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RESEARCH ARTICLE

Teachers' framing of argumentation goals: Working together to develop individual versus communal understanding

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Abstract
For students to meaningfully engage in science practices, substantive changes need to occur to deeply entrenched instructional approaches, particularly those related to classroom discourse. Because teachers are critical in establishing how students are permitted to interact in the classroom, it is imperative to examine their role in fostering learning environments in which students carry out science practices. This study explores how teachers describe, or frame, expectations for classroom discussions pertaining to the science practice of argumentation. Specifically, we use the theoretical lens of a participation framework to examine how teachers emphasize particular actions and goals for their students' argumentation. Multiple-case study methodology was used to explore the relationship between two middle school teachers' framing for argumentation, and their students' engagement in an argumentation discussion. Findings revealed that, through talk moves and physical actions, both teachers emphasized the importance of students driving the argumentation and interacting with peers, resulting in students engaging in various types of dialogic interactions. However, variation in the two teachers' language highlighted different purposes for students to do so. One teacher explained that through these interactions, students could learn from peers, which could result in each individual student revising their original argument. The other teacher articulated that by working with peers and sharing ideas, classroom members would develop a communal understanding. These distinct goals aligned with different patterns in students' argumentation discussion, particularly in relation to students building on each other's ideas, which occurred more frequently in the

classroom focused on communal understanding. The findings suggest the need to continue supporting teachers in developing and using rich instructional strategies to help students with dialogic interactions related to argumentation. This work also sheds light on the importance of how teachers frame the goals for student engagement in this science practice.

KEYWORDS

argumentation, framing, social network analysis

For the past several decades, the United States has undergone waves of science education reforms (e.g., National Science Education Standards; National Academy of Science, 1995). Grounded in research on how students learn, as well as the nature of the scientific discipline, these reforms build on findings that reveal the benefits of classroom environments in which students have opportunities to engage in inquiry (National Research Council (NRC), 2012). Yet, despite efforts made to incorporate inquiry into classrooms, most science instruction still includes students learning a set of predetermined information from their teacher and carrying out investigations and activities that reinforce this information (Schwarz, Passmore, & Reiser, 2017). A possible reason for the absence of authentic inquiry is the lack of clarity around what it means to learn science through this approach and how this type of learning requires that classroom members interact with one another in new ways (Osborne, 2014).

To support "learning environments that position students as sense-makers and 'doers' of science" (Miller, Manz, Russ, Stroupe, & Berland, 2018, p. 4), the National Research Council's *Framework for K-12 Science Education* (2012) and the Next Generation Science Standards (NGSS) (NGSS Lead States, 2013) emphasize student engagement in science practices, as opposed to inquiry more generally. By carrying out practices that mirror those used by the scientific community, students can develop an epistemic understanding of science—how evidence is used to construct, evaluate and revise knowledge about the natural world (Osborne, 2014). However, for students to meaningfully engage in science practices by taking on more active roles in their learning, substantive changes need to occur to deeply entrenched instructional approaches, including classroom discourse (Miller et al., 2018).

Much of the discourse in science classrooms is teacher-centered and authoritative in nature (Crawford, 2005). In particular, during whole-class discussions limited time is spent on the development of students' understandings and ideas; instead, emphasis is placed on their ability to retain and repeat information (Jiménez-Aleixandre, Bugallo Rodríguez, & Duschl, 2000). This approach to dialogue is commonly characterized as following an initiate–response–evaluate pattern (i.e., IRE; Mehan, 1979; Lemke, 1990). This pattern's structure limits the types of contributions students can make during discussions, as it serves mainly to help teachers assess students' content knowledge. As such, for students to have opportunities to do science through practices—collaborating with peers in scientific sensemaking instead of being taught science ideas by the teacher (Schwarz et al., 2017)—classroom discourse practices must change.

However, the implementation of new science reforms alone will not result in shifts to how talk occurs and is used in the classroom. Because teachers are critical in establishing how students are permitted to interact during discussions (Mortimer & Scott, 2003), it is imperative to examine their role in fostering learning environments in which students carry out science practices. This work specifically explores how teachers frame expectations for classroom discussions pertaining to the science practice of argumentation.

1 | THEORETICAL FRAMEWORK

1.1 | Shifts in classroom discourse practices

A major goal in science education has been to shift classroom dynamics so that students are active agents in knowledge construction, with science practices proposed as the means by which students should do this sensemaking work (NRC, 2012). Engaging in science practices inherently requires changes to how talk among classroom members is carried out and the purposes for which talk occurs (González-Howard, McNeill, Marco-Bujosa, & Proctor, 2017; Lee, Quinn, & Valdés, 2013). Unlike the teacher-dominated discourse that has traditionally permeated science classrooms (e.g., IRE, Mehan, 1979; Lemke, 1990), science practices encompass students socially interacting with peers to build and debate understandings about the natural world (Schwarz et al., 2017). For instance, in a study by Ford (2012), an argumentation discussion among high school students included them dually engaged in construction and critique around each other's ideas. Authentic inclusion of science practices also requires power dynamics in the classroom to change so that students are positioned as epistemic agents who hold responsibility in shaping their learning experiences (Miller et al., 2018). The practice of argumentation may be particularly difficult because it requires students to engage with multiple, often competing, ideas put forth by peers to progress the classroom community's understanding of a topic (Henderson, McNeill, González-Howard, Close, & Evans, 2018).

