Framing goals for argumentation discussions: Individual versus communal understanding

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Framing goals for argumentation discussions: Individual versus communal understanding

Science education has long encompassed students memorizing facts and ideas, and carrying out prefabricated experiments (Osborne, 2010). This depiction of science learning omits students participating in construction and critique, social elements that are fundamental to science (Ford, 2008). Recent standards (NGSS Lead States, 2013) argue for a shift away from passive student roles, contending that students ought to engage in science practices to develop and refine their own understandings of the natural world. Argumentation, one of the science practices, requires that students take on new roles in the classroom as they use evidence to construct, evaluate and revise claims about scientific phenomena (Berland, McNeill, Pelletier & Krajcik, 2017). One way students develop a sense of what they should accomplish, and how, when they partake in argumentation is by how the teacher frames the argumentation activity (Berland & Hammer, 2012). However, variations in framing can lead to students developing, and carrying out, different understandings of their expectations and the goals of argumentation. Thus, in this study we examine how two teachers (Ms. Ransom and Mr. McDonald; all names are pseudonyms) frame a particular argumentation task called a science seminar, focusing on how their framing aligns with student engagement in this science practice. Specifically, this work was guided by the following research questions:

1. How did Ms. Ransom and Mr. McDonald convey the participation framework that would inform the science seminar activity?
2. How does the teachers' framing during the introduction align with students' engagement during the science seminar?

Theoretical Framework

Argumentation in the Science Classroom

Argumentation plays an important epistemic role in how knowledge about the natural world, be it through explanations or models, is generated and revised over time (Osborne, 2010). Our work conceptualizes this science practice as including the dialogic interactions students are involved in (i.e., questioning, critiquing, and building on other's ideas) while they construct and debate the structural components of an argument (i.e., claim, evidence and reasoning) (Jiménez-Aleixandre & Erduran, 2008). The types of student-driven exchanges required by argumentation differ greatly from the interactions that occur in traditional classrooms. Thus, teachers are vital in cultivating a classroom in which argumentation is practiced (Sampson & Blanchard, 2012). Consequently, it is important that research examine the different ways that teachers foster a learning environment in which argumentation is successfully taken up.

Participation Frameworks for Argumentation

Prior research has found that the manner by which teachers frame argumentation tasks impacts how students understand and engage in this science practice (Berland & Hammer, 2012). One way to think about framing is through the notion of "participation frameworks" (Goffman, 1981). This concept is composed of two constructs: the actions individuals take during a particular type of activity, and the goals that drive the activity. It is important to consider teachers' framing of argumentation with respect to these constructs because this science practice encompasses new goals and interactional expectations for students in the classroom. As such, in this study we use the concepts embodied within participation frameworks (i.e., actions and goals) to examine the relationship between the language teachers use to frame a particular argumentation activity, and their students' subsequent engagement in this science practice.

Methodology

Curricular Context

This study took place during the pilot of a middle school science curriculum with a focus on argumentation. The curriculum concluded with an argumentation activity called a science seminar, a type of discussion in which students use evidence gathered during previous lessons to debate explanations to a question. To carry out the science seminar, students sat in two concentric semi-circles; the inner group, Group 1, debated the question while the outer group, Group 2, listened and took notes. Halfway through class time the two groups switched roles. Throughout, students – and not the teacher – were responsible for driving the discussion, working together to build the strongest explanation for the seminar's guiding question.

Data Collection and Analysis

The data for this study included transcripts of science seminars, and of teachers' introductions to this argumentation activity, from the classrooms of two teachers who piloted the curriculum. Ms. Ransom and Mr. McDonald taught 7th grade science in the same middle school. These teachers behaved similarly during the science seminar lesson: they mostly spoke during the introduction to the activity, and sat towards the back of the classroom speaking very little during students' discussions.

The analysis entailed an exploratory sequential design (Creswell, Piano Clark, Gutmann, & Hanson, 2003). Specifically, for this mixed-methods approach we first used social network analysis (SNA) to examine the interactional patterns across the structural and dialogic aspects of argumentation during the science seminars (i.e., who provided evidence to whom, or who received questions). Then, we employed multiple case study methodology (Stake, 2000) to make sense of the ways that Ms. Ransom and Mr. McDonald framed this argumentation activity. We subsequently examined how the teachers' framing aligned with their students' engagement during the science seminar. We now briefly discuss these analytic techniques.

SNA is a methodology that can make visible patterns of social relations between actors in a network (Scott, 1991), such as the teacher and students in a classroom. For this study, we quantified and visualized how classroom members engaged in the structural and dialogic aspects of argumentation. To do so, we first broke the transcripts from the four groups' science seminars (two from each teacher's class) into utterances. Two raters then independently coded 20% of each transcript using coding schemes that captured elements of an argument's structure (is the utterance a claim, evidence, or reasoning?) and dialogic interactions between individuals (does the utterance capture students questioning, critiquing or building off others' ideas?), obtaining 96.9% inter-rater reliability. Then, we determined the ties between turns of talk (e.g., who was questioning whom?). With this information, we created valued, directed matrices; "valued" refers to the extent to which a tie between two actors did or did not exist (e.g., 4 = 4 utterances made toward a person, 0 = no utterances made toward a person), while "directed" refers to whether the comment was reciprocated. The matrix's dimensions included the students in a seminar group and the teacher, with each actor represented by both a row and column. To carry out the SNA, these matrices were then input into UCINET 6 software (Borgatti, Everett & Freeman, 2006). This software program includes NetDraw, a visualization tool that creates sociograms, which we used to examine interactional patterns in the argumentation across the seminars. Noticing variation in how groups engaged in the various aspects of argumentation, we then used multiple case study methodology to examine how the teachers framed the science seminar activity to their students.

To create the two cases, one around each teacher's classroom, transcripts of the introductions to the science seminar activity were analyzed. We used open coding (Marshall & Rossman, 1999) to investigate how Ms. Ransom and Mr. McDonald used recurring language to convey the particularities of engaging in a science seminar to their students. Specifically, the constructs that make up a participation framework (i.e., actions and goals) helped guide the analysis of the language teachers used to frame this task. We read through the transcripts many times making notes and highlighting instances when each teacher articulated the expected actions for the science seminar, as well as the purpose of the argumentation discussion. This analysis concentrated on teachers' framing during the introductions to the science seminar because the teachers did the most work setting up the argumentation activity during this portion of the lesson; Ms. Ransom and Mr. McDonald spoke very little throughout their students' actual discussions. To find patterns across the classrooms, we then grouped each of the highlighted words or phrases by teacher, and construct (e.g., all instances when Ms. Ransom articulated an expected action). Both readers made notes of these trends, and afterwards we compared our notes of the actions and goals the teachers described. This iterative process resulted in final trends that described how the two teachers framed the argumentation activity to their students. These trends were then compared to each classroom's sociograms across the structural and dialogic components of argumentation.

