The role of 'togethering' in developing teamwork relationships and shared meaning

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1. Introduction

In response to accreditation requirements, many universities include team-based project courses in their curriculum. Most often these team-based projects are in engineering design courses, as they allow for longer-term projects that are sufficiently complex to require more than one individual's contributions for successful completion. These courses typically occur at either the freshman or senior level where students can engage with real-world industrial clients to solve actual problems. The accreditation requirement that we are interested in for this study is student outcome (d) "an ability to function on multidisciplinary teams."[1]

One approach to meeting this outcome -- developing and assessing student teamwork -- has centered around the development of team-member effectiveness frameworks and developing the ability of each student to be an effective team-member. [2-5] An approach like this in engineering makes sense as each student needs to develop and have assessed their ability to meet the accreditation requirements. Additionally, the skills engineering students learn from first year around working effectively in multiple teams simultaneously are necessary for their success in industry post-graduation; the team-member effectiveness competencies that they learn represent a framework of highly transferable skills, abilities and/or behaviors that are usable in all types of teamwork. However, the way in which these team behaviors combine across different team members to create effective teams in engineering education is less investigated. Faculty comment that they want their student team projects to run "smoothly",[6] thus it is important to faculty to develop teams that are effective at working together.

Several team-effectiveness models exist in the engineering and computer science education literature – for a review of these please see Borrego, Karlin, McNair and Beddoes.[6] These models look at what tasks or behaviors the team as a whole needs to demonstrate to begin creating an effective team environment. Team environments are created when a group of individuals work collectively and collaboratively to achieve a shared goal or objective. They can be comprised of the atmosphere, individual members (experience, skillsets, and motivations), communication, shared resources, and the space (cognitive, affective and physical) in which they work. Team-effectiveness within these environments can often be difficult and time consuming to measure, requiring training of the observers as well as a significant time investment in coding and analysis post-observation. As a result, observations of teams in engineering and computer science education have typically looked at which tasks are performed and/or which behaviors are exhibited over a specific observation period.[7-9] While these allow a researcher to get a sense of what the teams are doing and how they are doing it, it is more difficult from these studies to determine why or how these behaviors combine to create effective or ineffective team environments.

How teams are effective can be seen and analyzed through the discourse analysis of participatory or non-participatory observation of the teams. These qualitative studies can articulate why the teams are functioning as they are in a way that quantitative assessments of teamwork cannot, due

to their richness of contextual and event specific data. Discourse studies of team interactions have been conducted in engineering and computer science undergraduate settings previously,[10-12] the most notable of which is Tonso's ethnographic study of two student teams and the role gender plays in their effectiveness.[13] The conclusions Tonso draws about the reciprocal effects between identity archetypes and student team dynamics could only have been determined through analysing the interactions the students had with each other in their natural teamwork environment. Similar discourse analyses have also occurred in the military,[14] K-12 teacher teams,[15] and with executives[16] to determine how they make their teams more effective.

We posit that the way teams develop their effectiveness stems from the interactions of the team members with each other and the tone these set for future interactions. Thus, it is not just the team-member effectiveness behaviors exhibited but also the way in which the team interprets and responds to them. One approach to conceptualizing these interpret-respond processes is through team-shared mental models which have been argued to enhance team effectiveness and productivity.[17] These representations of group cognition are a common framework for the team members to understand their team, their project, and their situation, and can be negotiated through team interaction. While shared mental models are collectively developed out of the team's interactions, they are limited in their ability to explain the way in which team members develop a sense of commitment to each other.

Outside of team-based project courses, there is a long history of classroom research examining classroom interactions -- much of it beyond the scope and theoretical grounding of this study. Mehan, through a careful analysis of classroom interactions, described traditional interaction as a pattern of initiation-response-feedback (I-R-F);[18] where individual students would be asked a question by the teacher, would respond, and feedback or evaluation would be provided to the student. Mehan provides an excellent comprehensive review of the development of interest in classroom interactions as the subject of research from the 1960s until 1998.[19] Research in language, math, and science classrooms continues to reflect a more socio-cultural perspective. Interest in the concept of scaffolding in a classroom or during group work has also produced analyses that focus on interactions among students as well as between students and teachers. These interactions do not usually follow the predictable I-R-F pattern but make use of more open-ended questions and prompts. There has also been considerable research that examines the interactions in computer- or technology- mediated classrooms.[20] Much of this research has focused on classrooms at an elementary school level. More recent work has focused on how students and teachers make meaning and solve problems,[21] develop concepts,[22-24] or perform dynamic assessment.[25-29] Wells[30] focuses on the role of dialogue between students, between students and teachers while Swain and others[25-29] are more focused on how languaging mediates the development of concepts and/or intersubjectivity or a shared understanding. What each of these researchers and their investigations share is the idea that the interaction is the unit of analysis.

This qualitative study responds to Mathieu et al's call to "embrace the complexity of current team arrangements"[31] and studies first-year engineering design teams in their course setting attempting to "assess, model, and understand"[31] their teamwork processes as they completed their team project. This study drew data from the non-participatory observation of seven teams in two large first-year engineering design courses. As we observed these teams, it became apparent that the observed teams could not simply be reduced to a series of individual actions which,

when summed together, produce an effective and productive team. Individuals on different teams exhibiting the same behaviors, and pursuing superficially equivalent goals (designing a solution to a practical problem) created very different team work environments and relationships. This intrigued us - *how were teams exhibiting the same behaviors creating different team environments?* Grounded in an activity theory perspective, this paper discusses two teams from one of the courses observed in this study and how their actions created these different team environments.

2. Theoretical Framework

The theoretical framework for this work is grounded in activity theory,[32] with reference to a meaning-making framework and a team-member effectiveness framework[33] to articulate the behaviors, artifacts and components of the activity. We consider activity theory to be our analysis framework as it is used to make sense of the interaction between the students, their teams, and the meaning-making and teamwork actions/behaviors that we observed.

We chose to make our unit of analysis the interaction as it demands that the entire context be kept in view. This includes the physical space, the words, the gestures, the postures, the material artifacts and the tones, pitches and speeds at which the individuals are interacting. Radford and Roth have termed this a *space of joint interaction*.[21] It demands that attention be equally paid to ways in which these various relationships both shape and are shaped by one another. Sometimes this plays out in the construction of a shared understanding, a plan of action or tensions. In order to respect the nature of the meaning-making process however, it is imperative to look at these interactions in the context of the activity they constitute and are constituted by. Radford and Roth have termed this as *togethering*,[21] a concept we have adopted. We have chosen these two concepts over the idea of intersubjectivity because although intersubjectivity does focus on the dialogue and non-verbal interaction, it does not include the interaction with material mediational means nor does it include specific reference to the potential goals of the interaction.

2.1. Analysis Framework – Activity Theory

Our analysis framework derives from Vygotsky's sociocultural theory of mind.[32] Writing originally in 1934, Vygotsky asserted that learning led cognitive development, that all learning was mediated by symbolic and material artifacts (e.g. language, sign systems, pencils, Slinkys) and that learning began in social interaction. Vygotsky's work was not introduced to North American scholars until 1962 when Bruner wrote the preface for *Thought and Language.*[34] His work has slowly become more influential since then. Perhaps the most widely known sociocultural theory (SCT) concept within education is the Zone of Proximal Development or ZPD[35] (See Swain, Kinnear and Steinman[35] for an accessible introduction to this and other SCT concepts). The idea that learning must be understood as interactions, first on a social plane and then on an individual plane (inter-psychologically and intra-psychologically), differentiates an SCT approach from the dominant cognitive approaches to teaching and learning.[32] Thus, a Vygotskyian SCT theoretical framework begins with the assumption that "…the social and individual are conceived of as organically and irreducibly *imbricated* (Leont'ev, 1978)". [21]

Finding a way to operationalize these ideas for the purposes of research and explanation produced activity theory.[36] The concept of *activity* is the foundation of this approach. Vygotsky used the Russian word *dejatel'nost',* but the English word; "activity" catches only part of the meaning

conveyed in the Russian term. Activity, in sociocultural terms, is a collective undertaking motivated by a physical or psychological *object*. All efforts are intentionally directed towards that object which fulfills psychological or physical needs of the individuals and the society. An example for an activity motivated by a physical object could be the building of a bridge. The bridge is the object, building the bridge changes the patterns of interactions between the communities and the individuals in the communities on either side of the bridge. An example of a psychological object could be a research article. Writing the article changes the writers' relationship with past assumptions or understandings and, in the best of worlds, creates new understandings. Giest and Lompscher characterize activity as "the fundamental interaction between humans and the world – humans behave actively toward the world (fragments of it), change it (them), and change themselves in this process."[37] The changes Vygotsky and his colleagues were most interested in were not physical, but mental changes: the development of mind and consciousness.

The key concepts of activity theory fundamental to our understanding and analysis are the reciprocal relationships between the individuals, the social conditions, their goals and an object. These relationships between the object of the activity (effective teamwork) and the materials (course artifacts) and the individuals are not deterministic, as in studies that assume a unidirectional relationship between dependent and independent variables, but reciprocal. When we redefine these relationships as unities, rather than binaries or dualities, we can conceptualize interactions (and not sets of variables) as the main space of analysis. We feel this is imperative if we are to develop an understanding of how a complex phenomenon, such as effective teamwork, emerges.

2.2. Meaning-making Framework

Within sociocultural theory, interaction provides the initial 'space' and content for making sense of the world and experience. These interactions are mediated by both material and symbolic means. For Vygotsky, language was the primary symbolic mediational means[32] that humans used to both make sense of and act on their world. Language both shaped and was shaped by the individuals and the groups who used it. He based this on the premise that a word (a set of sounds or line patterns) is not simply associated with a single object but is already a generalization, the result of the cognitive act of thinking. Word meaning then is both an act of speech/writing and an act of thinking. As such, it is also dynamic as it is not limited to one association. Vygotsky also argued that the communication function of speech in interactions could not be separated from the function of thinking. Thus, in order to understand the complex activity of how humans make and share meanings, it was necessary to examine the unity of word and meaning, and the unity of speech and thinking—meaning-making in interactions. Although Vygotsky privileged language, language does not operate in isolation as a meaning-making tool. Language is used simultaneously with physical actions-gesture, posture, proximity, facial expressions, pitch and speed of an utterance, as well as drawings, sketches, charts, graphs, and a host of other symbols.[38-39] Therefore, for the purpose of this study, we include written and spoken language, and physical gesture as part of the interactions where meaning-making is attempted and may occur.