Challenging as it might be, argumentation plays an important epistemic role in how knowledge about the natural world is generated and revised over time (Osborne, 2010). As the NRC (2012) reports, "Learning to argue scientifically offers students not only an opportunity to use their scientific knowledge in justifying an explanation and in identifying the weaknesses in others' arguments but also to build their own knowledge and understanding" (p. 73). Building on prior argumentation work (e.g., Jiménez-Aleixandre & Erduran, 2008; McNeill, Lizotte, Krajcik, & Marx, 2006), we conceptualize this science practice as including the dialogic interactions students are involved in (e.g., questioning one another) while they construct and debate the structural components of an argument (e.g., evidence or reasoning). Because the types of student-driven exchanges required by argumentation differ greatly from the interactions that occur in traditional classrooms, teachers are vital in cultivating a classroom in which argumentation is practiced (Evagorou & Dillon, 2011; Sampson & Blanchard, 2012). Consequently, it is important that research examine the different ways that teachers cultivate a learning environment in which argumentation is successfully taken up. One approach toward this work is studying how teachers frame argumentation tasks.

1.2 | Participation frameworks

Research on classroom discourse has used the theoretical lens of a participation framework to make sense of these framing acts. This lens supports researchers in examining how academic tasks are coordinated, given social expectations of classroom behavior for accomplishing these tasks (O'Conner & Michaels, 1993). A participation framework is composed of two constructs: the actions individuals take during a particular type of activity, and the intended goals that drive the activity (Goffman, 1981; Goodwin, 1990). Within classrooms, participation frameworks are constructed and negotiated by the teacher and students through many means, including talk and gestures (O'Connor & Michaels, 1996). Thus, through the theoretical lens of a participation framework, one can examine how classroom tasks are framed, specifically in terms of the language used to promote certain actions and goals for the task.

For instance, during IRE-style discussions, classroom members' actions align with the goal of students reciting information back to the teacher. Lemke's (1990) work in science classrooms illustrated how interactional moves during a discussion cue those involved that a participation framework aligned with the IRE structure is being used. When a teacher asks a question and then pauses, the pause becomes a nonverbal sign that the teacher is bidding for students' responses and that they should raise their hands to be called on. The student called upon then answers the question, directing their response to the teacher. Then, when the teacher replies to a student's response with an evaluative remark (e.g., "very good"), it becomes clear that the purpose of the exchange is to ensure students know and can reiterate particular content.

It is important to consider how argumentation is framed through the theoretical lens of a participation framework because this science practice encompasses new interactional expectations and goals for students in the science classroom (Miller et al., 2018; NRC, 2012). Prior research has found that the manner in which teachers frame argumentation tasks impacts how students understand and engage in this science practice (Berland & Hammer, 2012). Some studies have highlighted the ways teachers make explicit to students the need to justify claims with evidence and scientific reasoning. For example, McNeill, González-Howard, Katsh-Singer, and Loper (2017) observed teachers taking time to discuss with students what counts as data in support of a claim, and then using prompts like, "What is your evidence?" to encourage students to attend to the structural aspects of this science practice. In another study by this research team, contextualized in a self-contained classroom of all English-learning students, the teacher used language supports, such as modeling expectations around the use of evidence, to encourage her students to justify their claims (González-Howard et al., 2017).

Other work has shown teachers emphasizing that students ought to work in coordination with peers while engaged in this sensemaking process. For example, Simon, Erduran, and Osborne (2006) highlighted the importance of teachers encouraging students to listen to each other, consider counterarguments and reflect on the argumentation process. Berland and Reiser (2009) examined goals related to participating in argumentation (namely, sensemaking, articulating, and persuading) in their study of three different middle school classrooms. Their observations led them to argue that attention to the goal of persuasion is important in classrooms, because of social expectations underlying argumentation. Thus, classrooms need to establish norms in which students are key participants of this discursive practice. However, to avoid "pseudoargumentation" (Berland & Hammer, 2012)—students carrying out rote actions associated with this science practice void of intentions related to meaning making and knowledge construction—it is critical to understand how to best support student learning about the epistemic role that argumentation plays in the discipline (Berland et al., 2016; Windschitl, Thompson, & Braaten, 2008). Students can have implicit goals for what the knowledge construction work of argumentation should look like in science classrooms (Berland et al., 2016). We propose addressing this need by focusing on teacher framing of argumentation tasks, specifically through the lens of participation frameworks, because this lens captures how and why individuals comport in particular ways to carry out tasks.

In this study, we use the concepts embodied within participation frameworks (i.e., actions and goals) to explore the relationship between the language teachers use to frame a particular argumentation activity, and their students' subsequent engagement in this science practice. Such an understanding could begin to inform ways to help meaningfully incorporate this science practice in classroom instruction. Specifically, our work was guided by the following questions:

1. As analyzed through the theoretical lens of a participation framework, how do teachers frame an argumentation task?
2. How does the teachers' framing align with students' engagement in argumentation?

2 | METHODOLOGY

We used multiple-case study methodology (Stake, 2000) to explore the relationship between how teachers framed an argumentation task, and their students' engagement in this science practice. This approach allowed for a deep dive into the complex happenings of a science classroom, which we were able to document with rich qualitative descriptions (Miles, Huberman, & Saldaña, 2013). Using the two-case method helped us compare and contrast across the focal classrooms, enabling us to better understand slight, yet significant, differences that may arise in teachers' framing of argumentation (Yin, 2013). In the subsections that follow, we describe the curricular context in which this study was embedded, as well as the methods used to collect and analyze the data to create the cases.