Findings

This section is organized as case studies for the two classes. To contextualize the findings, for each class we first describe the progression of the lesson as well as the classroom the day of the science seminar. This description is meant to provide a clear image of how the lesson went, what the classroom physically looked like during the teacher's introduction, and how the teacher and students were arranged during this time. Then, we tease apart the participation framework that the teacher articulated: first, discussing the language used to convey *what* students should do in the argumentation task (i.e., the actions), and then the language used to express *why* students were engaging in the science seminar (i.e., the goals). We then examine relevant sociograms from the social network analysis, which offer insight into how the participation framework expressed by the teacher related to students' actual engagement during the argumentation activity. We conclude with a summary of how the science seminar activity was framed across the two classrooms.

Case 1: Ms. Ransom's Class

Contextualizing the Science Seminar Lesson

As students entered Ms. Ransom's classroom on the day of the science seminar lesson, they picked up their science notebooks out of a bin located in the back of the room and sat down. Lab tables, which were normally placed in rows facing the front of the class, were moved to the edges of the room, and seats were arranged into two semi-concentric circles that were directed towards the whiteboard at the front of the room. Once all students were seated, Ms. Ransom welcomed them to class and asked students to complete the warm-up that was written on the board. The warm-up asked students to consider which claim they felt answered the science seminar's guiding question – When a person trains to become an athlete, how does her body change to become better at releasing energy? Students independently worked on the warm-up while the teacher circulated the classroom and answered questions. After a few minutes, Ms. Ransom called for attention and gave students a preparatory task for the seminar ("…write the claim you choose to work with during the science seminar… And then you'll wanna list any evidence that you decide you should support your claim with").

After about five minutes, Ms. Ransom provided students with time to practice reading aloud their arguments to a partner so that each had the opportunity to "hear what your claim sounds like and what your pieces of evidence sound like." The partner not speaking was told to "just listen this time though and maybe give them a point of suggestion or not." Before students had an opportunity to practice, a student asked if they would "be up there alone or with a partner" during the science seminar. This prompted Ms. Ransom to provide students with a brief description of the science seminar activity. Then, students practiced reading their arguments aloud as the teacher walked around the room and listened to a few pairs talk. Following this pair practice, the teacher assigned students to particular seats for the science seminar (i.e., who would sit in the inner semi-circle, Group 1, and outer semi-circle, Group 2, during the first round). After students re-arranged themselves in their new seats, Ms. Ransom began explaining the science seminar activity to students in more detail. During this time, the teacher stood at the front of the classroom and projected images onto the whiteboard. These images included a picture of students engaged in a science seminar, a list of student expectations, and data from one of the studies students examined prior to the lesson.

During both groups' science seminars, Ms. Ransom physically placed herself away from students, sitting on one of the lab tables located along the side of the classroom. As students engaged in the argumentation discussion the teacher took notes on a clipboard and rarely interjected. When Ms. Ransom did speak, it tended to be to inform students of the time they had left in the seminar. Using the classroom context just described as a frame of reference, we now discuss the participation framework that Ms. Ransom articulated for the science seminar activity.

Participation Framework: Student Actions During the Science Seminar

During Ms. Ransom's introduction, the teacher emphasized that students should drive the argumentation discussions. Although Ms. Ransom explained that students, and not the teacher, would be directing the science seminar activity, related exchanges between the teacher and her students suggested that students were seeking further clarification about their roles at first. For instance, the interaction in Table 1 took place after Ms. Ransom provided instructions for the pair practice. As seen by this exchange, the student expressed a lack of clarity as to his role during the science seminar. Both of the student's initial questions appear to map onto activities students are more familiar with: giving a class presentation ("Are we gonna be up there alone or with a partner?") or turn-taking to share ideas ("So are we gonna read one by one?"). Ms. Ransom responded by providing a general description of what the science seminar would entail ("…the people in the inner circle are gonna be the ones who start the talking. People on the outside are just gonna be doing all the listening"). In this response, the teacher explained that only the students sitting in the inner semi-circle would talk, and that all students would have the opportunity to experience that role. Ms. Ransom did not yet say what she would do during the activity. Yet, she used a passive construction to implicitly indicate that she did not intend to partake in the students' conversation ("I'm just gonna let you guys start talking about the question"). However, this message did suggest that the teacher ultimately held the power in the classroom and during this discussion. This is particularly evident in her use of the phrase "let you," which implied that students could speak to one another because they had the teacher's permission to do so.

Table 1: Ms. Ransom's initial description of student roles during the science seminar

Speaker	Quote
Student	Are we gonna be up there alone or with a partner?
Ms. Ransom	Ok. So, this is the tough thing. It's hard for you to get that. Ummm you'll notice that you guys, without me giving the instructions, so you notice that you guys are sitting in uh we have two sort of semi-circles set up. So, what will happen, and I'll give you more details in in a minute, is that part one of the science seminar, I'm gonna take about half of you, well, roughly half of you, put you in the inner circle the inner semi-circle, and the rest will sit on the outside. And the people in the inner circle are gonna be the ones who start the talking. People on the outside are just gonna be doing all the listening. Ummm and then halfway through, about ten minutes into it, we're gonna flip-flop. And so, the people on the outside are gonna have a chance to speak and people on the inside are gonna have a chance to just listen. Okay. Does that help you?
Student	So, are we gonna read one by one?
Ms. Ransom	Ummm not necessarily. I'm just gonna let you guys start talking about [points to the whiteboard] the question.
Student	So, it's like one big group?
Ms. Ransom	Yes.

Later during the introduction, Ms. Ransom's language conveyed a clearer message about students directing the argumentation activity. For example, after assigning students to be in Group 1 or Group 2 Ms. Ransom explained, "During the seminar, you'll be talking to one another, not to me. Students will run the conversation. That's you guys." By adding the clause "not to me" Ms. Ransom confirmed that students would be debating the guiding question with their peers, not presenting their claims to the teacher. A few minutes later, she clarified:

> *So, you guys run the conversation. But my role is, I'm gonna start it off, just get you going, and offer prompts if needed. As much as possible, I want you to run the discussion. So, it's ok if things are quiet for a few minutes and you're just sort of sitting there, looking at each other. It's ok while you think about your ideas. It's your time to direct the conversation and share your expertise about this topic.*

Here, Ms. Ransom expressed that she wanted students to carry out the seminar and make the argumentation discussion their own, and that she would interject only if necessary.

Ms. Ransom continued to communicate this message throughout the introduction to the science seminar. The teacher rarely spoke throughout her students' seminars; indeed, her contribution at the beginning of Group 1's discussion served to redirect a student who engaged in a more traditional teacher-student dynamic (see Table 2). The interaction in Table 2 captures this student's uncertainty with his role as he shared his claim about how training changes an athlete's body to get better at releasing energy. Although this transcript demonstrates the tension some students experienced taking ownership of the seminar, Ms. Ransom's language and gestures illustrate how she reminded students that they need not turn to her for guidance or approval ("you guys are in charge" and "It's up to you").

Table 2: Reminder by Ms. Ransom of seminar being student led

Speaker	Quote
Student	[Turns away from classmates and faces the teacher] Can I just do it?
Ms. Ransom	Yup. You guys are in charge.
Student	[Reads from notebook] Athletes can create more mitochondria in their body to release more energy. Oh yeah, [faces the teacher] can I do the evidence?
Ms. Ransom	[Gestures toward other students with hand] Please. It's up to you.