2.3. Teamwork Framework

Teamwork was investigated in terms of the way in which the individuals contributed to creating a cohesive team environment. In particular, we were interested in which behaviors the team members displayed, when they displayed them, and how they contributed to the team's

atmosphere and ability to work effectively together. The particular behaviors we used come from Sheridan et. al's Team-member Effectiveness Framework which articulates 12 behaviors across 3 ways of contributing to the team's effectiveness, Table 2-1. Effective team members were those seen exhibiting these behaviors and encouraging the rest of the team to exhibit them as well.

Table 2-1: Behavioral Team-member Effectiveness Framework (adapted from Sheridan et al 2014[33])

Organizational	Relational	Communication
1. Attend team meetings prepared	5. Demonstrate accountability	9. Exchange information in a timely manner
2. Do their fair share of the work	6. Seek and include input from team members	10. Openly express ideas and opinions
3. Deliver their work on time	7. Show respect for team members	11. Promote productive discussion
4. Help to plan and organize workflow	8. Listen and pay attention to team members	12. Raise contentious issues in a constructive way

3. Study Design, Methods and Population

This study involved non-participatory observation of first-year engineering design teams during their team meetings. Students from a large first-year engineering design course of approximately 1000 students at a large publicly-funded research-intensive university, University of Toronto, participated in the study. Students in this course are paired with a client and asked to develop a design to respond to their client's needs over a 12 week term. This design is described by the students in three written deliverables articulating the problem and requirements, as well as two design specifications of increasing fidelity. Written deliverables follow a clear format outlined by the course.

The designs are developed in teams of 5-7 students, where all students receive the same grade on the project. Team formation is completed by the instructors to normalize the performance abilities of each team in the course. Student teams are instructed on Tuckman's model of team formation,[40] strategies for project planning and management, and different decision making strategies. At the start of the term, teams were asked by the course to develop a set of team rules that would guide how their team operated for the remainder of the project. Teams had one two-hour tutorial every week, which was designated as a team work period. Course support was available on request during this time block.

3.1. Study Design

Three teams from the course were followed during the winter semester, January to April 2014. Teams volunteered to be a part of the study, and each team member received a gift card to the university bookstore upon completion of the study. Students consented to have three of their in-tutorial team meetings video-recorded, and to participate in a stimulated recall interview (SRI) at the end of the course. All teams in the study had different tutorial instructional staff, and had

their tutorials on different days of the week to minimize any bias one instructor could have over the teams. Video recordings occurred in the tutorial where the team first met, in the tutorial immediately after their first major deliverable, and in the last tutorial of the project.

All video-recordings were taken in a private room where only the team was working. Three cameras were positioned around the room to capture each student's facial expressions as well as any shared work spaces (i.e. whiteboard, flip chart, communal computers). The videos from the three cameras were then synchronized using video-editing software to create a panoramic video of the team and their workspace.

Stimulated recall interviews occurred at the end of the term, once all course deliverables were submitted. In these interviews, we met with each student individually, and the student was shown three to four two-minute clips from their three video-recorded team meetings. The objective of these interviews was to triangulate our interpretation of the incident with the student's to gain a more robust understanding of the incidents. At the end of each clip, students were asked to recall what they remembered happening during the incident, the circumstances before and after the incident, the role they played in the incident, why they were motivated to behave as they did, and what impact the incident had, if any, on the team's future trajectory. Students were also asked about their team processes, leadership and how their team strove to work effectively together.

3.2. Research Methods

The approach taken to this qualitative research was one of constant comparative analysis.[41] Video-recordings were analyzed and coded according to the meaning-making and teamwork frameworks outlined previously, as well as coded to describe what was happening in the videos. The videos were coded separately, and then the researchers met to compare and discuss their coding.

In endeavouring to assess our team-member effectiveness behaviors in a similar manner to the course, we chose to adapt Sheridan's framework,[33] which is used for mid-term and end-of-term peer evaluations. While the framework is intended to be used as an instrument to assess how each team member has responded over a 3-4 week period, we adapted Sheridan's framework to analyze individual behavioral cues, rather than complete behaviors demonstrated over time. We understand behavioral cues as the combination of language, gesture and tone present in the discourse moves; whereas, we see behaviors as completed sequences of discourse moves that fulfill an intention. Some behaviors can be comprised of only one cue where others may require multiple cues.

To determine if a behavioral cue exhibited by a team-member matched a behavior from our team-member effectiveness framework, we focused on the *function of the behavior* seen. If the language, gestures and visual elements contributed to the team as a whole being able to achieve more of that behavior, we marked it as present. For example if a team member's comment resulted in further discussion from the team we marked "promote discussion" as seen. If a question or recommendation from a team member resulted in another team member providing a response or clarification, we marked "seek and include input from others" as seen. Some behaviors were not able to be analyzed solely through discourse moves in the recorded team meetings, and thus are not in the categories for analysis. While we may have been able to find evidence of the behavior having taken place from the team's discussion of their behaviors, we

could not directly see the cues of the behavior in the recorded meetings. For example, the behaviors "Attend team meetings prepared" and "Exchange information in a timely manner" would have behavioral cues that take place outside of team meetings.

Meaning-making was defined in terms of meaning-making episodes comprised of a series of discourse moves made up of words, gestures, facial expressions, and tone that provided evidence of the achievement of some kind of shared understanding. Cues that defined the boundaries of meaning-making episodes included: introduced or challenged ideas, questions, requests for clarification, requests for agreement together with expressions of agreement or disagreement, expressions of understanding, or acceptance of another team member's idea or explanation.

As we watched the videos, we also coded interesting behavioral cues, conversations or decisions to allow us to capture any additional themes that were not covered in the inventories we were using for our respective studies. Some of the interesting behaviors of note that helped round out our description of the teams included: an out of character move or comment, a change in an individual's response patterns, a shift in team atmosphere or discussion tone, and incongruities of action-response sequencing in conversation. These were behaviors seen in addition to those in the inventories that helped identify and describe critical incidents in the teams' interactions.

From these team meetings, critical incidents were identified for each team and/or individual team members to be used in the stimulated recall interviews (SRIs) once the course had finished. Critical incidents were defined as any interaction where a decision was made, a decision was abandoned, a common understanding was reached or a contentious issue was addressed. Any of these interactions could be seen to have altered the direction in which the team progressed after the incident occurred. Critical incidents for each team were analyzed using discourse analysis[42] to find evidence of the speech moves, gestures, facial expressions, or use of material mediational means that we could interpret as the contributions and roles of the team members in the process of meaning-making and teaming. To ensure triangulation between our interpretation of student behaviors and the students' intentions, critical incidents were selected and shown to students as video clips in their SRIs to validate our interpretations of the situation.

3.3. Demographics of the Studied Course and Population

The teams who volunteered to participate reflected the demographic of the Faculty, a purely serendipitous occurrence. Of the 16 participants from this course there were two students who were not visible minorities in engineering, four students who appeared to be English dominant and six who were female. None of the teams investigated in this paper consist of all monolingual English speakers or all domestic students. The language diversity of the teams was representative of the University's (and in particular the Faculty of Applied Science and Engineering's) linguistic diversity. Given the demographics of the teams and the student population in this course, the probability of having teams volunteer that did not have similar diversity to the student body was minimal. The students' motivations for participating ranged from "I had a terrible experience first term so I want to do everything I can not to repeat it" to "This might be interesting" to "I wanted the $30 gift card". With this range of demographic and motivational diversity in each of the teams, we do not feel that that there was a unified demographic or motivational volunteer bias.

4. The Studied Teams

The two teams discussed in this paper were selected based on our ability to credibly make claims about seeing the same behaviors creating different team environments. We selected teams from within the same first-year engineering design course to eliminate course pedagogy as a variable that could affect our conclusions. To ensure the clarity of our arguments, we selected two teams on opposite extremes of team effectiveness. Of the teams at these extremes, the selected teams were the most self-aware; each team member was aware of their effectiveness and the team's sense of togetheredness. As a result, this allowed us to feel more credible in our claims as we were able to triangulate our observations and interpretations of the teams' effectiveness with at least two team members for each team discussed.

Team 1, a team of 5 males from different first-year engineering disciplines, was comprised of Ken, Hisham, Victor, Zhao, and Mehrdad (real names redacted to maintain participant anonymity). Ken was both the designated team leader and the only English-dominant member of the team. Team 1 spent approximately 15 minutes discussing their team rules and shared past team experiences and issues, commuting times to campus, and past team rules they had had. They discussed the following rules in depth:

1.1. Respecting other team members - do not swear at each other or call another member a derogatory term
1.2. Communication will take place via text message and on Google Docs

Team 1 met twice a week for approximately 1-2 hours, once in their course tutorial, and once outside of the tutorial setting. Most of their written deliverables were completed virtually on Google Docs 48-72 hours in advance of the deadline. Hisham did not participate in a SRI.

Team 2, a team of 2 males and 4 females from different first-year engineering disciplines, was comprised of Meghan, Analyn, Wu, Jing, Yin and Zoya (real names redacted to maintain participant anonymity). Meghan was the designated team leader, and she and Analyn were the only English-dominant members of the team.

Team 2 spent 1.5 minutes discussing their team rules, and documented two team rules. The discussion was superficial and did not include any sharing of past experiences or personal concerns about the team.

2.1. "Don't be a dick" [in regards to how to behave]
2.2. Decision making will be done by consensus but will be done by voting if consensus cannot be reached. The topic must be discussed before a decision can be made.

Team 2 met once a week for approximately 1-2 hours in tutorial and focused their discussion on planning and decision making; additional meetings occurred around course deadlines. They completed their written deliverables virtually on Google Docs, however they had long in-person editing sessions in a university computer lab the day before each deliverable was due.

5. Analysis

Grounded in an activity theory perspective, we explored how the interactions -- specifically the ways students used the behaviors, language, gestures and visual elements -- have helped us to begin to answer the question:

How were teams exhibiting the same behaviors creating different team environments?

Combining the data from both the video recordings and the SRIs, we observed what we have labelled 'togethering'-- "an analytical category that accounts for the ethical manner in which individuals engage, respond, and tune to each other, despite their cognitive, emotional, and other differences"[21] -- as the differentiating factor across these teams.

"Togethering is not the result of some social contract or norms evolved from classroom communities. Togethering is both entailed by and the outcome of a joint form of ethical engagement, a collectively motivated activity based on trust and responsibility."[21] 'Togethering' allowed us to articulate how the teams were working in visibly different manners despite appearing to do similar activities. We saw teams that togethered as teams in which team members were able to engage, respond and tune to each other, the team as a whole and their object through their interactions with each of these respectively. In the absence of any of these three types of interactions, a team would not be able to together or pursue a collectively motivated object as a whole.