2.1 | Curricular context

This study took place during the pilot of a middle school curriculum called *Metabolism* (Regents of the University of California, 2013) that was written to offer students multiple opportunities to engage in argumentation while addressing disciplinary core ideas in life science. The curriculum concluded with an argumentation activity called a science seminar, a discussion in which students use evidence to debate explanations to a question. The seminar's central question is based on key science ideas learned throughout the unit, and to answer the question, students must draw upon evidence gathered and analyzed during previous lessons. In this study, the question anchoring the science seminar was: *When a person trains to become an athlete, how does her body change to become better at releasing energy?*

Before the science seminar, students had been divided into three groups, each of which was given data from studies about bodies' responses to exercise. For instance, one study included results from a lung test and a mitochondria test to illustrate how the bodies of identical twins are different if one twin does more athletic training than the other. Analyzing these data enabled students to construct multiple claims in response to the guiding question. To carry out the science seminar, students sat in two concentric semicircles; the inner group (Group 1) debated the question, whereas the outer group (Group 2) listened and took notes. Halfway through class time, the two groups switched positions and roles so that all students had an opportunity to engage in argumentation around the guiding question.

2.2 | 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 *Metabolism* curriculum. Ms. Ransom and Mr. McDonald (all names are pseudonyms) taught seventh grade science in the same public middle school. This school served almost 900 students across grades 6–8. Less than 25% of the student population was eligible for free and reduced lunch, and less than 25% was identified by the school district as English-language learners.

At the time of the study, both teachers had been educators for several years, with Ms. Ransom teaching for over 20 years and Mr. McDonald for nearly 10 years. In terms of their knowledge of, and experiences with, argumentation before the study, Ms. Ransom reported attending one training around this practice and including it in her instruction a few times. Mr. McDonald reported going to 2–3 trainings and using argumentation in his classroom many times.

The analysis entailed an exploratory sequential design (Creswell, Plano Clark, Gutmann, & Hanson, 2003). Specifically, for this mixed-methods approach, we first used open coding (Marshall & Rossman, 2015) to make sense of the ways that Ms. Ransom and Mr. McDonald framed the science seminar activity. Second, we used social network analysis (SNA) to examine student interactions during the discussions. We then examined how the teachers' framing aligned with their students' argumentation. Rich descriptions of both the teachers' framing and students' engagement were used to create two cases (Stake, 2000) addressing the phenomenon of interest, one case around each classroom.

As previously noted, open coding (Marshall & Rossman, 2015) was used 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 embedded in the theoretical lens of 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 students' actual discussions. To find patterns across classrooms, we then grouped each of the highlighted words or phrases by teacher and construct. For example, we assembled all instances when Ms. Ransom articulated an action, she expected her students to take during the seminar, or all of the moments Mr. McDonald explained the purpose of their argumentation discussion. This process enabled us to begin developing categories of actions and goals for the science seminar as emphasized by each of the focal teachers (Marshall & Rossman, 2015). Two readers systematically and comprehensively documented these trends (Yin, 2013) and compared notes. We iteratively engaged in this process, seeking confirming and disconfirming evidence to test the validity of the groupings (Locke, Spirduso, & Silverman, 2013), which resulted in final trends describing how the two teachers framed the argumentation activity.

Noticing variations in how Ms. Ransom and Mr. McDonald articulated the participation framework for the science seminar, we then turned to SNA to examine how the students took up this science practice. 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 argumentation, specifically in terms of the dialogic aspects of this science practice. We decided to focus this portion of the analysis on the dialogic dimension of argumentation because the actions inherent to this practice differ greatly from the types of exchanges students make during typical science instruction (Miller et al., 2018; NRC, 2012). Moreover, this decision aligned with a goal of this study being to explore ways that students are supported in taking on new interactional expectations when engaged in argumentation. The specific types of exchanges evaluated using SNA are summarized in Table 1. Descriptions of these exchanges and examples, which were taken from the science seminars in Mr. McDonald's classroom, are included in the table.

To carry out the SNA, we first broke the transcripts from the four groups' science seminars (two from each class) into utterances. Afterward, two raters independently coded 20% of each transcript using the coding scheme focused on students' dialogic interactions and obtained 96.9% inter-rater reliability. Contributions that did not align with the focal interactions were coded as "Other" (see Table 1). Then, we determined the ties between turns of talk (e.g., identifying who was questioning whom). With this information, we created valued, directed matrices that captured contributions made during each of the seminars in terms of the types of exchanges expressed in Table 1. To carry out the

TABLE 1 Synthesized coding scheme for dialogic interactions

Code	Description	Example
Questioning	Asking about some aspect of the discussion	"I had a question about your claim. Like, what did you mean by larger lungs?"
Critiquing	Evaluating some aspect of the discussion, which may include feedback	"But having more oxygen isn't really gonna help unless you have more mitochondria to release more energy."
Building on other's ideas	Recognizing some aspect of a previous contribution and utilizing it to further the discussion	"Both of those are good points, and I actually think it's those two factors combined. So, an athlete's body is better at releasing energy because of a combination of a larger lung capacity, and more mitochondria."
Other	All other utterances not included in the three previous codes for dialogic interactions	"I just wanna say that I think athletes' hearts are stronger."

SNA, these matrices were then input into UCINET 6 software (Borgatti, Everett, & Freeman, 2006). This software includes NetDraw, a visualization tool that creates sociograms (images of social relations in a network), which we used to examine interactional patterns associated with students' argumentation. This analysis resulted in a total of 12 sociograms; three for each group's science seminar, which correspond to the three types of dialogic interactions focused on in this study (see Table 1). For a detailed account of how the SNA was carried out, please see González-Howard (n.d.).