Despite some students' initial struggle with driving the science seminar, both of the argumentation discussions in Ms. Ransom's class comprised mostly of student talk. Specifically, student utterances made up 83.9% of Group 1 and 90.8% of Group 2's science seminars. As seen through the sociograms in Figure 1, all students engaged in the science seminar activity to some extent either by talking and/or by being talked to during the argumentation discussion. For Group 1 the smallest student node (the blue diamonds) was sized as one, which means all students contributed at least one utterance during the science seminar. During Group 2's seminar, there were a few students (Students 6 and 7) who did not verbally participate, although remarks were directed at them. Additionally, as indicated by the variation in node size, there appeared to be certain students who dominated the argumentation discussion in both groups (e.g., Students 3, 4, 5 and 7 in Group 1, and Students 3, 4, 5, 8, 9 and 10 in Group 2).

When comparing Ms. Ransom's node (the red circle) in both sociograms, it becomes evident that the teacher did speak more during Group 1's seminar (26 utterances) than during Group 2's seminar (16 utterances). However, many of these instances were similar in nature to the example shown in Table 2 in which the students looked to the teacher for permission to participate. It is also important to note that, although students did direct many comments to their peers both sociograms indicate that students spoke to the teacher as well. This may capture the tension students initially felt driving the argumentation discussion and directing conversation to other students, instead of to the teacher. Also, the fewer ties to the teacher during Group 2's seminar may be a reflection of these students having had the opportunity to see and learn from their peers in Group 1 as they engaged in the argumentation activity.

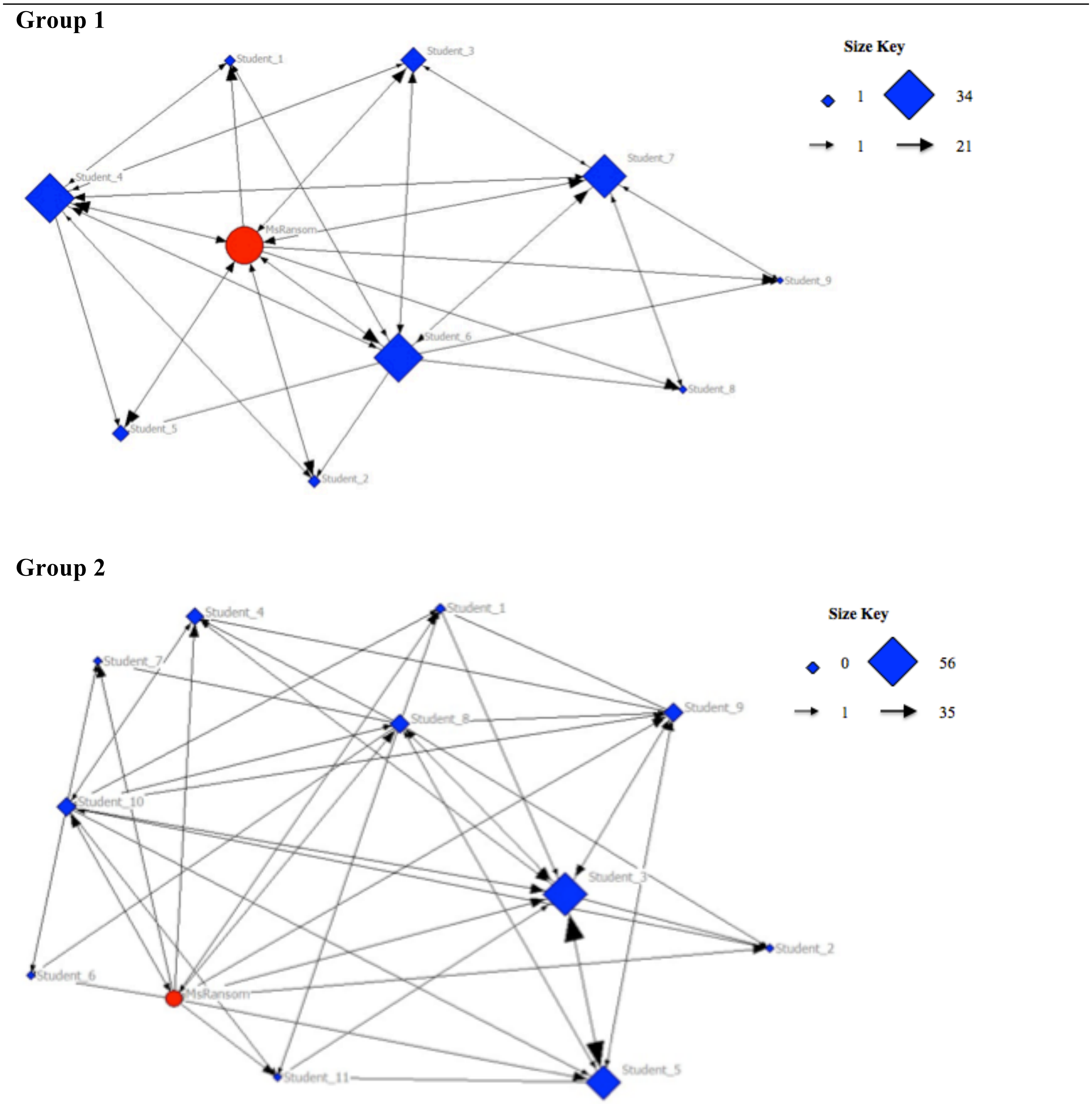


Figure 1: Sociograms of general participation in Ms. Ransom's class

Participation Framework: Science Seminar Goals

There were a few instances during the introduction to the science seminar in which Ms. Ransom explained *why* students were engaging in the argumentation discussion. When she touched upon this idea, the teacher focused on the ways that interactions during the seminar could improve students' understanding of the topic being debated. For instance, while introducing the activity she explained, "The purpose of the science seminar is to use everyone's knowledge to come to a deeper understanding of something." A few moments later, Ms. Ransom added, "During a science seminar you have a chance to learn something new and change or build on your own ideas by listening to what others have to say." The teacher's explanation encouraged students to pay attention to their peers' comments during the discussion, and described that doing so would result in their learning from each other. Ms. Ransom later repeated this sentiment when she said, "The goal here is to work together to better understand possible answers to this [science seminar's guiding] question". While Ms. Ransom noted that student interactions could support learning, her language tended to focus on the evolution of each student's individual understanding of the topic being debated (i.e., "your *own* ideas"), as opposed to a general understanding shared by all members of the class.

Ms. Ransom reiterated this individualistic goal a few minutes later, when a student asked about the ways that they could respond to their peers' ideas (see Table 3). Ms. Ransom's response shows that she supported students adding onto, and evaluating, their classmates' arguments. Yet, the reason the teacher urged them doing so was that these types of interactions would enable each student to improve their own argument (i.e., "…bring in new ideas, review, adapt, and change what *your* thoughts are.").

Table 3: Ms. Ransom reiterating individual understanding

Speaker	Quote
Student	Ummm well, if we're not in the same group as like ummm like someone who makes a point, I'm listening and they're talking, like the next time when we come in are we allowed to like add on to their point or like go against it?
Ms. Ransom	Absolutely.
Student	Okay.
Ms. Ransom	That's the whole point of doing this, is to bring in new ideas, review, adapt, and change what your thoughts are. This is a moving system here. It's not stationary. What you have written on the paper is not, you know, you're not gonna get a stamp on it. This is ummm you're adapting right now.