From the twelve behaviors presented in the team-member effectiveness framework presented in Table 2-1, based on the discourse analysis of the video-recordings, there were five behaviors the teams were exhibiting similarly, two they were exhibiting differently, and five that we cannot make claims about from the evidence obtained. The five behaviors that were exhibited similarly in both teams were: helping to plan and organize the work flow, seeking and including input from team members, showing respect from team members, openly expressing ideas and opinions, and promoting discussion. You will note that in Table 2-1 the eleventh behavior is promoting productive discussion; for this analysis we have chosen to look simply at whether the teams promoted discussion. We chose to look only at the promotion of discussion as the teams exhibited the same behavioral and gestural moves in terms of guiding the conversation, adding appropriate arguments, and responding to others' arguments even when the moves were judged as not productive.

Team 1 attempted to work together on a design project, but even though they did not exhibit any personal animosity toward one another, the course, or their project, there was no evidence of a shared commitment to any kind of shared object. Without that commitment, they found it difficult to stay focused, to collaborate with one another's ideas or to understand how their individual responsibilities and contributions within the project were interdependent.

Team 2 worked together effectively to create a cohesive team environment centered around excellence in planning and execution of deliverables. Their focus on planning and organizing their work gave the team the discussion space to create a shared mental model of the object around which they were togethering (their design documentation). This commitment to their object and their desire to create it with a unified voice facilitated an interdependence between the

team members that allowed them to leverage each other's strengths, and maximize their performance and effectiveness.

To demonstrate these two teams and the environments that we saw, we have chosen to compare one segment from each team's set of meetings which was representative of a typical discussion of that team. We are able to say that these segments are representative of the interaction of the respective teams as a result of comparisons of critical incidents across the three meetings of each team. To demonstrate the similar behaviors that we saw and how they manifested in different environments, the two segments have been selected similarly such that:

- each team is engaging in a planning activity
- the activity solicits the open expression of ideas and opinions
- the team leaders are focusing the inquiry of the activity
- both discussions meet the respective 'respect requirements' of the teams' rules

For each of these incidents, we will explain the context of the planning activity, detail for each utterance any specific team-member effectiveness behaviors or meaning-making moves it corresponds to, and describe how the utterances link together to demonstrate whether the teams have or have not togethered.

The images of the teams included in this paper to show the team members' gestures are a merge of two cameras at opposite ends of the room. The image of the members sitting on the right side of the table has been flipped 180° in the y-axis, therefore when the team looks like they are staring at opposite ends of the table in the figures, they are actually looking at the same side.

The conversations of the interactions have been coded in terms of the team-member effectiveness and meaning-making frameworks in the transcripts of the interactions in Appendix A for Team 1 and Appendix C for Team 2. Images of the team's configuration, gestures, and visual elements at specific intervals during the analyzed interactions are presented chronologically in Appendix B for Team 1, and Appendix D for Team 2. Select sections of the transcripts and select figures are repeated in the analysis below; figures whose captions begin with the letters C or D can be found in Appendix C or Appendix D respectively.

5.1.1. Team 1 - an example of not togethering

Our analysis of Team 1 left us with the image of multiple solitudes. Although the team members freely raised issues, stated ideas and opinions, and individually seemed to try to be productive, their discussions rarely produced a decision or created any kind of shared understanding. The team appeared to be using the behaviors and making discourse moves that would lead to productive team work but neither our evaluations of the recorded team meetings nor the team members' own evaluations characterized the team as productive. We sought instances of the team members building on each other's contributions, reaching mutual decisions, and their gestures and postures indicating a single focus. We found instead, individual members making discourse moves such as focusing, agreeing, confirming, seeking clarification, initiating, countering and disagreeing, but rarely building. Without building on the contributions of others, the team was unable to co-construct shared understandings of the team or their work.

In the second meeting that we video recorded, Team 1 opened the meeting by deciding to reflect on what went wrong in creating their first deliverable. They focused on generating content for

the next deliverable, “Lessons Learned”, an individual assignment about their experience with the design project thus far. This clip presents the first 2 minutes of that discussion. Seated from left to right around the table at the start of the clip shown in Figure 5-1 are: Mehrdad, Victor, Hisham, Zhao, and Ken.

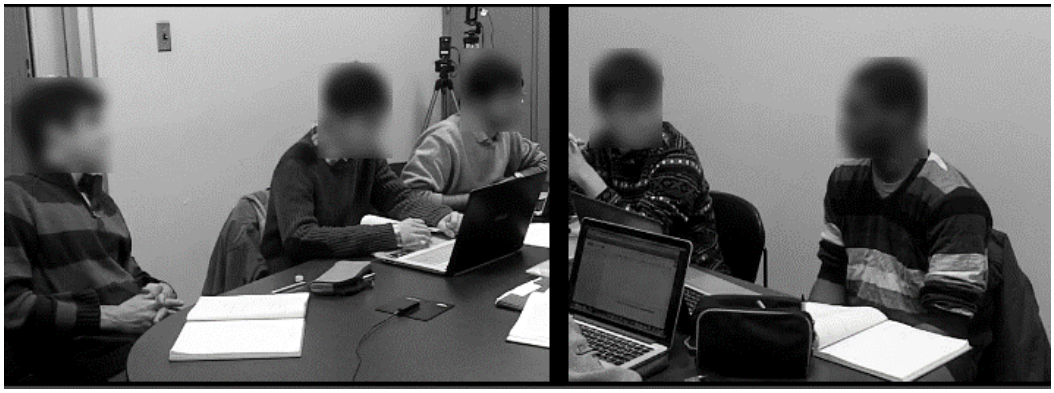

Figure 5-1: Ken presents the idea to the team of collecting their lessons learned from their experiences on the team deliverable they had just submitted.

In the clip we have selected for analysis we have identified an example of the team members’ inability to tune or respond to one another. We found this to be typical of the patterns of their interactions across all three meetings. The clip begins with the team trying to decide what they will do during this meeting. It is interesting to note the amount of overlapping talk. We would expect this overlapping to indicate engagement and response with one another. However, the overlaps do not connect, but rather compete for focus. The first 19 lines of the clip, Table 5-1, are all overlapping utterances with only two utterances that built on a previous one, one of which built on the speaker’s original proposition. The competition for focus can be seen in the discourse moves of the team members: three different topics initiated, three disagreements, two references to a previous topic, two confirmations and two clarifications. The only agreement came with the two confirmations at the beginning when one of the team members agreed with Ken’s nomination of the task, “Why don’t we write down our lessons learned.”

The overlaps begin near the beginning or the middle of a previous speaker’s utterance, without any change in either speaker’s volume or pace; it is as though each individual speaker is unaware that anyone else is speaking. They do not expand, complete, confirm, or counter the utterance, they simply state. We see this as evidence that the team members are not engaging with each other’s ideas or responding to one another. This is particularly evident in lines 5 - 12 when Mehrdad asks a question about the lessons learned that is never answered. None of the other four team members seem to even hear the question. Instead Victor repeats the topic they will cover (line 6), Hisham nominates the first ‘lesson’ (line 8), Zhao disagrees with the task they are focused on (line 9) and Ken remains silent. They are not particularly engaged in the activity nor with one another. They do not respond to what anyone else is saying or doing. Their postures and orientations to one another physically do not respond to one another beyond a momentary turn of the head. We can say that without engaging or responding to one another, we see no evidence of the team members tuning to one another.

Table 5-1: First 19 lines of the clip selected for analysis where the team attempts to decide what activity to pursue. All lines in this excerpt are cross-talk. Line-specific coding can be found in Appendix A.

Line	Speaker	Transcript
1	Ken	Actually, why don't we write down our lessons learned
2	Victor	Oh, yeah, yeah, yeah, yeah, I like that (Victor and Mehrdad both lean in pick up pens and prepare to write.)
3	Mehrdad	Oh shit (overlapping w/Victor)
4	Ken	Let's do that today 'cause since there's nothing really else to do
5	Mehrdad	We have to show it today?
6	Victor	Lessons learned...
7	Mehrdad	We have to show it today?
8	Hisham	We had no internal deadlines.
9	Zhao	We have to be writing the status report
10	Mehrdad	No, we did. But we couldn't...
11	Victor	No, lessons learned due like last day
12	Zhao	No, but...
13	Victor	We have to write like a...
14	Zhao	No but, we still have to write... (overlapping with Victor)
15	Victor	...transcription
16	Zhao	...the status report
17	Mehrdad	Ya but its better to make some mistakes here
18	Victor	yeah, yeah and you can refer to this as well
19	Zhao	Lessons learned (writes in his notebook)

The team's inability to engage with either their topic or one another is painfully evident in their second attempt to focus on their lessons learned when they unsuccessfully try to establish a process and boundaries on the idea generation activity they are pursuing in lines 20-48. In line 20 Ken plans how they will do this activity, and seeks everyone's input. Hisham seeks clarification in line 22 which both Victor and Ken provide in lines 23-26. But in line 27 Mehrdad initiates a new topic, which could be interpreted as the first contribution to their lessons learned, but in line 28 Ken undermines that move with, "Listen, you're on camera"[*], Victor responds with a greeting to the camera and Ken follows with an invitation to Mehrdad to go first, which Mehrdad turns down. A move to start a discussion or at least identify the lessons learned that started in line 20 has yet to begin by line 48. If we look at the categorization of the utterances between lines 20 and 48, four different initiation moves were made: one about the camera, one an attempt to go

[*] Another reference to being on camera had been made at the beginning of this meeting with comments from each of the other team members that characterize the team's attitude toward the presence of cameras, "Nice", "Who cares", "Doesn't matter", "It's all confidential", "You're free to say anything", "You're free". The students exhibited other behaviors (swearing, rude gestures, etc) in other meetings that indicated they felt quite comfortable with the cameras in the room.

first, one, incomplete, to identify a lesson, and one that takes the group to review the Google Doc of their previously submitted assignment. None of these initiations builds on the topic of lessons learned nor develops any of the new topics into a lesson learned. They never hold eye contact with one another for more than an utterance, such as Mehrdad and Ken in lines 30-31, before returning their focus to the computer screen, notebook or something else directly in front of them. They did not engage with each other. Hence, we found no builds in this section and rather than moving the discussion forward, the content continuously recycled back to a previous topic. Despite establishing a process and boundaries they do not engage in identifying any lessons learned.

Lines 49-58 provide yet another example of how this group of individuals, while exhibiting behaviors of openly expressing opinions were not able to promote discussion, help to plan or even seek and include input, Table 5-2. Hisham has identified their major challenge in line 49 to which Ken agrees and Victor contributes, but the build stops there. During this discussion we can see that the five team members are facing one another, however, each of them is also focused on their own notebook or computer, Figure 5-2. Hisham continues on, further clarifying his point, but no one else engages and responds to that point. Hisham continues to expand this idea but Ken summarizes it in four words, "Next time, divide tasks." The group did not engage or respond to Hisham's detailed description, Ken did not engage or respond to it other than to note it and move on to the next point. These selected episodes clearly show the team members' lack of commitment to each other, to their activity of identifying lessons learned, and to improving the team through this process. They have not togethered.

