Potential Barriers to Epistemic Negotiation

Below we discuss several potential barriers that may have prevented Team X from deeply engaging with the epistemic questions posed. It is important to note that we inferred these barriers based on our initial analysis of a few observations of the team and by asking the team members about their interpretations of the instance (member checking). As we continue our research study, we will stay attuned to these barriers and how they might show up for other engineering education research teams.

Barrier 1: External Situational Factors

We focused our initial analysis on how the CCE norms presented in Team X's group meetings. We treated these team meetings as isolated from external factors and did not directly consider how situational factors (e.g., stress from COVID-19, teaching responsibilities, time in the semester) may have impacted how the team engaged with the epistemic questions. From research studying engineering students' epistemic cognition in problem solving, we know that situational factors can impact whether or not an individual sets goals that are epistemic in nature [17]. As such, it is possible that situational factors influenced the goals the individuals on Team X had for the meeting, leading the focus to be on checking things off their to-do lists. This goal is non-epistemic and deep engagement with the two epistemic questions would have directly opposed this goal. For this initial study, we do not understand exactly how situational factors may have influenced this particular critical interaction. As we continue this work, we plan to collect data that will help us better understand how situational factors might serve as a barrier to epistemic negotiations and how they interact with the CCE norms.

Barrier 2: Differences in Disciplinary Knowledge

The first epistemic question posed in this meeting was regarding the impact of noise in a case study. Case study is a research method that "...investigates a phenomenon (the 'case') in depth and within its real-world context" [18, p.15]. Once the case has been defined, the researcher defines the boundaries of the case. These boundaries provide a clear scope for the project and help the researcher make decisions about what data to include [18].

As Team X's original plan was to use a case study methodology to study traditional, in-person classrooms, Hudson brought up a valid concern regarding the generation of knowledge in this research project. Depending on how the team defined the boundaries of their case, the online classroom observations could have been outside the original scope and context. However, Wyatt seemed to quickly dismiss Hudson's concern because the "N is so small, so there's no real noise that can happen within a case study." It is possible that the lack of meaningful discourse on this

topic was due to a difference in interpretation of disciplinary terms. Hudson has a quantitative research background, therefore he might reach for a familiar term to describe a disturbance in their data set - “noise”. Wyatt, as more of a qualitative researcher, seems to have responded to the fact that the specific term of “noise” is not a term used in qualitative research by explaining that noise is not a concern in a case study. However, case studies do need to consider disturbances in data, which in this instance presented as a change in the context of the study - from in-person classroom observations to virtual. It is possible that Hudson’s concern was simply lost in translation between qualitative and quantitative research contexts.

Barrier 3: Unfavorable Venue and Misaligned Public Standards

Longino [13] argues that the venues inherent to academia and industry do not allow sufficient space for critical discourse. This lack of space is due to a variety of complex and interconnected factors such as the commercialization of knowledge generation in both sectors. In academia, publications enhance the prestige of an institution, this prestige brings in more grant money and draws skilled researchers in who, in turn, put out more publications. Thus, academic institutions actively set the public standard of productivity for their researchers. If researchers do not intentionally design their venues with space for critical interactions and set public standards which encourage dissent and dialogue, they may not see the full benefits of interdisciplinary collaboration: “vigorous and epistemically effective critical discourse” [13, p.131].

In this instance, we can clearly see how the venue and resulting public standards may hinder engagement with the epistemic questions posed. Put simply, Team X’s meetings are a formal space for discussing project tasks and progress. Because of the setting, discourse would then be centered on how to effectively and efficiently accomplish tasks and meet project milestones. The public standards of the team mirror the goals of the venue. As a result, when two critiques of their data collection methods are posed, they are used as justification for marking the task as complete and furthering progress. While this is not a terrible outcome, it does clearly marginalize critical discourse. By not engaging with Wyatt’s question regarding the value of certain activities, they may have missed an opportunity to analyze the value of other project tasks. They also missed out on an opportunity for the members from a non-qualitative background to gain a better understanding of research methods being used in the project.

Barrier 4: Threat to Competence-Based Trust

The final barrier we discuss, threat to competence-based trust, is not necessarily one that we believe Team X faced in this instance. Instead, it is a barrier that came up as our research group discussed the instance and thought about how certain dynamics on engineering education research teams might foster barriers to epistemic negotiation.