The analytic process resulted in a summary document for each case that was comprised of grouped phrases pertaining to how the teacher framed the science seminar activity, as well as descriptions of students' argumentation engagement. The latter included sociograms capturing various types of interactions during the discussion. These summary documents were used to create detailed case studies depicting the most salient features of each classroom with respect to the teacher's framing and students' subsequent argumentation (Stake, 2000). Each case study was developed by the first author and then read and evaluated by a graduate research assistant who was deeply familiar with the data after having helped with its analysis. Overall, these cases were consistent with her interpretations, with a few questions arising over which examples best illustrated particularities of the case (e.g., the manner by which Ms. Ransom described the goals of the science seminar).

3 | FINDINGS

This section is organized as two case studies, one for each classroom. To contextualize the findings, we first describe the progression of the lesson the day of the science seminar. This description is meant to provide a clear image of the classroom arrangement during the teacher's introduction and an understanding of how the lesson developed. Then, we tease apart the teacher's framing using the theoretical lens of participation frameworks: 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). Throughout, relevant sociograms are shared to offer insight into how the teachers' framing related to students' argumentation. We conclude by highlighting and discussing differences in how the activity was framed across the two classrooms.

3.1 | Ms. Ransom: interactions as a means for improving individual understanding

3.1.1 | Contextualizing the science seminar lesson

The day of the science seminar, laboratory tables normally placed in rows facing the front of the class were moved to the edges of the room, and seats arranged into two semi-concentric circles were directed toward the whiteboard at the front of the room. Ms. Ransom welcomed students to class and had them complete a warm-up, which asked students to consider which claim they felt best answered the science seminar's guiding question. 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").

Ms. Ransom then provided students time to practice reading their arguments aloud 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 a brief description of the science seminar activity. Students then practiced reading their arguments aloud as the teacher walked around the room and listened to pairs talk. Following this 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 rearranged themselves, Ms. Ransom explained the science seminar activity in more detail. While doing so, she stood at the front of the room 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 before the lesson.

During both groups' science seminars, Ms. Ransom placed herself away from students, sitting on one of the laboratory 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.

3.1.2 | Ms. Ransom's framing of expected student actions for the science seminar

During Ms. Ransom's introduction, she emphasized that students should drive the argumentation. Although Ms. Ransom explained that students, and not the teacher, would be directing the science seminar, related exchanges between the teacher and her students suggested that students were initially seeking further clarification about their roles. For instance, the interaction in Table 2 took place after Ms. Ransom provided instructions for the pair practice.

TABLE 2 Ms. Ransom's initial description of student roles during the science seminar

Turn	Speaker	Quote
1	Student	Are we gonna be up there alone or with a partner?
2	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?
3	Student	So, are we gonna read one by one?
4	Ms. Ransom	Ummm not necessarily. I'm just gonna let you guys start talking about [points to the whiteboard] the question.
5	Student	So, it's like one big group?
6	Ms. Ransom	Yes.

In this exchange, the student expressed a lack of clarity around his role. Both of the student's initial questions map onto activities students are more familiar with: giving a class presentation ("Are we gonna be up there alone or with a partner?") and turn-taking to share ideas ("So are we gonna read one by one?"). In Turn 2, Ms. Ransom provided a general description of what the activity would entail, explaining that only 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 say what she would do during the seminar. Yet, in Turn 4, she used a passive construction to implicitly indicate that she did not intend to partake in students' conversations.

Later in 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 her introduction. She 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. The interaction in Table 3 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 exchange demonstrates the tension some students experienced taking ownership of the seminar, Ms. Ransom's language and gestures in Turns 2 and 4 illustrate how she reminded students that they need not turn to her for guidance or approval.

Despite some students' initial struggle with driving the science seminar, both of the argumentation discussions in Ms. Ransom's class comprised mostly student talk. Specifically, student utterances made up 83.9% of Group 1 and 90.8% of Group 2's science seminars. Delving into the types of utterances, students made during the discussions, Table 4 provides a summary of the dialogic interactions that took place in Ms. Ransom's class. The percentages of each type of exchange are out of the entire seminar. For example, 7.5% of total utterances during Group 1's discussion included students engaging in critique by evaluating a peer's contribution.

TABLE 3 Reminder by Ms. Ransom of science seminar being student led

Turn	Speaker	Quote
1	Student	[Turns away from classmates and faces the teacher] Can I just do it?
2	Ms. Ransom	Yup. You guys are in charge.
3	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?
4	Ms. Ransom	[Gestures toward other students with hand] Please. It's up to you.

TABLE 4 Breakdown of dialogic interactions in Ms. Ransom's class

Group	Questioning (%)	Critiquing (%)	Building on other's ideas (%)	Other (%)
1	11.2	7.5	27.3	54
2	7	38.4	10.3	44.3

As seen in Table 4, during both of the groups' seminars in Ms. Ransom's class, students carried out different dialogic interactions with peers, although to varying degrees. For instance, although 27.3% of Group 1's seminar included students' building on each other's ideas, only 10.3% of the total utterances in Group 2's discussion were coded in this way. Conversely, Group 2's seminar included more critique in comparison to Group 1.

To complement the information conveyed in Table 4, Figure 1 includes sociograms that illustrate what these particular interactions looked like among classroom members during the argumentation discussions.