Table 5-2: The last 10 lines of the clip selected for analysis where the team attempts to determine their first lesson learned. Line-specific coding can be found in Appendix A.

Line	Speaker	Transcript
49	Hisham	I think, I think one of the problems was, uhm, we didn't have, like we didn't divide the tasks properly, like everybody was working everywhere.
50	Ken	Oh, yeah, yeah, yeah,
51	Mehrdad	Yeah, (writes)
52	Hisham	And everything
53	Victor	People were jumping around
54	Hisham	And like looking at the, you know, PS, PSQ, Problem statement and then I'm like oh he's working on it and I'll go to functions and someones written on it (Ken laughs, is writing, so is Mehrdad, Zhao smiles, Victor looking at Hisham) but, but, but
55	Victor	It was the last thing we finished
56	Hisham	And then we have, and then someone else comes in functions and says oh this is wrong (Victor agreeing, Mehrdad looking at Hisham, Zhao looking down, Ken looking down) and he changes it and then I go back, No, it was supposed to be that. And you know we had a problem, we should have divided the task amongst each other and that would be better.
57	Ken	Next time, divide tasks (writing in notebook)
58	Hisham	(Jumping in over Ken) And then, then we should have like a meeting where we would just look at our, like at what we've written and just

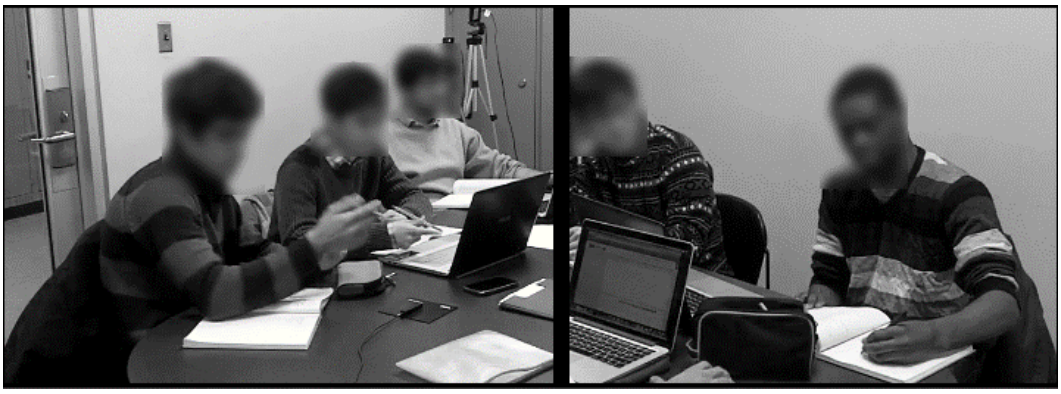

Figure 5-2: The team agrees with the lesson learned that Hisham just offered. Zhao is looking at Hisham, Ken is recording something in his Engineering notebook, and it is unclear what Mehrdad or Victor are looking at.

5.1.2. Team 2 - an example of togethering

Our analysis of Team 2 left us with the image of a collective individual harmony. During the team discussions, all members contributed what they felt would add to the discussion, and the inputs of all team members were equally valued. There was a sense that every member of the team had a purpose and was necessary to create the team's design. We consider Team 2 to have togethered as they can engage, respond and tune to each other during their interactions, both verbally and behaviorally. We see this in particular through the highly productive interactions the team had. In these interactions, Team 2 shares, develops, and elaborates on each other's relevant ideas and opinions as a means of developing a shared understanding of the team and their work.

The clip we analyze occurred in the third meeting that we video recorded. In this meeting, Team 2 spent the majority of their time planning their final presentation. This was the next course deliverable following the meeting, and Team 2 focused heavily on creating a presentation that fit the course requirements but was also memorable. This clip presents the first decision the team made around their presentation structure and medium – What medium(s) should the team use to convey their design? Seated from left to right around the table at the start of the clip shown in Figure 5-3 are: Yin, Meghan, Jing, Analyn, Zoya, and Wu.

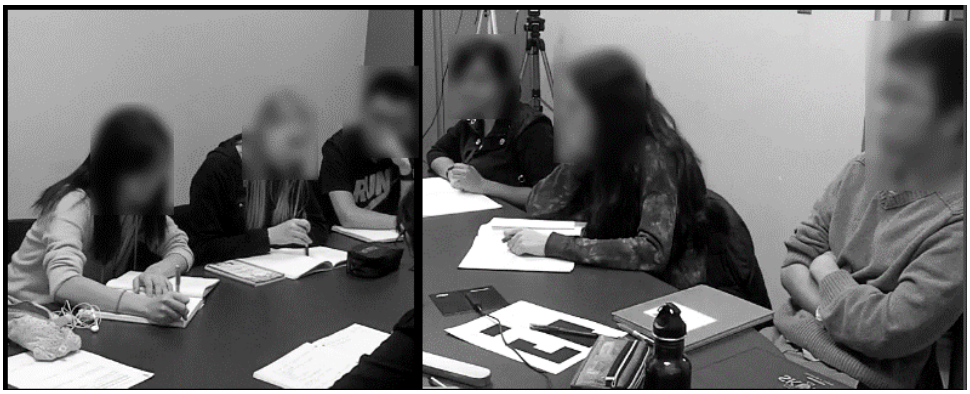

Figure 5-3: Meghan introduces the discussion topic for the interaction. Most team members are recording the previous decision in their engineering notebooks, while Wu sits back reflectively.

When we look at how Team 2 engaged and responded with each other, we see it in how the team members presented relevant and contextually appropriate ideas and opinions to be discussed. At the opening of the excerpt in Appendix C, Meghan initially proposes an idea for discussion "are we doing PowerPoint" (line 1) which focuses the attention of the team and allows them to engage with the topic at hand. Behaviorally, we see the response to this invitation to engage in how Wu sits up and leans forward to physically move into the space in which the discussion will happen (line 3), and in how the other team members look up and direct their attention at Meghan. In these movements, they create a space of joint action in which they can begin to tune to each other.

We also see this engage and respond pattern in how the team develops each other's partial ideas into a whole. The overlap style of Team 2, in contrast to Team 1, is not one of competing ideas, but one of completing each other's partial ideas by allowing a series of utterances to co-construct a complete idea. This can be seen throughout the excerpt in the quantity of clarification and build coding that exists. The team endeavours in this excerpt to create a functional understanding of Prezi. The two occurrences of this with the most overlapping speech are in lines 7-14, as the team determines what Prezi is and does, and in lines 23-28 when the team co-constructs an understanding of the potential motion-sickening properties of Prezi transitions, see Table 5-3.

Table 5-3: The team further developing their understanding of Prezi's transitions All lines in this excerpt are cross-talk. Line-specific coding can be found in Appendix C.

Line	Speaker	Transcript
23	Analyn	But like is it uhhh, um one thing I notice about Prezi is it's helpful but sometimes it moves around a bit too much
24	Wu	Makes you so dizzy.
25	Analyn	(Gesture with two hands left, right, up and down vocalizing uhhhhhhhhh)
26	Yin	You can, you can change that
27	Zoya	That's easy, uhhh, it's usually for like if you need a lot of videos
28	Analyn	I think we can

The tuning of the team-members to each other, such that they can engage with the discussion and respond appropriately, can be seen in the fact that the team members can complete each other's ideas. The speakers don't challenge the next overlap nor correct the next speaker; each next utterance is accepted by the previous speaker. We feel this is evidence that the person completing the idea understood it and is offering appropriate information that would complete or expand on the initial incomplete idea. This pattern of engaging and responding to each other in a tuned manner demonstrates their togethering; it is as though you are listening to the team's voice discuss the idea rather than each individual's contributions distinctly.

The co-construction of a shared understanding of an idea does not only come in completing other team member's utterances but also in the team's development of ideas to a point at which they can be accepted or rejected as appropriate. This development, or building, of an idea occurs across the majority of the team in response to Wu's suggestion in line 30 that the team could do a demonstration of their design, Table 5-4 and Figure 5-4. The idea is agreed on as a possibility by Zoya (line 31), and is then countered and developed by Meghan, Analyn and Yin (lines 32-40). These responses demonstrate the tuning that the team members had to each other and their

engagement with the activity of deciding on a presentation medium through their focused contributions. Without Wu providing any description of how he conceptualized a demonstration, we can see Zoya (line 34) providing clarification on the idea to Analyn without seeking clarification from Wu, and without him countering or challenging the clarification provided by Zoya. The other team members are all equally able to add to the discussion and lead the team towards making a decision about the demonstration idea without Wu having to focus the team on his understanding of his demonstration idea. The team is tuned to each other sufficiently that they all 'get' his initial idea.

Table 5-4: The team negotiates Wu's suggestions of a demonstration as a presentation medium. Line-specific coding can be found in Appendix C.

Line	Speaker	Transcript
30	Wu	We could do a demonstration
31	Zoya	Yeah, we could
32	Meghan	But that takes time...
33	Analyn	Oh, oh, like on the spot?
34	Zoya	Yeah...We can open Google Docs
35	Meghan	Well you don't want to make it too on the spot but yeah something
36	Analyn	Like our (looking at Meghan and Yin)
37	Wu	just quickly ...
38	Yin	We can show them step by step
39	Analyn	exactly, exactly... Our invitation cards (laughing)
40	Meghan	Yeah, if we can yeah and that can be part of like someone's presentation explaining what's going on …

In the physical space, this is seen in the development of a space of joint action as different team members add their presence to the discussion. This can be seen in postural shifts to guide visual focus towards the discussion and speakers (Wu line 3, posture change between Figure D-1 and Figure D-2 and Analyn seeking visual confirmation from Meghan and Yin in line 36), and the use of visual cues such as nodding (Zoya, lines 43 and 55), and hand signals (Analyn, line 25). Team 2 continually moves to create a space that includes everyone, and in which there can be direct eye contact with anyone presenting an idea so as to demonstrate their engagement with both the person and the idea (Analyn's movement at line 31, Figure 5-4). We see this happen primarily as the team develops a collective sense of the constraints that are imposed on them by the presentation environment. As Meghan and Analyn negotiate the information made available to them by the course, the other members of the team (while they do not contribute verbally) do not disengage – eye contact is maintained and invitations for others to join in the discussion are continuously presented (see Meghan's posture in Figure D-5). Ultimately, the agreement that using Prezi is an idea that is good enough is reached through non-verbal response in line 57 when the members of the team simultaneously record in their notebooks that they will use Prezi.