Figure 2 summarizes how Ms. Ransom framed the goal for the science seminar. The side of Figure 2 labeled "The actions" captures how each student was expected to bring his or her own idea into the debate to share and discuss with others; the various shapes represent students' different ideas.

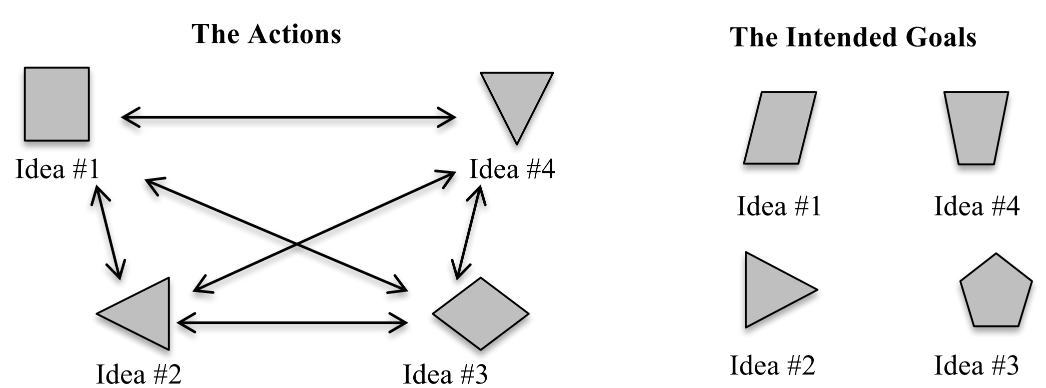


Figure 2: Individual understanding emphasized in Ms. Ransom's classroom

The altered shapes on side of Figure 2 labeled "the intended goals" illustrates how each student's individual ideas were to be adjusted and revised based on what they had learned from others during the discussion. Ms. Ransom encouraged interactions amongst students, noting that "everyone's knowledge" would enable students to develop a "deeper understanding" of the topic being debated, which is illustrated by the arrows connecting students' ideas. However, Ms. Ransom's emphasis was on each student's individual understanding. For example, she said, "…you have a chance to learn something new and change or build on your *own* ideas" and "That's the whole point of doing this, is to bring in new ideas, review, adapt, and change what *your* thoughts are". Thus, the activity was framed as supportive of individual learning; a particular student's understanding could be altered as a result of an interaction during the seminar. Also, because the teacher's language stressed that students would take up different ideas from these interactions (that would subsequently impact their initial thinking), there are multiple final ideas possible on "The Intended Goals" side of the figure.

The data thus indicate that Ms. Ransom used language to frame a particular goal for students during the science seminar: *interact with peers to learn new ideas, which might possibly result in revisions to their original arguments.* We now describe Mr. McDonald's framing of the science seminar activity; although similar to Ms. Ransom's regarding the actions students were expected to engage in, Mr. McDonald's was different in terms of the goals for the argumentation activity. As we discuss in the Summary section, there is alignment between these varying goals, and the different ways students in these classrooms partook in the science seminar.

Case 2: Mr. McDonald's Class

Contextualizing the Science Seminar Lesson

As the bell rang, signaling the beginning of class, students entered Mr. McDonald's classroom and took a seat. Without direction from the teacher, students sat down in chairs that were arranged into two semi-concentric circles and opened up their science notebooks. The seating arrangement for the science seminar faced the whiteboard at the front of the room, and the lab tables (where students typically worked) were moved to one side of the classroom. Two sign language interpreters (SLI) that translated for three students who were deaf or hard of hearing sat down near the science seminar arrangement – one at the front of the classroom near the whiteboard, and the other at the back of the room. As the class started, Mr. McDonald requested that students move "into the inner or the outer circle" and clarified that the initial seating was not final, as "you'll get a chance to be in the inner circle and in the outer circle." Once students rearranged themselves, Mr. McDonald explained that they would be "discussing the following question today…when a person trains to become an athlete, how does the body change to become better at releasing energy?"

Before getting into any details of what students would be doing during the seminar, Mr. McDonald asked if "anybody had an experience like this where you've been in a seminar and you've been kinda sitting in an arrangement like this?" Three students replied, mentioning, "it was not exactly a seminar, but it was like this fishbowl discussion;" "I've been at a conference table;" and "last year, in Social Studies, we did an argument thing with all the class." The teacher repeated each student's contributions after they shared, and then related those experiences to a science seminar. The teacher then directed students to complete the warm-up activity, explaining that they would "have some time to write down some notes for ourselves that we wanna bring up during the actual seminar portion." Specifically, he asked students to "look back at page forty-six, at the claims you came up with based on the studies" in order to "figure out which claim you would like to umm present today." Students worked independently on the warm-up while the teacher worked individually with a student who had been absent the previous day, so that she would be prepared to participate.

After a few minutes, Mr. McDonald brought the class back together and began discussing the goals for the science seminar activity. He acknowledged that this particular argumentation activity might be a new experience for students, and thus he was "not gonna start you in a whole group," but instead would first have students "share ideas with a partner." Before the partner practice, Mr. McDonald gave students about six minutes to engage in a preparatory task. He said, "Take a look at the claim you came up with yesterday, you can refer back to the study you read, and write down your claim again, and then you wanna write down some evidence." Then students engaged in the pair practice; as students talked to a peer, the teacher circulated the classroom attending to student questions. Following the pair practice, the teacher transitioned to the science seminar, explaining the logistics for the argumentation task ("how things are going to happen in class today"). As Mr. McDonald described the science seminar, he projected a few images onto the whiteboard including a list of student expectations and a picture of students carrying out a science seminar. The teacher also pointed to and read aloud sentence starters he had written out on a poster, which he said students could reference "if you don't know how to enter the conversation."

During both groups' argumentation discussions, the teacher sat at the back of the classroom, took notes on a clipboard, and spoke only to inform students of the time remaining in the seminar. With this classroom context in mind, we now turn to how Mr. McDonald framed the participation framework for the science seminar, starting first with the student actions he articulated and then moving onto the goals for the activity.

Participation framework – Student Actions During the Science Seminar

Throughout the introduction to the science seminar, the action Mr. McDonald emphasized was that students should drive the discussion. For instance, preceding the science seminar Mr. McDonald often used language to indicate to students that they would be carrying out the argumentation activity, and that he would not be involved. For instance, he explained that the science seminar would allow students to "learn a little more from each other without the interference of well me really." He expanded on this idea, saying:

> *My role today is gonna be pretty limited. You are responsible for running this discussion, you're responsible for the exchange of ideas, you're responsible for your own learning today.*

Here, Mr. McDonald expressed how students would be in charge of conducting the science seminar ("you are responsible for running this discussion") and that the teacher's part would be small ("My role today is gonna be pretty limited."). Furthermore, his repeated use of the phrase "you are responsible" continued to place emphasis on students' roles during this activity.