Before unpacking these interactions, it is necessary to understand how to make sense of all the information conveyed in these visuals. A sociogram is made up of nodes that represent either the teacher (depicted by a circle) or students (represented by diamonds) and ties among these nodes, which in this case capture whether or not the focal types of dialogic interactions took place among classroom members. Moreover, these ties may include one or two arrows that indicate the direction in which a particular type of utterance was directed. Two arrows mean the focal type of utterance was reciprocated (e.g., see tie between Students 4 and 6 in Group 1's sociogram of critiquing utterances). The sizes of the nodes and arrowheads are also meaningful in that they are proportional to the frequency of an utterance (see Size Key in Figure 1 for details). In addition, if an individual did not make a particular type of utterance and they were not the recipient of such an utterance, their labels appear separate from the sociogram. For example, see the labels of the four individuals in Group 2's sociogram of building utterances.

As indicated by the variation in node size, certain individuals dominated the discussions in terms of engaging in particular types of exchanges, such as Students 4 and 6 in Group 1's sociogram of questioning, or Students 3 and 5 in Group 2's sociogram of critiquing. It also becomes clear that not everyone engaged in certain dialogic interactions. For instance, 6 of the 10 individuals in Group 1 neither make a critiquing utterance nor were the recipient of one. Yet, this is unsurprising given that a small amount of that discussion included this type of talk (see Table 4). Moreover, looking across all six sociograms, the various types of ties between students indicate that they exchanged many comments with their peers, which aligns with the teacher's framing of expected actions for argumentation (i.e., students should drive the conversation and interact with peers). That said, a few sociograms also show that students spoke to Ms. Ransom as well (e.g., the sociograms for utterances around building on other's ideas). Most instances where students directed talk to the teacher were similar in nature to the example shown in Table 3, in which the students looked to the teacher for permission to participate. This may capture the tension students initially felt driving the argumentation discussion and directing conversation to other students, instead of to the teacher. However, these interactions are not captured in Figure 1 because they do not align with this study's focal types of exchanges related to argumentation.

3.1.3 | Ms. Ransom's framing of the goals for the science seminar

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'

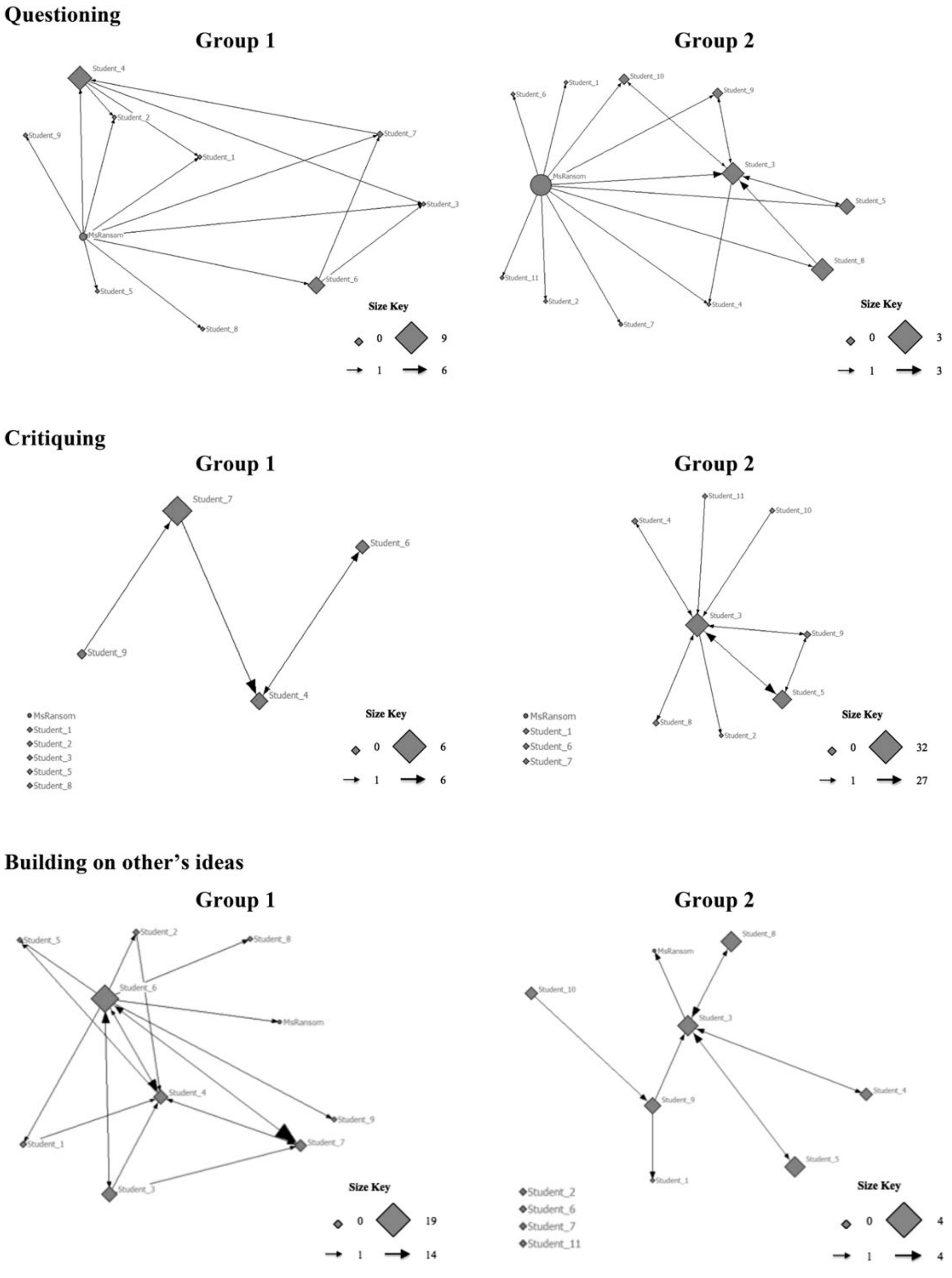

FIGURE 1 Sociograms of dialogic interactions in Ms. Ransom's class

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

TABLE 5 Ms. Ransom reiterating students developing an individual understanding

Turn	Speaker	Quote
1	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?
2	Ms. Ransom	Absolutely. 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.