This final barrier is embedded within a lack of intellectual vulnerability (a CCE norm). Trust and vulnerability are frequently studied in the field of team science as it is an indicator of effective collaborations. Bennett and colleagues [19] argue that there is mutual dependence on scientific research teams as individual performance impacts team performance. They write, “Dependence begets vulnerability and, without trust, vulnerability leads to protective or defensive, rather than collaborative action”[19, p.770]. Bennett describes three different kinds of trust:

1. Identity-based trust: present when team members understand each others desires and values

2. Calculus-based trust: present when team members believe that members will "keep their word" regarding productivity, meeting deadlines, communicating in a timely manner, etc.
3. Competence-based trust: present when team members are confident in the capabilities and skills of their fellow team members

Competence-based trust is especially essential on scientific and engineering research teams as "it affects team members' judgements about another's abilities, designs, observations, and scientific results. When one loses trust in a colleague, everything that person does become suspect" [19, p.771]. That being said, if team members put up walls to protect their appearance as competent, the team will lose the essential benefits of evaluating questions and criticism in productive exchanges:

New and stronger relationships being built within the group, keeping problems or issues from accumulating, preventing resentment from growing over time, continued reevaluation of the group dynamic and the rules to be followed, strengthened trust, and emergence of new creative solutions to pesky problems [13, p. 129]

We expect that epistemic questions and negotiations pose a potential risk to competence-based trust as they pose a challenge to a team member's knowledge of the field or research methods they are an expert in. Thus, it is entirely possible that some members would be less likely to ask epistemic questions or admit that they do not readily know an answer and need more time to think. Meetings like the one we discussed are a relatively safe space for maintaining competence-based trust, there is a shared goal of box checking and project management. In these spaces, as long as an individual is completing the work they agree to, developing an action plan to accomplish work, or providing justification as to why a task should be discontinued, they are not at risk of their team members losing calculus- or competence-based trust in them. In the context of the instance we analyzed, it is more vulnerable to be put on the spot and explain, as a qualitative researcher, why noise is not a problem in case studies or admit, as a quantitative researcher, when you do not know that much about case studies.

We anticipate that to fully reap the benefits of an interdisciplinary collaboration, it will be essential for teams to establish a space where they can be vulnerable. For example, a space where questions would be seen as coming from a space of curiosity rather than as a threat to their competence-based trust. In future work, we will explore how engineering education teams could use the CCE norms to create a space in which members feel there is minimal risk to competence-based trust as result of critical interactions.

6 Limitations and Future Work

For this work in progress paper, we only observed a small number of Team X's meetings. Additionally, these meetings occurred during the beginning of the COVID-19 pandemic, presenting a number of situational factors and circumstances that had to be addressed or considered by the team. We completed our observations of these team meetings about three years after the meetings occurred. This time difference makes it difficult for us to gain significant insight into the specific situation facing the team. We were also not able to conduct interviews to gain a better understanding of how individuals' beliefs or ideas about knowledge may have changed as a result of the

epistemic questions posed during this instance. We were able to engage in some member checking and get overall feedback from the members of Team X. This feedback helped provide additional context for our observation and emphasized the impact that the COVID-19 pandemic had on the team's interactions during this time.

The potential barriers to epistemic negotiation we present in this paper are based on our observations of a single team. This team, like any team, had specific norms around which they structured their research group meetings. In this work, we saw how these norms defined the venues for criticism and public standards. Using the CCE model, we inferred how these norms likely impacted the team's engagement with epistemic questions and potential to uptake criticism. Since we only observed one team, we do not know how the norms for Team X compare to the norms set by other teams. We also do not know how common the challenges faced by Team X are across other engineering education research teams.

In future work, we plan to shorten the time between our analysis of team meetings and the time they occur. This approach will provide the opportunity to conduct ethnographic interviews to gain insight into the experiences of individual team members. This approach will also mean that we will not be conducting our observations during the initial stages of the COVID-19 pandemic. While there will likely be other important situational factors to consider, we will interview the team members about their goals, focus, and challenges so that we have a more complete understanding of the context within which our observations occur.

In future work, we will also conduct in-depth interviews with each member of the team. These interviews will allow us to understand the ideas and beliefs of individual team members. We will use the epistemic identity framework[5] as a lens to understand the epistemic beliefs and identities of team members, which will influence how team members engage during meetings. This framework will also be used to analyze and develop questions for the ethnographic interviews we conduct after observations of specific team meetings.

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