Mr. McDonald also acknowledged that this type of argumentation task was different for students, especially in terms of their driving it. For example, he said "it's probably gonna feel a little weird, not having someone directing you what to do with what to say and when to say it". Such language called attention to the distinction between this science seminar activity, and previous experiences students might have had in science classes. During the introduction, a few students demonstrated uneasiness with this amount of responsibility (see Table 4). As illustrated in this excerpt, in making sense of how the seminar would run, students mapped the argumentation discussion onto activities with which they were more familiar.

Table 4: Mr. McDonald stressing a student-driven discussion

Speaker	Quote
Student 1	When you're discussing with like your group or like the inner circle and the outer circle, umm will there be like raising hands and like talking or –
Mr. McDonald	So, that's up to you. I'm not running the show.
Student 2	Ummm how are we just gonna decide who goes? Who gets to talk first and like go after?"
Mr. McDonald	You're running the show. Number One, the number one expectation today, you are running the conversation. You're running the conversation. I'm not running the conversation. I'm not picking on people to respond to questions. It is solely up to you as the inner circle.

For instance, Student 1's question ("will there be like raising hands and like talking") aligns with the expectations of a traditional initiate-response-evaluate (IRE) conversation, in which students take turns speaking and only do so when given permission by someone with more authority, which is usually the teacher. Even after Mr. McDonald continued to articulate the non-traditional role he intended to take ("So, that's up to you. I'm not running the show."), and students kept conveying discomfort ("Ummm how are we just gonna decide who goes? Who gets to talk first and like go after?"), the teacher persisted to express and place responsibility for the discussion on students (e.g., "you're running the show," "I'm not running the conversation. I'm not picking on people to respond to question").

Furthermore, Mr. McDonald touched on how this particular argumentation activity would enable students to engage in a discussion with peers. For example, he later said "I'm expecting that you respond to one another. This is an opportunity to have a conversation, not go around in the circle and just state claims. It's a real conversation". The teacher thus used language to push back on a seminar encompassing typical turn-taking interactions. Throughout the introduction, Mr. McDonald continued using language both to liken the science seminar to an organic discussion amongst peers, and to acknowledge that students might feel odd taking the reins. For example, just before Group 1 started their seminar, the teacher mentioned, "It might be a little rough at the beginning, but once you get into it, feel free to have that free-flowing conversation." At other times, the teacher mentioned his limited role in the seminar, but let students know that if necessary he would interject to guide them. "If you get stuck in the conversation, that's okay," Mr. McDonald told the class, explaining that students would not engage in this task without the necessary supports:

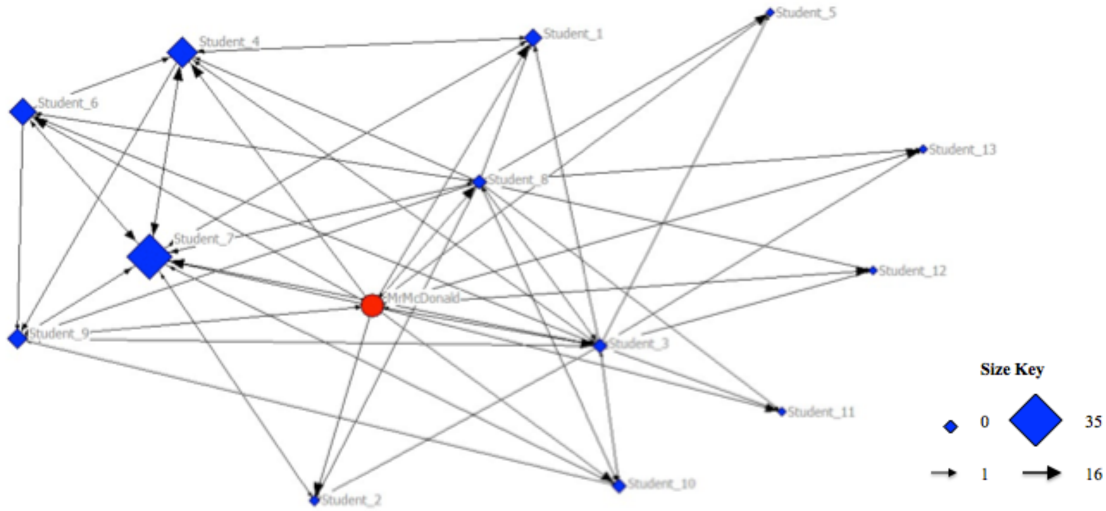
> *That's what I'm here for. I might do a little prompting to say, "Hey, we're a little off topic right now. Let's get back on the train tracks." But otherwise, I'm pretty much going to be out of your hair today.*

Similar to earlier in the introduction, Mr. McDonald's language took an informal tone as he removed himself from the activity (e.g., "…without the interference of well me really" and "I'm pretty much going to be out of your hair today"). Such language moves served to place the teacher on equal footing with students, further enabling them to drive the science seminar.

Despite the hesitancy some students expressed carrying out the science seminar activity, both argumentation discussions in Mr. McDonald's class included mostly student talk (see sociograms in Figure 3). Specifically, student utterances made up 88.1% of Group 1 and 88.5%

of Group 2's seminars. Across both groups, all students engaged in the science seminar in some capacity; either they talked to a peer, or another classroom member directed a remark at them.