Team 2 demonstrated this tuning in how they both behaviorally and orally contributed to the discussion and responded to one another in this meeting. This shows how comfortable team members were openly expressing ideas and opinions, seeking and including input from others, and promoting discussion; the team members fluidly transition between these behaviors over the

excerpt. While Meghan is the only one engaging in helping to plan and organize the workflow in the discussion, this does not affect the abilities of the others to contribute and be heard.

Figure 5-4: Wu presents the idea of using a demonstration during their presentation. As Analyn does not normally have direct eye contact she leans in to see Wu while he presents his idea. Meghan and Yin also turn their focus to Wu who is seated at their left.

6. Discussion

This section aims to elaborate on the analysis of the two interactions discussed above, as well as introduce other contributing factors to togethering that were evident in other interactions and the teams' SRIs. We saw the development of a collectively-motivated object as mutually constructed by the engagement, responsiveness, and tuning discussed above, as well as through the team's commitment and collective responsibility.

While we acknowledge that the teams in this study are slightly larger than the optimal undergraduate team size of approximately 4 students, this was a variable that was held constant across the study. The teams investigated in this paper of 5 and 6 students did not discuss in their interviews that the project work or project requirements were too small to require all team members' participation. Additionally, during the team meetings we observed, all team members contributed to the discussion either using speech or gestures; while there were some team members that talked more or talked less, our observations were that all team members were engaged in the conversations. Whether those conversations created a shared understanding or multiple individual conceptions was the key differentiating factor in the togetheredness of the teams; the team members were all engaged in conversation despite not being engaged with a shared object or goal. As a result, we are confident that it is not team size that changed the effectiveness of the teams, but the emergence of a shared understanding and shared object that differentiated them.

We have not been able to identify an object that Team 1 togethered around in spite of differences. There were several potential objects for Team 1 to together around: the project, successful completion of the course, the "Lessons Learned" or the team as an entity. Although we noted some interest in the design project in the first meeting, we found few other references to the project or even any aspects of the design in the recordings we made of the three meetings. We found only two references in Mehrdad's SRI and a second in Ken's SRI. Each mentioned a different decision made during the design; the successful completion of the project itself did not seem to inspire any kind of collective commitment.

Successful completion of the course, defined as a desired mark within a certain range, managing to meet deadlines, or even completing the deliverables to a certain level of quality did not appear in any of the recorded meetings or the SRIs of Team 1. Victor addressed this in his SRI when he talked about the lack of a vision or team culture. He said "what we were missing is...umm...something to move... like uh results, we were missing" He defined it as not having any sense of a team culture because they never saw any results from their work, e.g. a good grade. He seemed to associate 'team culture' with a shared goal as something that might make a team effective. We would define that as an object to which the team could commit.

We see more evidence of this inability to commit to an object in meeting 3 when the team began preparation for their final presentation. When Ken asks, "What's our opening strategy?" Victor counters with "Maybe everyone should read the FDS [Final Design Specification] first, because I'm pretty sure everyone didn't read it." Only Ken and Victor have eye contact during the exchanges about reading the FDS in preparation for working on the final presentation. None of the other team members, through posture or eye contact, indicate any engagement with this idea. They have worked together for nearly three months at this point, they have written three team deliverables, and yet only two of the team members, Ken and Victor, have read anything other than the section they were responsible for. The work, as manifested in the deliverables, did not function as an object that the five team members could make a commitment to. This is corroborated in Victor's SRI when he stated: "We did reflect after PR/PMP [Project Requirements/Project Management Plan]...but I feel like people are not actually telling me what they think about others. Like... Because we didn't need to storms[†]... we are actually...*we still have a wall between each other*" [emphasis added]. He goes on to add that their reflection did not address the fact that they were not communicating with each other, or that they didn't use their agreed-on communication method in Google Docs. In their team document, no one commented on other people's sections or answered the comments that someone had left. This goes back to their inability to engage and respond that we witnessed in so much of the recorded meetings. They did not seem to be able to engage and respond in a face-to-face meeting nor in their Google Docs mode.

Ken provides a possible explanation, from his perspective, of the team's inability to engage, respond or tune to one another when he described the team's interactions at the beginning of the course: " 'cause we all like didn't know each other right? So like we were just trying to get used to each other and also the fact that I was just mentioning everyone was just ya know…they very much wanted to …they were very much at the beginning….I don't want to say like mini leaders or something but they all wanted to like get their own point…get their own point in so sometimes it uh. This came to like be ya know "your point's bad, my point's better" sort of stuff like that but we discussed that." The discussions Ken refers to in this quotation were individual one-on-one discussions, rather than team-level discussions. As a result, there was no collective meaning-making or shared understanding of the points each team member was trying to make.

Whereas, with Team 2, the object of their togethering is clear – Team 2 togethered around each other and their success in their design work. The togethering around each other stemmed from their valuing of each other's contributions (see Section 5.1.2) and the role that inquiry played in their team. Inquiry was demonstrated as a key value of the team through a combination of

[†] Refers to the storming stage of the Tuckman model[40]

Meghan's guiding of the discussion, Wu's role in continually asking clarification questions, and Analyn's role of interrogating the contributions of her team members. Wu described in his SRI that it was important to "focus on understanding... to make sure everyone is on the same page." This can be seen in the cyclic pattern of the interaction moving from a statement seeking the input of others, to a clarifying, confirming, or countering move. Not once during the interaction analyzed in 5.1.1 is there a space in which an idea is not taken up by another team member, demonstrating their continual engagement in the discussion and desire to achieve their object -- success in their design work.

The team's ability to engage with one another and the topic was based heavily on their ability to tune and respond to each other. For example, Meghan's strategies to include everyone in the discussion was confirmed by other team members in their SRIs. Analyn commented that Meghan made an effort to include everyone by directly asking those that were less vocal what they thought. Meghan confirmed this as an intentional move on her part when she said that "[she] would ask them some questions and force [the team members] to make a few decisions as well." This inclusion strategy also contributed to the tuning of the team, as it allowed a calibration of team members' preparedness -- the ability for everyone to start 'on the same page,' as Wu previously described. Such actions allowed the team to focus on the development of an effective team as one of the objects of their design-project activity, and one that they successfully togethered around.

This inclusion strategy led to discussions in which team members' inputs were valued, and a space where they all felt the freedom to present any thoughts they had. Yin discussed in her SRI the way in which she engaged with the team in discussions. She commented on how she would "watch other people closely, and once they were done, start talking" to make sure that there was a space for her to add her thoughts to the team. She similarly felt that she was listened to because "they had a response" to whatever she shared, and took her seriously. Zoya similarly felt that she could easily get a space to talk, and when asked if it was difficult she said "no, not really, like, I would just talk about [my ideas], and mostly everyone would listen."

Their togethering around the success of their design work can be seen in the team's collective responsibility toward the development of the design and its documentation. This is most evident in what we uncovered in their SRIs as "editing sessions" the day before the deliverable's due date. While we do not have any video-recordings of these meetings, these sessions were discussed by all team members in their SRIs. These sessions forced the team to be accountable for their individual responsibility toward the collective object of the design work because, as Yin commented, "when you are in person you can't ignore anyone." This statement alone provides a stark contrast between the two teams, where Team 1 was capable of ignoring all the different planning ideas presented during the interaction analyzed in Appendix A. The role of these editing sessions to the team did not only present as a productive way of preparing a "consistent" document, but also as a way of reiterating the equal voice that the team members held in their team's work. Having everyone read through and edit the documentation enforced the 'team' nature of the deliverable and the collective responsibility of the team to their object. As Analyn shared in her SRI " it was very useful, especially in creating the final document because we all just sat together as a team, and we just discussed every aspect of the document bit by bit and went over it like a million times over." This is in stark contrast to Victor's comment that the team couldn't discuss their design because no one had read the entire document they had

submitted as a team hours before. Here it is clear to see how Team 2 developed a collective responsibility towards the development of their design and documentation in a way that Team 1 did not. As Radford and Roth argue "To realize the object of the joint activity, each party has to enact its part in the irreducibly collective responsibility."[21]

7. Role of Togethering in the Engineering Teamwork Classroom

We cannot prescribe a clear set of recommendations for togethering because togethering emerges out of the interactions and is not created from a series of controllable variables (gender, cultural or linguistic affiliations, performance level, motivation, ...). However, facilitating a space in which togethering can occur is possible. Our findings suggest a number of questions an instructor can ask to determine the development of the togethering process, and artifacts an instructor can provide to facilitate that process.

Providing a large physical communal workspace facilitates a space of joint action. Such a space allows students to engage in discussion, debate, drawing, sketching, acting out, and public note-taking to develop a more coherent sense of their object. A more coherent sense of the object makes it much easier to together around.

Urging students to supplement their computer-mediated communication with real-time face-to-face discussion increases opportunities to develop shared understandings when debating concepts, processes, or course/project-related artifacts. Written words alone are not sufficient. The teams discussed in this paper used a combination of in-person meetings, in-person editing sessions in a computer lab, and Skype-mediated discussions. In the SRIs, Team 1 commented explicitly that they could **not** use just the chat function on Google Docs but required a higher-resolution medium for communication. Allowing for both word and meaning to be conveyed through multiple media facilitates students' abilities to understand, and more openly question, why a team member is communicating that information.

In order to become aware of a team's togethering (or lack of togethering) instructors can to ask themselves a number of questions about the team and explicitly observe team interactions. For example:

> Does the team have a **shared** object?
>
> How well do these team members know each other? Does each student know their team members' potential contributions to the project (strengths, personal interest(s) in the project or subject matter), preferred modes of contribution, motivation to contribute, and availability to contribute?
>
> Do students build on each other's ideas? Do they provide constructive critiques? Can the team have a focused discussion?

Questions directed to the team members that might facilitate awareness of and efforts toward a better togethering process could include:

> How does the team think they are working to create a **shared** understanding of themselves and their work?

What characterizes the team interaction patterns? Can they identify when (if) they are building off the contributions of others or presenting disconnected responses? Does anyone avoid contributing? Why?

The answers to the questions may suggest a number of strategies an instructor may use or suggest team members use to support their team work, or in this case, their togethering. These suggestions are neither exhaustive nor universal. Just as a shared object emerges out of the interactions, questions and strategies will also emerge out of observation and interrogation of team processes and practices.