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 question." Although 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 5). Her response in Turn 2 shows that she supported students adding onto, and evaluating, their classmates' arguments. Yet, the reason the teacher urged them to do so was because 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 [emphasis added].").

In summary, Ms. Ransom encouraged interactions among students, noting that "everyone's knowledge" would enable students to develop a "deeper understanding" of the topic being debated. 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, Ms. Ransom framed the activity as supportive of individual learning; a particular student's understanding could be altered as a result of interactions during the seminar. The teacher's language also stressed that students might take up different ideas from these interactions, which could impact their initial thinking, possibly resulting in students with differing final ideas about the focal question. The data thus indicate that Ms. Ransom framed a particular goal for students for the science seminar: *interact with peers to learn new ideas, which might possibly result in revisions to their original arguments.*

3.2 | Mr. McDonald: interactions as a means for cultivating a communal understanding

3.2.1 | Contextualizing the science seminar lesson

In Mr. McDonald's class, the seating arrangement the day of the science seminar lesson faced the whiteboard at the front of the room, and laboratory 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 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 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: "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 contribution and related those experiences to a science seminar. Mr. McDonald then tasked students with a warm-up, explaining they would "have some time to write down some notes for ourselves that we wanna bring up during the actual seminar portion." Students independently completed this task.

After a few minutes, Mr. McDonald brought the class back together and began discussing the seminar goals. He acknowledged that this particular 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." As students engaged in the pair practice, the teacher circulated the room addressing questions. Following the pair practice, the teacher explained the logistics for the task. As Mr. McDonald described the science seminar, he projected a few images 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 written on a poster, which he said students could reference "if you don't know how to enter the conversation."

During both groups' 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.

3.2.2 | Mr. McDonald's framing of expected student actions for the science seminar

Throughout his introductory remarks, the action Mr. McDonald emphasized was that students should drive the discussion. His language indicated that students 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 then expanded on this idea:

> 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. So, 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.

Here, Mr. McDonald expressed how students would be in charge of conducting the science seminar and that the teacher's part would be small. 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. Such language called attention to the distinction between this activity, and previous experiences students might have had in science classes.

During the introduction, a few students demonstrated uneasiness with this amount of responsibility. As illustrated in Table 6, in making sense of how the seminar would run, students mapped the argumentation discussion onto activities with which they were more familiar.

Student 1's question in Turn 1 aligns with expectations of a traditional IRE conversation, in which students take turns speaking and only do so when given permission by the teacher. Even after Turn 2, when Mr. McDonald continued to articulate the non-traditional role he would take, and students kept conveying discomfort, the teacher persisted to express and place responsibility for the discussion on students (e.g., "I'm not picking on people to respond to questions").

In addition, Mr. McDonald touched on how this particular argumentation activity would enable students to have 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

TABLE 6 Mr. McDonald stressing a student-driven discussion

Turn	Speaker	Quote
1	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 –
2	Mr. McDonald	So, that's up to you. I'm not running the show.
3	Student 2	Ummm how are we just gonna decide who goes? Who gets to talk first and like go after?"
4	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.

claims. It's a real conversation." The teacher thus pushed 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 among peers and to acknowledge that students might feel odd taking the reins. For instance, 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. 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.

His explanation let students know that they would not engage in this task without the necessary supports. Similar to earlier in the introduction, Mr. McDonald's language took an informal tone as he removed himself from the activity (e.g., "I'm pretty much going to be out of your hair today"). Such language moves can help place the teacher on equal footing with students, further enabling students to drive the science seminar.

Despite the hesitancy, some students expressed carrying out the science seminar, both argumentation discussions in Mr. McDonald's class included mostly student talk. Specifically, student utterances made up 88.1% of Group 1 and 88.5% of Group 2's seminars. Table 7 breaks down these student utterances further, specifically in terms of the dialogic interactions of interest. As a reminder, the percentages of each type of exchange are out of the entire seminar.

As seen in Table 7, during both of these groups' argumentation discussions, students engaged in questioning, critiquing, and building on other's ideas, the latter of which took place most often. We return to this point and unpack it further, in the last section of the findings.

Figure 2 encompasses sociograms that illustrate the patterns of these interactions. Mirroring some of the information portrayed in Table 7, it is clear that students more often interacted with one another's ideas through building, as opposed to questioning or critiquing (see Size Key for details). Overall, these sociograms highlight how numerous students engaged in dialogic interactions, with some students being prominent figures in these exchanges.