Group 1



Group 2

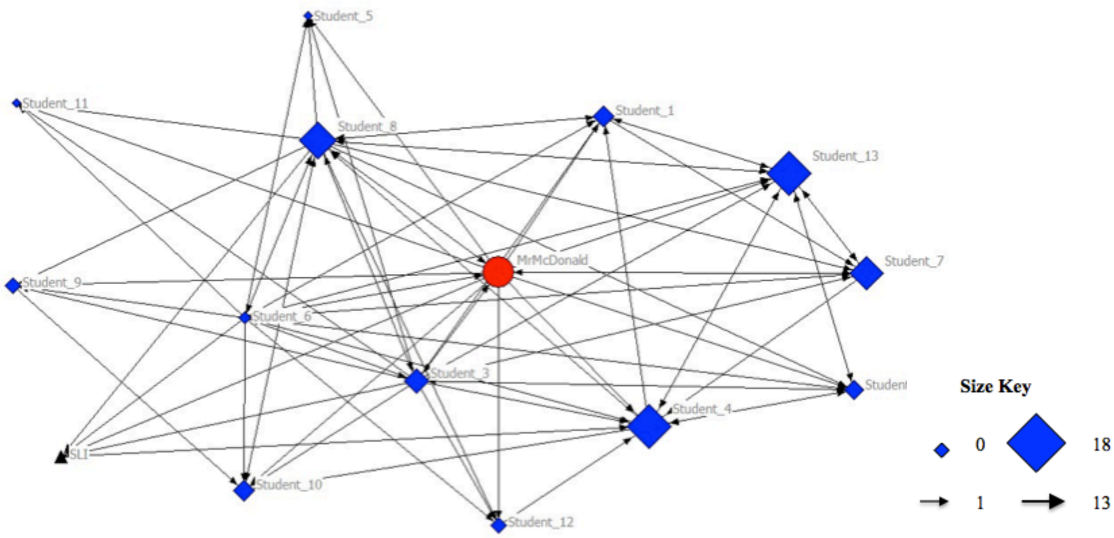


Figure 3: Sociograms of general participation in Mr. McDonald's class

More individual students spoke during Group 1's seminar than during Group 2's seminar. This is evidenced by the largest student node including 35 utterances for the first discussion, compared to 18 utterances for the second discussion (see Size Key in Figure 3). Node size also indicates that across both seminars particular students participated most during the argumentation discussion (Students 4, 6, 7 and 9 in Group 1, and Students 4, 7, 8 and 13 in Group 2). The size of Mr. McDonald's node indicates that he spoke slightly more during the first seminar (16 utterances) than during the second (13 utterances). However, all of the teacher's utterances were managerial in nature (i.e., informing students how much time was left in the activity, or wrapping up the activity and bringing the class to a close). Additionally, although students did direct comments toward their peers (captured by the ties between students), they also talked to the teacher. Specifically, 3 out of 13 students in Group 1 made a comment to Mr. McDonald, while 4 out of 13 students in Group 2 directed an utterance at the teacher. Similar to Ms. Ransom's class, this may have been a result of the initial discomfort students felt driving the argumentation discussion.

Participation Framework: Science Seminar Goals

Throughout the introduction to the science seminar, there were a few moments during which Mr. McDonald explained to students the purpose of engaging in this particular argumentation activity. When the teacher framed the goals for the seminar, he emphasized how the classroom members' joint understanding would be improved as a result of students working together and discussing the question (When a person trains to become an athlete, how does her body get better at releasing energy?). For example, prior to the pair practice Mr. McDonald said, "The goal for today really, and really the goal for any science seminar, is to share information with each other uh that's gonna help us deepen our understanding of a particular question that we're talking about." In this explanation, the teacher touched upon the ways that interactions amongst students could support the group's learning ("…share information with each other uh that's gonna help us deepen our understanding"). Mr. McDonald's use of the phrase "our understanding" specified that it was the class's communal learning that would be enhanced.

On multiple occasions during the introduction, the teacher reiterated this communal goal, emphasizing that the best way to achieve it was by students listening to their peers. For instance, he articulated that students ought to:

> *… be sharing some ideas with each other, uh some thoughts you had after reading some of those studies yesterday, some thoughts you have uh regarding some of the other evidence we've collected using the sim, and any other observations you've made throughout the unit to really kinda deepen our understanding.*

Here, Mr. McDonald clarified the various data sources that students could bring into the discussion. Implied here was that, since students had analyzed different studies prior to the day of the science seminar lesson, each student would contribute ideas and perspectives with which others were unfamiliar. This aligns with the language the teacher used to highlight student actions during the science seminar, especially in terms of the activity being student-driven, which would subsequently support their learning (e.g., "You are responsible for running this discussion, you're responsible for the exchange of ideas").

Up to the point in which Group 1 commenced their discussion, Mr. McDonald continued to convey the goal of the seminar as students working together to develop a stronger and shared understanding of the scientific phenomenon being debated. For example, right before the start of the science seminar, the teacher reminded students of the following:

> *Our big goal today, work together to better understand possible answers to the question…That's our goal for today. We wanna increase our understanding of this question, we wanna deepen our understanding, we wanna learn from each other about this question.*

As illustrated by this excerpt, Mr. McDonald repeated the need for students to interact with their peers in order to improve the class's understanding of how athletic training changes a person's body. Again, the teacher used the phrase "our understanding," highlighting the ways that each student's engagement in the science seminar would lead to the group developing a more nuanced, collective comprehension of the topic of interest.

Figure 4 represents the goal for the science seminar that Mr. McDonald expressed throughout the introduction to the activity. Like Figure 2 (described in Ms. Ransom's case study), this figure also involves the actions and goals of the science seminar since both aspects inform the purpose of students carrying out the argumentation discussion. The side of Figure 4 labeled "The Actions" illustrates how the teacher emphasized the expectation of each student bringing in their own ideas of how the body changes with athletic training (e.g., "…evidence we've collected using the sim, and any other observations you've made throughout the unit…"), which they would share with peers during the seminar. This aspect of the goal is reflected in the different colored shapes being distributed amongst individuals. Yet, Mr. McDonald stressed that the reason students ought to engage in the science seminar was that it could improve everyone's communal understanding of the discussion topic (i.e., "*our* understanding of the question"). The side of Figure 4 labeled "The Intended Goals" represents this communal understanding, showing all classroom members developing one all-encompassing idea of the scientific phenomenon being debated that was built from everyone's contributions, but is also new in itself.

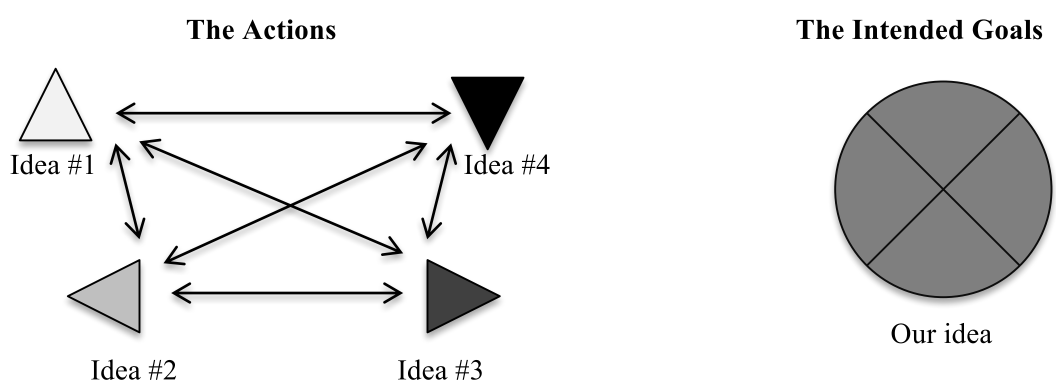


Figure 5.4: Communal understanding emphasized in Mr. McDonald's classroom

Moreover, although not explicitly stated, Mr. McDonald's framing implied that students' original arguments would change as a result of their interactions with other students that held other ideas.

Mr. McDonald conveyed a particular goal for students when participating in the science seminar – *interact with peers to share ideas, which results in the whole class developing a stronger, shared understanding of the scientific phenomenon*. In the following section, we discuss the similarities and differences between the two teachers' framing of the participation framework for the science seminar activity.

Summary

In this study, we explored the ways by which Ms. Ransom and Mr. McDonald's language during the introduction to the science seminar framed particular participation frameworks for this argumentation activity. As seen in Table 5 below, both teachers expected their students to interact with their peers while driving the science seminar. Demonstrated by the sociograms presented thus far, the ways students across both classrooms engaged in the activity aligned with this expectation. However, although both Ms. Ransom and Mr. McDonald promoted social interactions between students, the teachers gave different reasons for students to do so.