8. Conclusions

This study looked at the role of the team-member effectiveness behaviors and meaning-making moves in creating an effective team environment. From our analysis of the interactions of the team-members during their meetings, and their comments on other aspects of their teamwork from their SRIs, we have determined that teams demonstrating similar behaviors can create different team environments. In these teams, the demonstration of team-member effectiveness behaviors across multiple team members was not sufficient to create an effective (or togethered) team environment; these teams were not the sum of their collective abilities and behaviors. At this point, we feel we can conclude that when shaping team environments, the negotiation of a collectively motivated object which the team can engage with and commit to appears to be necessary to creating an effective project team where team members can tune and respond to each other.

However, these are preliminary analyses that have looked only at the role of interaction in creating a togethered team environment. We have yet to analyze how artifacts, team-member effectiveness feedback, learning or assessment affect a team's ability to create a shared object. These analyzes are necessary to complete our understanding of the role togethering plays in team effectiveness and/or proposing methods or strategies on how to facilitate the development of togethering in team-based project courses.

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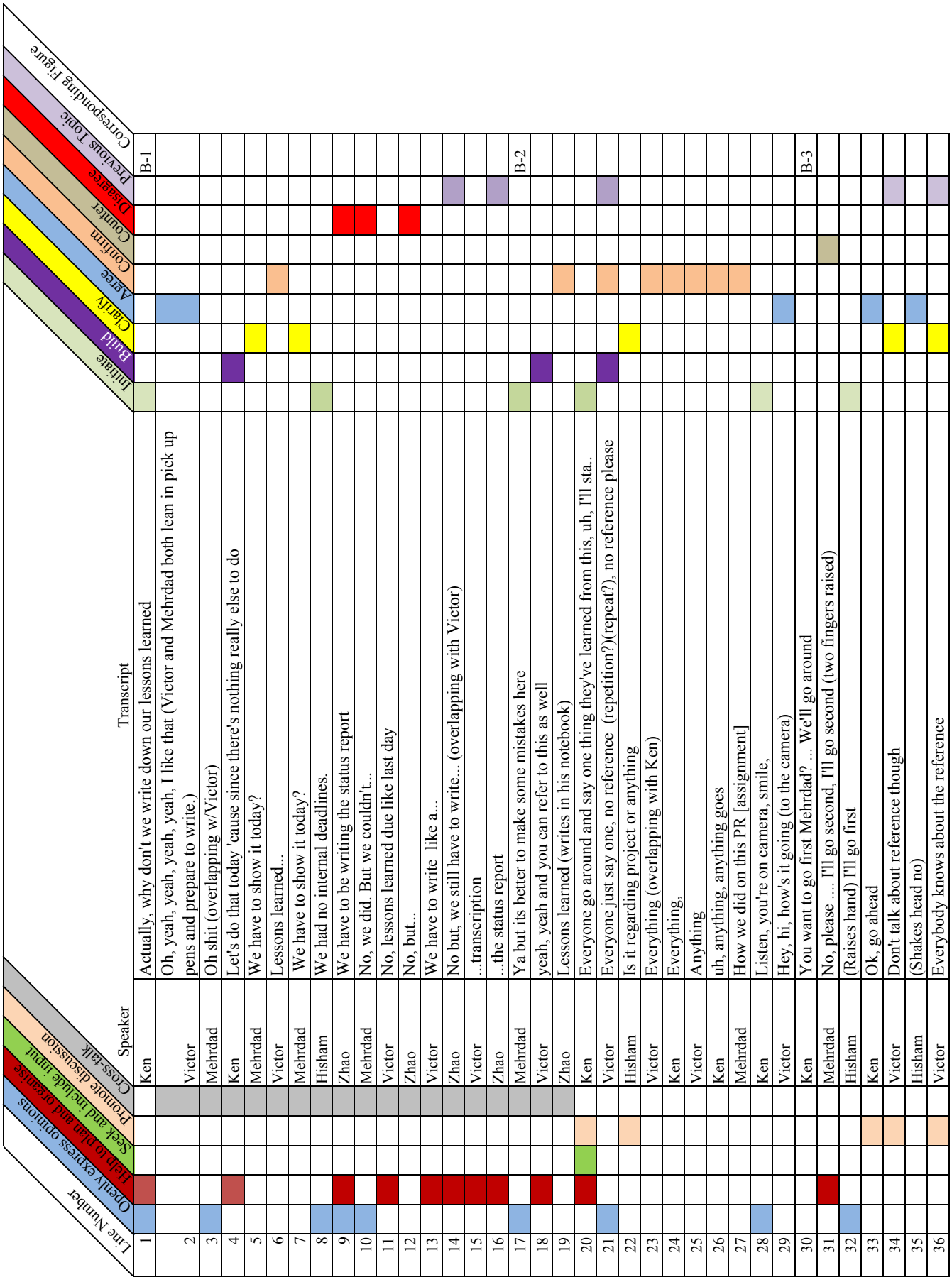
Appendix A. Discourse analysis of Team 1's interaction



Line Number	Openly express opinions	Help to plan and organise	Seek and include input	Promote discussion	Cross-talk	Speaker	Transcript	Initiate	Build	Clarify	Agree	Confirm	Counter	Disagree	Previous Topic	Corresponding Figure
37						Hisham	I think, uh, we do not (Mehrdad leaning in and looking directly at Hisham around Victor who is looking at Ken across the table)									
38						Ken	xxxx references last? (directed at Zhao)									
39						Victor	I think we did...									
40						Zhao	We do references last, I think									
41						Victor	We did it last time (Mehrdad sitting up looking at Victor, hands raised together) I mean, yesterday,									
42						Zhao	Where?									
43						Victor	(over Hisham, looks at Ken and Zhao) We talked about lessons learned. (looking at computer) Oh, my god, there's no history. [referring to google docs chat history]									
44						Zhao	There's no chat history, 'cause									
45						Victor	What? Really?									
46						Mehrdad	As soon as you close it you lose it									
47						Victor	What, I thought it saved.									B-4
48						Ken	No, you have to save it yourself.									
49						Hisham	I think, I think one of the problems was, uhm, we didn't have, like we didn't divide the tasks properly, like everybody was working everywhere.									
50						Ken	Oh, yeah, yeah, yeah,									
51						Mehrdad	Yeah, (writes)									
52						Hisham	And everything									B-5
53						Victor	People were jumping around									
54						Hisham	And like looking at the, you know, PS, PSQ, Problem statement and then I'm like oh he's working on it and I'll go to functions and someones written on it (Ken laughs, is writing, so is Mehrdad, Zhao smiles, Victor looking at Hisham) but, but, but									B-6
55						Victor	It was the last thing we finished									
56						Hisham	And then we have, and then someone else comes in functions and says oh this is wrong (Victor agreeing, Mehrdad looking at Hisham, Zhao looking down, Ken looking down) and he changes it and then I go back, No, it was supposed to be that. And you know we had a problem, we should have divided the task amongst each other and that would be better.									
57						Ken	Next time, divide tasks (writing in notebook)									B-7
58						Hisham	(Jumping in over Ken) And then, then we should have like a meeting where we would just look at our, like at what we've written and just									

Appendix B. Snapshots of Team 1's Interaction

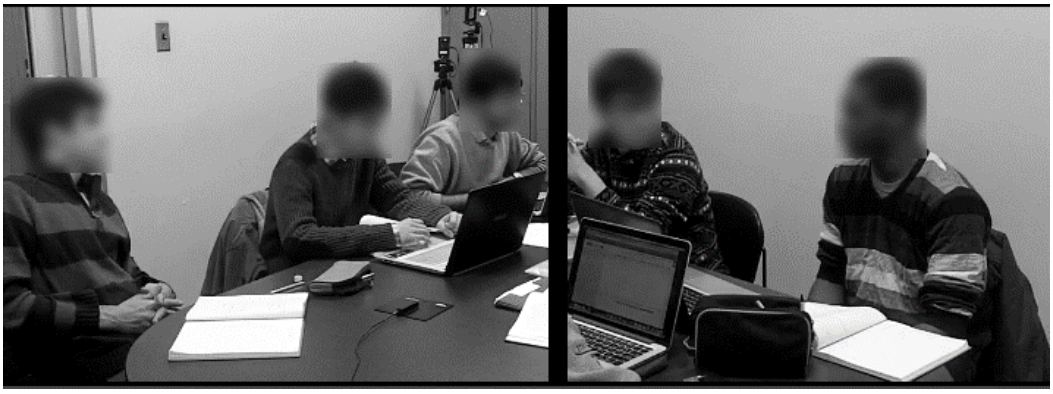


Figure B-1: Ken presents the idea to the team of collecting their lessons learned from their experiences on the team deliverable they had just submitted. (Also Figure 5-1)

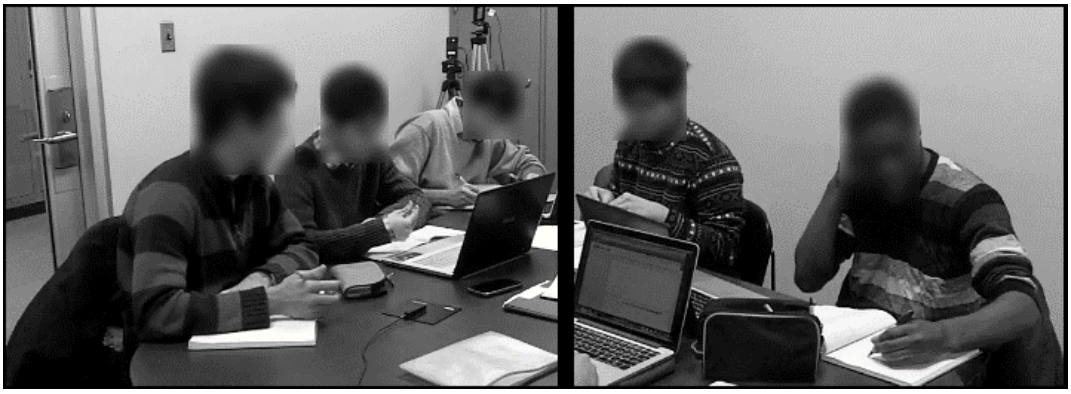


Figure B-2: The team is engaged in cross-talk about the previous topic of conversation and the current topic. Everyone is looking at their own device or notebook and sharing their individual perspectives on what is important. No shared meaning is developed as the ideas and individuals are fragmented.