TABLE 7 Breakdown of dialogic interactions in Mr. McDonald's class

Group	Questioning (%)	Critiquing (%)	Building on other's ideas (%)	Other (%)
1	5.2	3	62.7	29.1
2	4.4	4.4	62.8	28.3

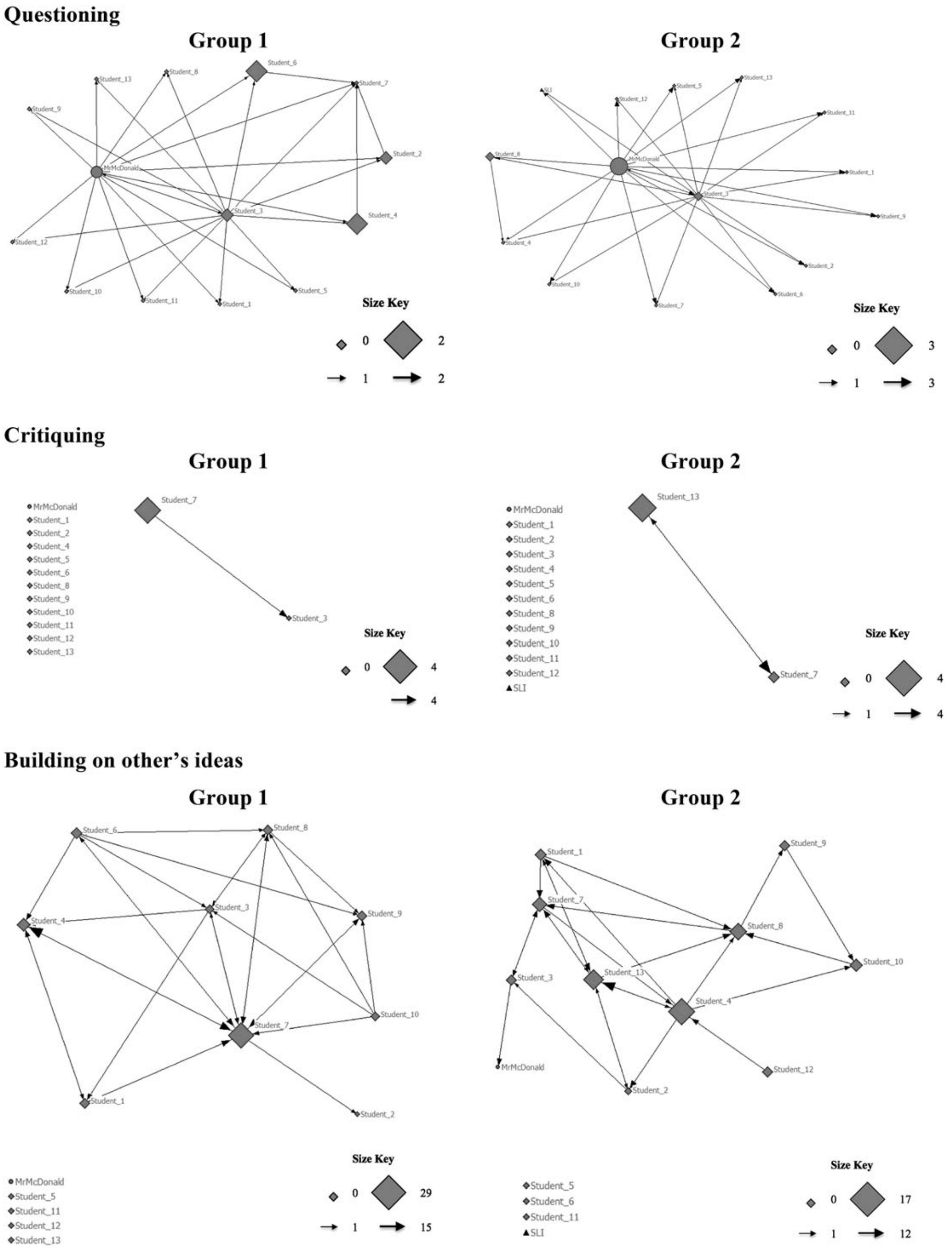

FIGURE 2 Sociograms of dialogic interactions in Mr. McDonald's class

For example, Student 7 from Group 1 was involved in 29 exchanges with peers in which Student 7 built on another's idea. Specifically reflected in the number of ties between various students in the sociograms of building, this high frequency of student to student interactions aligns with the actions

Mr. McDonald emphasized during the introduction. Although students directed comments to peers, a few also talked to Mr. McDonald during the science seminar (as seen by the arrowhead directed to the teacher in Group 2's sociogram of building utterances). Similar to Ms. Ransom's class, this may have been a result of the initial discomfort students felt driving the argumentation discussion.

3.2.3 | Mr. McDonald's framing of the goals for the science seminar

When Mr. McDonald framed the goals for the seminar during the introduction, he emphasized how the classroom members' joint understanding would be improved as a result of students working together and discussing the guiding question. For example, before 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 among students could support the group's learning. 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, 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, because students had analyzed different studies before science seminar, each student would contribute ideas with which others were unfamiliar. This aligns with the teacher's language highlighting 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 that the purpose of the seminar was for students to work 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 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.

Overall, similar to Ms. Ransom, Mr. McDonald emphasized the expectation of each student bringing their own ideas of how the body changes with athletic training, which they would share with peers during the seminar. Yet, Mr. McDonald stressed that the reason for engaging in the science seminar was that it could improve everyone's communal understanding of the discussion topic (i.e., "*our* understanding of the question"). This shared understanding involved classroom members developing one, all-encompassing idea of the scientific phenomenon being debated that was built from everyone's contributions. Although not explicitly stated, Mr. McDonald's framing implied that students' original arguments would change as a result of their interactions with peers who held other ideas. Thus, this teacher conveyed a particular goal for students participating in the science seminar—*interact as a classroom community to share ideas, which results in the whole class developing a stronger, shared, and new understanding of the scientific phenomenon.*