Table 5: Participation framework articulated by teachers during the introduction

	Student actions during the science seminar	Goals for the science seminar
Ms. Ransom	• Student driven discussion	• Individual construction and revision of argument
Mr. McDonald	• Student driven discussion	• Communal construction and revision of argument

Ms. Ransom explained that through these interactions, students could learn from their peers, which could result in each *individual* student revising their original argument. While Mr. McDonald also expressed that the seminar would result in revisions to students' initial ideas, he articulated that by working with peers and sharing ideas, classroom members would develop a *communal* understanding. Thus, the teachers described different goals for the seminar. This difference is interesting to consider when examining the sociograms for "building" that emerged from these classrooms argumentation discussions (see Figure 5).

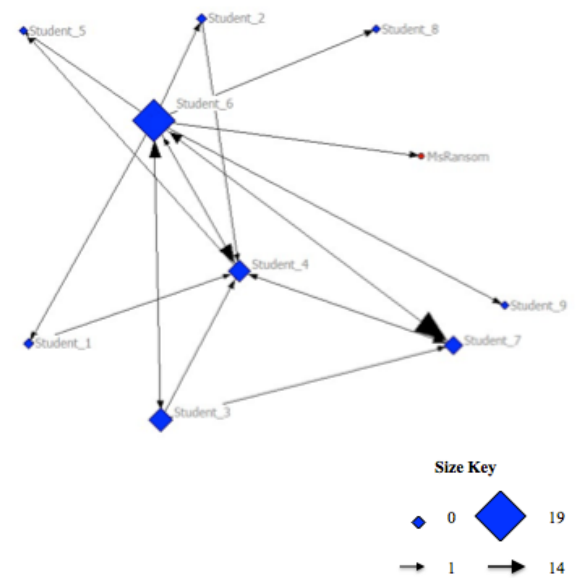
In both classrooms, students built on other's ideas during the science seminar activity. Specifically, in Ms. Ransom's class, 27.7% of Group 1 and 10.3% of Group 2's utterances included students recognizing some aspect of a previous contribution and utilizing it to further the discussion. Conversely, 62.7% of Group 1 and 62.8% of Group 2's utterances in Mr. McDonald's class were identified as "Building". Examining the sociograms for building in Figure 5 offers more insight into which individuals were engaged in this aspect of argumentation, and whose ideas they were adding onto.

The sociograms from Mr. McDonald's seminars show how his students built off more peers' ideas (as seen by the number of ties between students) in comparison to the sociograms from Ms. Ransom's seminars. Although a few students in Ms. Ransom's Group 1 also made numerous building ties, these were off comments made by three students (i.e., Students 4, 6 and 7). Students in Mr. McDonald's seminars however, built off the ideas of more students (i.e., namely, Students 1, 3, 4, 7, 8 and 9 in Group 1, and Students 1, 2, 3, 4, 7, 8, 10 and 13 in Group 2). Furthermore, by analyzing the size of nodes in the sociograms (see Size Keys in Figure 5), it becomes clear that more students in Mr. McDonald's class often engaged in this type of dialogic interaction. It is important to keep in mind the amount that each discussion was coded as "Building" (see percentages in previous paragraph), otherwise the patterns of the sociograms might give off the impression that the science seminars across these classrooms were very similar (e.g., Ms. Ransom's Group 1 and Mr. McDonald's Group 2), when they were not.

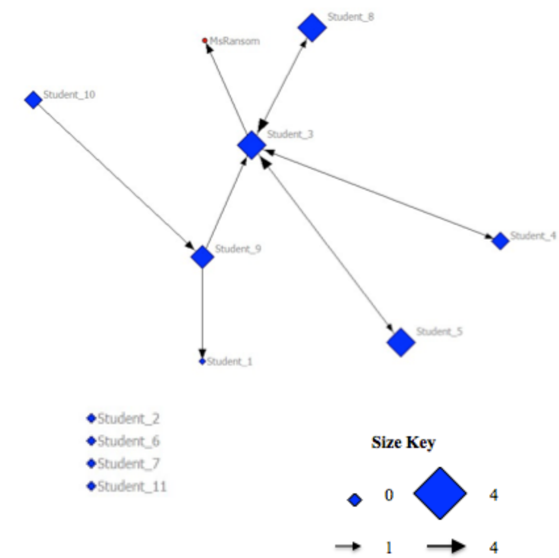
The manner by which students in these classes partook in the science seminar, especially in terms of interactions in which they built off each other's ideas, aligned with the goals the teachers emphasized. For instance, Ms. Ransom's framing of the goal highlighted the importance of students developing a stronger individual argument, informed by what they learned during this particular activity. However, Mr. McDonald's framing stressed a communal understanding. As illustrated in Figure 5, Mr. McDonald's articulation focused on students working to bring together different ideas, a purpose that would have more strongly encouraged students building off each other. Although both teachers were successful in supporting students in dialogic interactions, the articulated underlying goal for scientific argumentation was different. Consequently, there was variation in the types of student dialogic interactions, specifically in terms of students building on each other's ideas.

Ms. Ransom's Class

Group 1

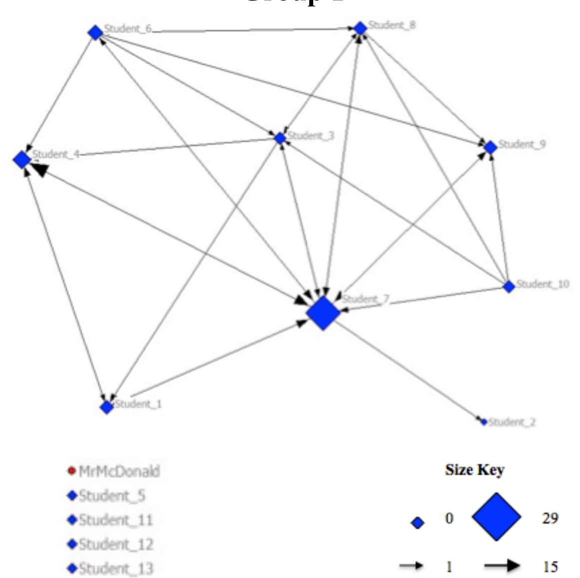


Group 2



Mr. McDonald's Class

Group 1



Group 2

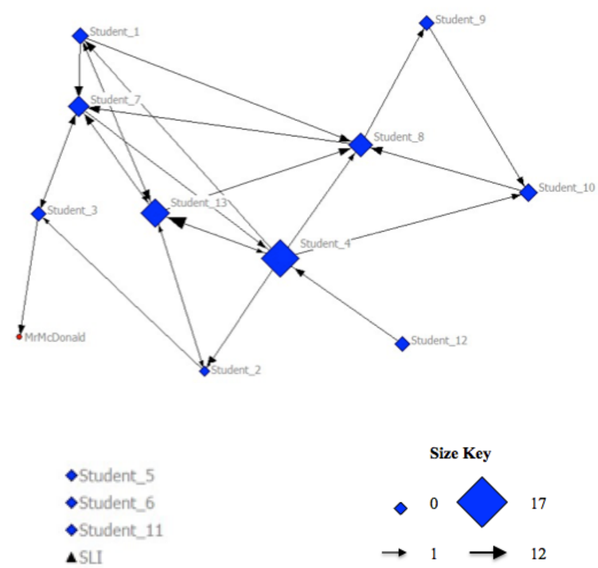


Figure 5: Sociograms of building across both classrooms

Discussion

Examining the manner by which Ms. Ransom and Mr. McDonald articulated the participation framework for the science seminar resulted in a deeper understanding of their student expectations and goals for the argumentation activity. While both teachers emphasized the importance of their students driving the conversation and interacting with peers, they highlighted different purposes for students doing so. These findings suggest the need to continue supporting teachers in developing and using rich instructional strategies to help students with the dialogic component of argumentation. Additionally, this work sheds light on the importance of how teachers frame the goals for student engagement in this science practice.