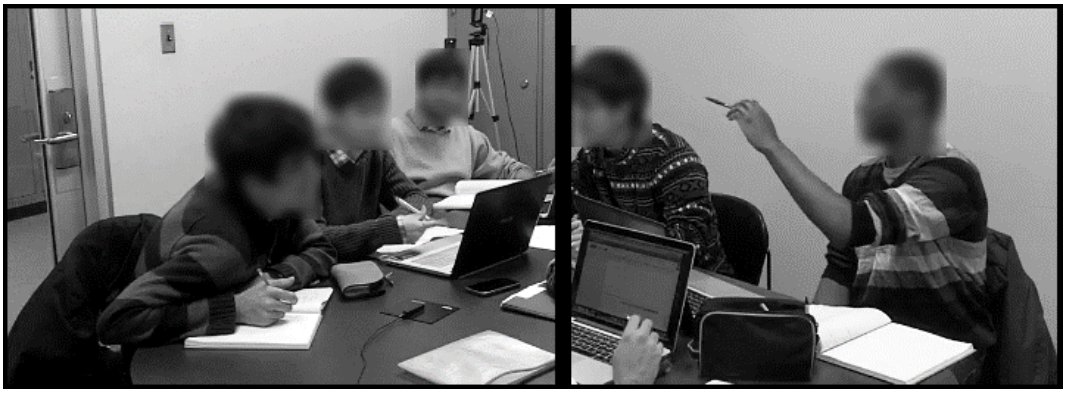


Figure B-3: Ken guides the conversation back to their solicitation of lessons learned. He suggests that Mehrdad (in blue and navy stripes) go first, and points across the table at him.

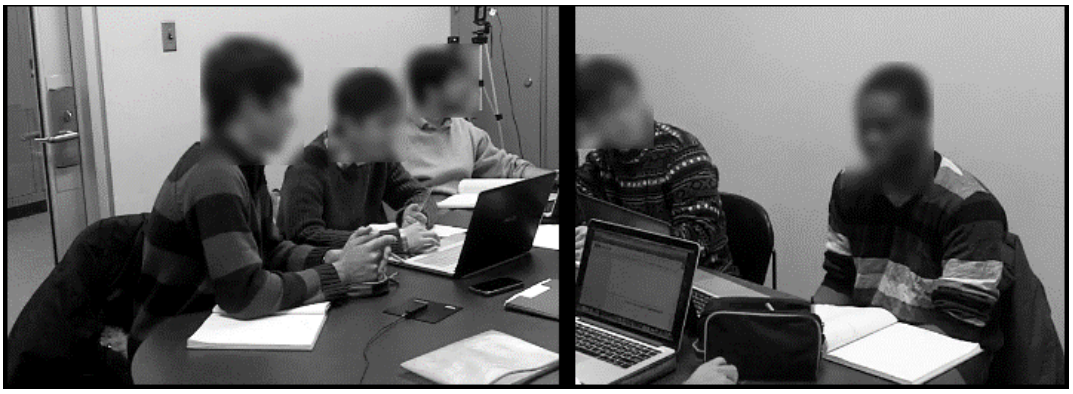


Figure B-4: The conversation has been derailed by a previous discussion about the references in the document. Victor claims something existed in the chat history on Google Docs about lessons learned. He goes back to discover that the history has been deleted. Only Victor and Mehrdad are visually engaged in the discussion, everyone else is focused on other things.

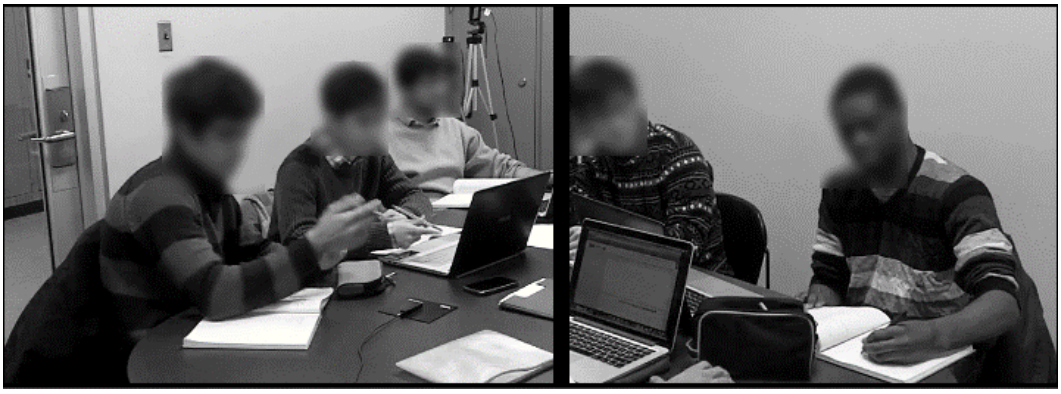


Figure B-5: The team agrees with the lesson learned that Hisham just offered. Zhao is looking at Hisham, Ken is recording something in his Engineering notebook, and it is unclear what Mehrdad or Victor are looking at. (Also Figure 5-2)

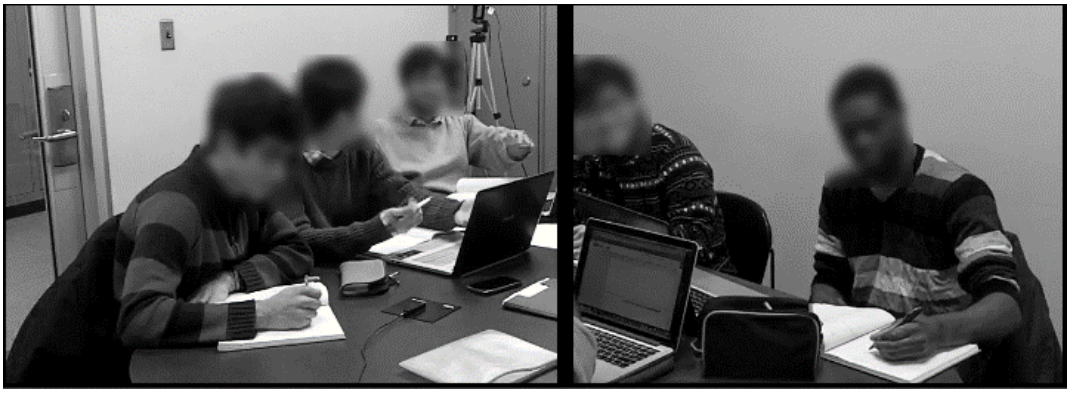


Figure B-6: Hisham elaborates on the lesson learned by sharing more information on the issue. Everyone is engaging in eye contact with Hisham except for Mehrdad and Ken who began writing when Hisham started elaborating.

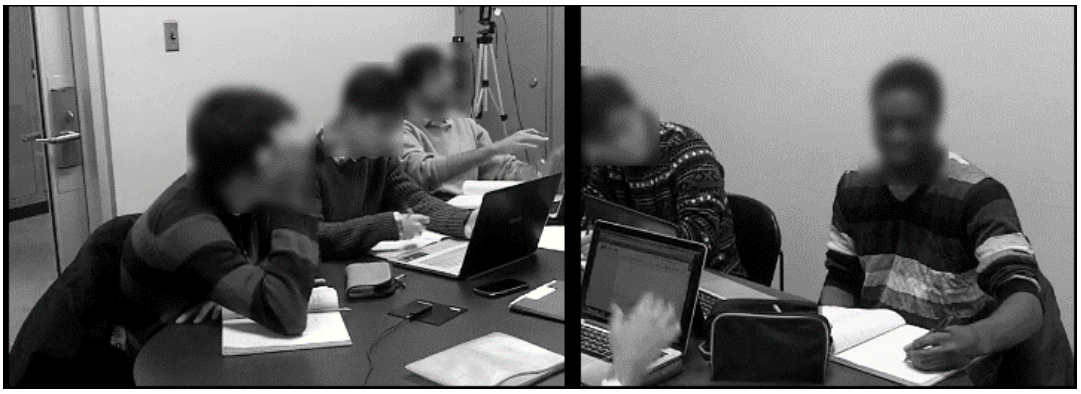
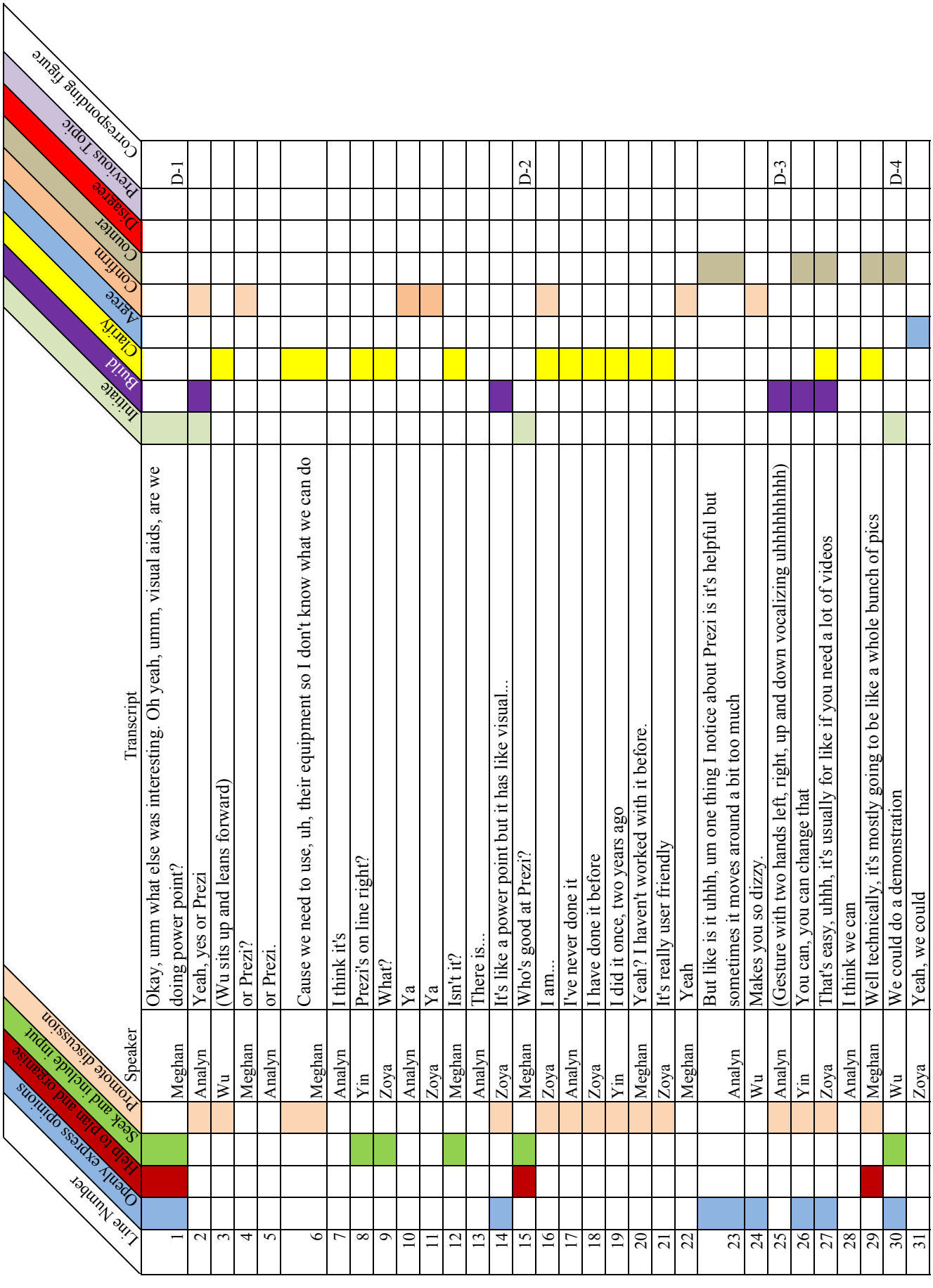


Figure B-7: Hisham finishes discussing his lesson learned idea, Ken summarizes and records it, and Hisham immediately begins presenting another lesson learned. Zhao and Mehrdad are looking at Hisham.

Appendix C. Discourse analysis of Team 2's interaction



Line Number	Openly express opinions	Help to plan and organise	Seek and include input	Promote discussion	Speaker	Transcript	Initiate	Build	Clarify	Agree	Confirm	Counter	Disagree	Previous Topic	Corresponding figure
32					Meghan	But that takes time...									
33					Analyn	Oh, oh, like on the spot?									
34					Zoya	Yeah...We can open google docs									
35					Meghan	Well you don't want to make it too on the spot but yeah something									
36					Analyn	Like our (looking at Meghan and Yin)									
37					Wu	just quickly ...									
38					Yin	We can show them step by step									
39					Analyn	exactly, exactly... Our invitation cards (laughing)									
40					Meghan	Yeah, if we can yeah and that can be part of like someone's presentation explaining what's going on while you guys we have to make sure we are able to like switch on the internet fast enough too									D-5
41					Analyn	yeah, yeah, I don't know if they have internet									
42					Meghan	Yeah, that's the problem, so we have to think of that									
43					Zoya	Oh (nodding)									
44					Meghan	We may not be able to do that									
45					Analyn	I think it's in the instructions like there was an email that [course manager] sent out									
46					Meghan	Yeah there was some kind of equipment testing									
47					Analyn	Well and for when, if you're doing it from a usb you just have to plug it in									
48					Meghan	Yeah									
49					Analyn	And make sure that it works									
50					Meghan	Yeah, yeah.									
51					Analyn	That's ....probably how it has to be, well depending on how we(gesture)									
52					Meghan	Well, I don't know, does that, so I'm thinking that, shall we do Prezi then?									
53					Analyn	Prezi or Powerpoint									
54					Meghan	What do you guys think? ....Well then, 'cause you guys are going to have to deal with that, are you okay with that?									
55					Zoya	(nodding)yeah									
56					Meghan	Or like whoever's had experience with Prezi. Ya just like...Okay, so Prezi?									
57					Analyn	Prezi (Zoya, Analyn and Jing write something)									D-6

Appendix D. Snapshots of the Team 2's interaction

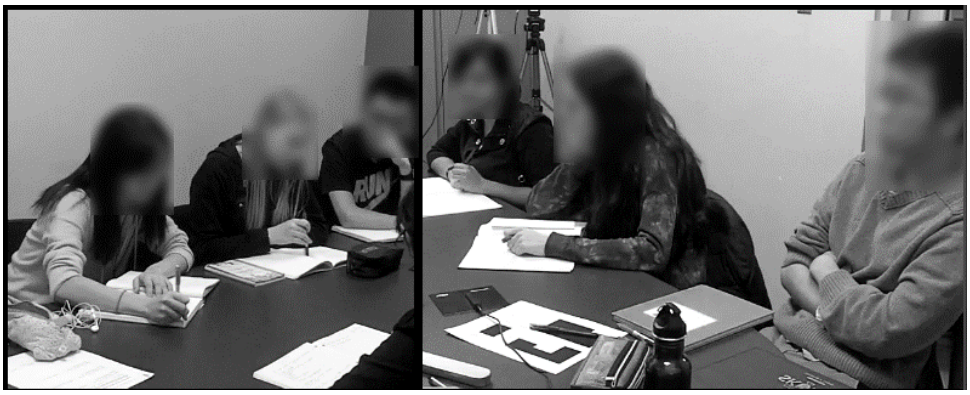


Figure D-1: Meghan introduces the discussion topic for the interaction. Most team members are recording the previous decision in their engineering notebooks, while Wu sits back reflectively. (Also Figure 5-3)

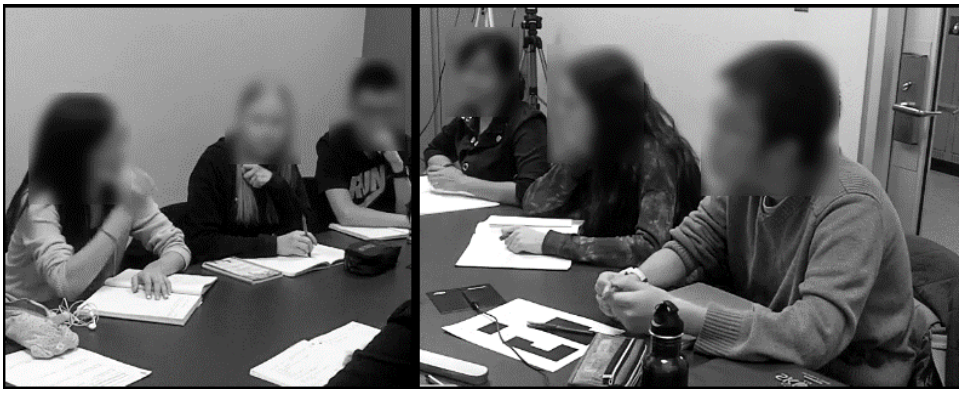


Figure D-2: After the idea of using Prezi for the discussion has been introduced, Meghan asks who on the team knows how to use Prezi. Zoya, and Yin seated at Meghan's right respond that they have used it before.

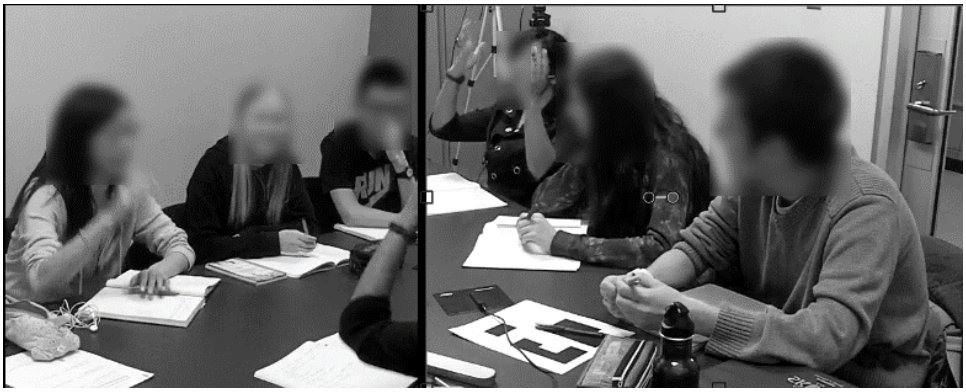


Figure D-3: Analyn demonstrates visually how Prezi makes her feel. She moves her hands around as though they are moving along the track of a roller coaster as her head follows the same path. All team members look on to see her movement.

Figure D-4: Wu presents the idea of using a demonstration during their presentation. As Analyn does not normally have direct eye contact she leans in to see Wu while he presents his idea. Meghan and Yin also turn their focus to Wu who is seated at their left. (Also Figure 5-4)

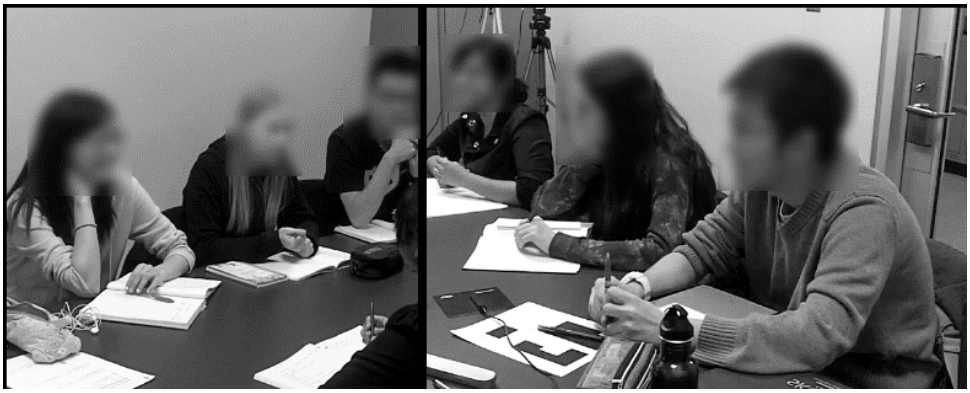


Figure D-5: Analyn presents the idea of using the team's invitation cards [possibly a component of something they had developed together] and everyone laughs and smiles at the idea. While it is not clear verbally in the transcript, the communal laughter demonstrates a shared meaning of the invitation cards that does not need to be vocalized.

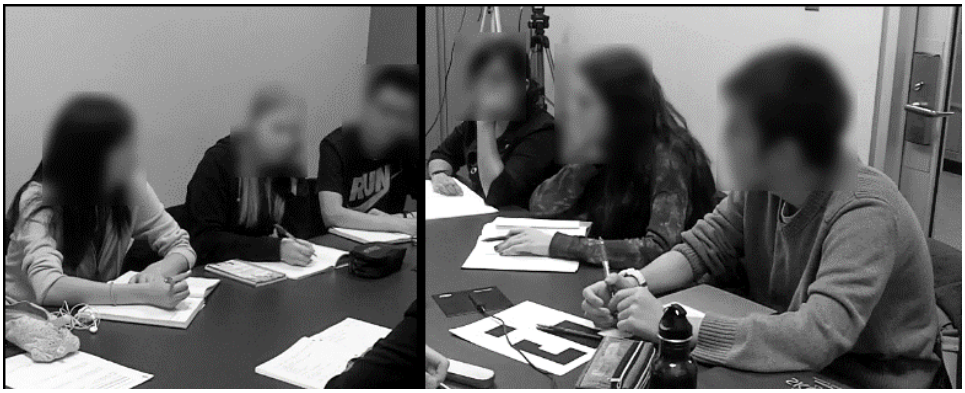


Figure D-6: The team decides to move forward with Prezi as their visual aids medium. The team members grasp their pens and record the team's decision in their engineering notebooks.