Teachers' Support for Dialogic Argumentation

Teachers play a vital role in argumentation being included in classroom instruction in part because their use of instructional strategies around this science practice impacts if and how it is integrated. For instance, the types of language supports employed by a middle school science teacher influenced her English-language learning students' successful engagement in argumentation (González-Howard, McNeill, Marco-Bujosa, Proctor, 2017). In terms of dialogic interactions, this teacher was observed modeling particular language expectations to help students interact with peers during an argumentation activity. In another study, Simon and colleagues (2006) worked with a group of twelve secondary science teachers, providing them with professional development workshops around argumentation, and examining the teachers' instructional strategies for this science practice as they implemented it into their classrooms. They found that teachers with lower quality instruction offered students with narrow definitions of argumentation, definitions that focused mainly on the structural features of an argument (e.g., justifying a claim with evidence). However, the teachers whose lessons included higher quality argumentation attended to the dialogic aspects of this science practice. Specifically, these teachers recognized different positions that students could take around an argument, and highlighted the importance of counterarguments.

The dialogic aspects of argumentation require a considerable shift in instruction for teachers, which may be why some teachers continue carrying out traditional forms of discourse (e.g., IRE) even when they believe they are authentically engaging their students in this science practice (Alozie, Moje & Krajcik, 2010). For instance, in a recent study, Marco-Bujosa and colleagues (2017) found that one teacher altered argumentation activities to make them more manageable – from whole class discussion to small group work, where students eventually reported out their thinking to the teacher. Yet, the teacher did not realize that this alteration made the activity more teacher-centered, and minimized opportunities for students to speak to peers. Given the difficulties that many teachers face around the dialogic components of argumentation, it is impressive that the students in this study successfully engaged in rich social interactions with peers. The participation frameworks articulated by Ms. Ransom and Mr. McDonald may be one reason for this success.

Through various actions teachers establish how students can interact with one another during classroom tasks (Mortimer & Scott, 2003). Prior work focused on the framing of whole class discussions found that teachers often reinforce interactions in which students direct their remarks to the teacher for evaluation (e.g., Pimentel & McNeill, 2013). However, Ms. Ransom and Mr. McDonald used multiple supports for student-driven interactions, and highlighted this element in their framing of the argumentation activity. For instance, Mr. McDonald said to students, "You're running the conversation. I'm not running the conversation." Like other researchers, our findings suggest that the manner by which teachers articulate student expectations for an argumentation task impacts the extent to which students directly interact with their peers' ideas. For example, Berland and Hammer (2012) found that when a teacher repeatedly framed an argumentation discussion as including the need for students to reach consensus, students drove the activity, compared their disparate understandings of the topic, and worked towards persuading their peers of the strongest argument. Thus, it might be important for teachers to say many times, and in numerous ways, that they expect students to drive argumentation discussions. Ms. Ransom was heard articulating this idea many times; for example, at one point she said, "As much as possible, I want you to run the discussion… It's your time to direct the conversation and share your expertise about this topic." Additionally, similar to the teacher in Berland and Hammer's (2012) study, both Ms. Ransom and Mr. McDonald physically removed themselves from the argumentation activity, which provided their students with another visual reminder that the teacher would not direct the discussion.

Furthermore, Mr. McDonald openly acknowledged that the science seminar experience would be new for students and that they might feel uncomfortable at first (e.g., "It might be a little rough at the beginning, but once you get into it, feel free to have that free-flowing conversation."). Such an approach might ease students as it helps them realize that the teacher is aware of the new roles they are all being expected to take. This openness from the teacher might ultimately support students in taking risks and trying new things with peers (e.g., questioning another student, or disagreeing with the interpretation of a piece of evidence). Also, Mr. McDonald's language frequently took on an informal tone when he described the science seminar task to students. For instance, at one point during the introduction he said, "I'm pretty much going to be out of your hair today." Using such an informal tone when he spoke to students likely emphasized the teacher's framing of the argumentation task as encompassing a partner participation structure (Tabak, 2002) – a type of participation structure that promotes a symmetrical relationship between the teacher and students, encouraging students to direct discussions while learning from peers.

Goals for Argumentation

Students engage in argumentation activities for particular purposes, whether they be to write persuasive arguments that explain some scientific phenomena, or engage in discussion with peers in order to learn from one another's ideas. Berland and Hammer (2012) have suggested that students' prior experiences with situations that they recognize as argumentation can be leveraged to support their learning of, and engagement in, this science practice. However, the classroom community's shared understanding of how success is defined (i.e., how they will know they achieved the goal of the argumentation task) will influence how the teacher and students engage in the science practice (Berland, 2011). It is important for the goals of argumentation to be perceived as different from those of typical science instruction so that students engage in "doing science" instead of "doing the lesson" (Jiménez-Aleixandre et al., 2000); the latter of which places authority on the teacher to direct students' learning. Research around the framing of argumentation has also described the ways that already established classroom practices influence the degree to which students take up particular goals (Berland, 2011). In other words, students may be more apt to work towards argumentation goals that align with familiar student expectations.

This study highlighted another important aspect of framing for argumentation tasks – the distinction between whether the goal is individual (one that each student should strive to achieve), or communal (whether it is a goal that the entire classroom community is working towards together). Depending on the focus of prior argumentation studies, researchers have examined both individual and communal goals with respect to students' engagement in this science practice. For instance, work around students' written arguments have explored the degree to which individual students attend to particular structural features, such as the quality of evidence (Sandoval & Millwood, 2005). However, studies focused on dialogic interactions, which tend to be in the context of an oral argumentation task, have looked into the ways that classroom communities jointly develop an understanding of scientific phenomena (e.g., Berland

& Reiser, 2011). This suggests that the different foci on goals may be related to the modality in which students' argumentation is being examined (i.e., written or spoken). However, in this study, which focused on an argumentation discussion, teachers were seen articulating both goals, and students appeared to also be working towards both means.

In the case of this study, both individual and communal goals resulted in the classrooms successfully engaging in this science practice, particularly in terms of students driving the discussion. However, there were differences in *how* students interacted with peers. Specifically, students in Mr. McDonald's class built on each other's ideas much more than students in Ms. Ransom's class. Recall that Mr. McDonald framed the seminar activity as encompassing a communal goal, while Ms. Ransom's language described an individual goal. The variation in how students talked to peers prompts the question – are there instances when one framing is more appropriate or productive than the other? For instance, if a teacher notices that her students are not adding onto others' arguments to further the discussion, perhaps it would be beneficial for her to frame the next argumentation task as communal, so that students are cued into building off other's ideas. This finding suggests that intentionally framing argumentation activities in particular ways (i.e., towards encompassing individual or communal goals) might be an instructional approach teachers use to support their students with particular aspects of this science practice.

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