3.3 | Differences in framing across the two classrooms

In this study, we used the theoretical lens of a participation framework to explore how two teachers framed an argumentation activity. Ms. Ransom and Mr. McDonald's framing demonstrated that they both expected students to interact with peers while driving the science seminars. As seen in the sociograms presented in Figures 1 and 2, the ways students across classrooms engaged with one another in the activity aligned with this expectation. However, although Ms. Ransom and Mr. McDonald both promoted social interactions between students, the teachers described different purposes for their students doing so. Ms. Ransom explained that through these interactions, students could learn from peers, which could result in each *individual* student revising their original argument. Mr. McDonald also expressed that the seminar would result in revisions to students' initial ideas, but 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 types of exchanges students carried out during the argumentation discussion (see Tables 4 and 7). The most striking difference between the classrooms is the extent to which students built on other's ideas during the science seminar. On average, across both groups, approximately 18% of Ms. Ransom's students' argumentation included them building on other's ideas, whereas nearly 63% of the discussions in Mr. McDonald's class encompassed this exchange. Tables 8 and 9 include sample-coded transcripts that illustrate how student interactions differed across both classrooms.

In examining these transcripts, it seems that the teachers' framing may have manifested in different student approaches to the argumentation discussion. Specifically, Table 8, which captures a snapshot of Group 1's seminar in Ms. Ransom's classroom, shows instances of students using individual-focused language. For example, In Turn 11, Student 5 expresses "…so what I think like this text is saying is that like the Twin A already before they conducted the test, they were already working out three hours per week." A bit later, this same student says to a peer, "Well, you exactly proved yourself wrong…" (Turn 13). The manner by which this student distinguishes between his idea and his peer's idea does not give the impression that Student 5 is looking to reconcile their differing understandings. However, Table 9, which is from Group 1's discussion in Mr. McDonald's class, demonstrates more occurrences of students trying to resolve and merge their disparate understandings.

Turn 10, in particular, shows a student using language that captures this goal. Here, Student 4 explains, "… Like you're right that they all combine to make what makes a person an athlete, but we're just saying different parts of it. Like some people are gonna just mention the mitochondria, and some people are just gonna mention the lungs." Unlike the conversation just described from Ms. Ransom's class, the students in Mr. McDonald's class were clear in their attempts to bring together students' different knowledge about how exercise changes the human body.

Revisiting the sociograms focused on "building" offers insight into which individuals engaged in this aspect of argumentation and whose ideas they were adding onto (see Figure 3).

The sociograms from Mr. McDonald's seminars show how his students built on 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 ties

TABLE 8 Sample-coded transcript from Ms. Ransom's Group 1

Turn, timestamp, and speaker	Contribution (/utterance/)	Dialogic code
Turn #11 [5:59] Student 5	[*Facing Student 3*] Because it says like so what I think like this text is saying is that like the Twin A already before they conducted the test, they were already working out three hours per week. / And the Twin B was already having twelve hours umm of exercise per week. / So, I think [inaudible].	Critiquing Critiquing Other
Turn #12 [6:20] Student 3	[*Facing Student 5*] I don't think that's true / because it says that, [*reading from notebook on lap*] "Scientists tested every person in the study in the same way at the beginning of the study," which means before they were subjected to their exercise schedules.	Critiquing Critiquing
Turn #13 [6:30] Student 5	[*Facing Student 3*] Well, you exactly proved yourself wrong [*laughs*] / because they could have just ummm done the three hours per week of ummm athle- of training before they started even started the test.	Critiquing Critiquing
Turn #14 [6:41] Student 3	[*Facing Student 5*] But the three hours a week isn't exactly athletic.	Critiquing
Turn #15 [6:44] Student 9	It's not athletic.	Critiquing
Turn #16 [6:44] Student 5	[*Facing Student 3 and Student 9*] Then, it's doing a sport. / Whatever, same thing.	Critiquing Other
Turn #17 [6:48] Student 3	Yeah, but if they're doing a sport, they're gonna do more than three hours a week.	Critiquing
Turn #18 [6:51] Student 4	You don't know that.	Critiquing

TABLE 9 Sample-coded transcript from Mr. McDonald's Group 1

Turn, timestamp, and speaker	Contribution (/utterance/)	Dialogic code
Turn #8 [32:41] Student 3	Ummm I agree. / I think the same umm claim as Student 4. / And umm I also did the twins. / And in the test, the athletes' average on how much air they could hold was greater than the normal person.	Building Building Building
Turn #9 [32:57] Student 7	Yeah. / I think that that would be good, / but it wouldn't really help unless you have more mitochondria to release more energy / because having more oxygen, there's just gonna end up being a bunch of oxygen that isn't being used until there's enough glucose. / But with more mitochondria, the glucose is gonna get there faster / 'cause there are more ways to go.	Other Building Critiquing Critiquing Critiquing Critiquing
Turn #10 [33:23] Student 4	I agree with what you're saying, / but I think like everyone is just saying different points of it. / Like you're right that they all combine to make what makes a person an athlete, / but we're just saying different parts of it. / Like some people are gonna just mention the mitochondria, and some people are just gonna mention the lungs.	Building Building Building Building Building
Turn #11 [33:47] Student 6	Umm ok. / I think ummm this is the strongest claim / because like we have different examples like what Student 7, Student 4, and everyone else said. / We were mentioning the twins and like all the simulations we ran on the iPads. / We always saw that the athlete was getting more oxygen or mitochondria, like we all said.	Other Building Building Building Building
Turn #12 [34:08] Student 7	To support that lung claim, / always the heart and breath rate was always lower for the athletes or about the same, but usually a little bit lower. / Umm but the oxygen per breath was always way up / and then the energy release level was a lot of the times, really high up. / And that's probably in part because of the oxygen that they take in.	Building Building Building Building Building

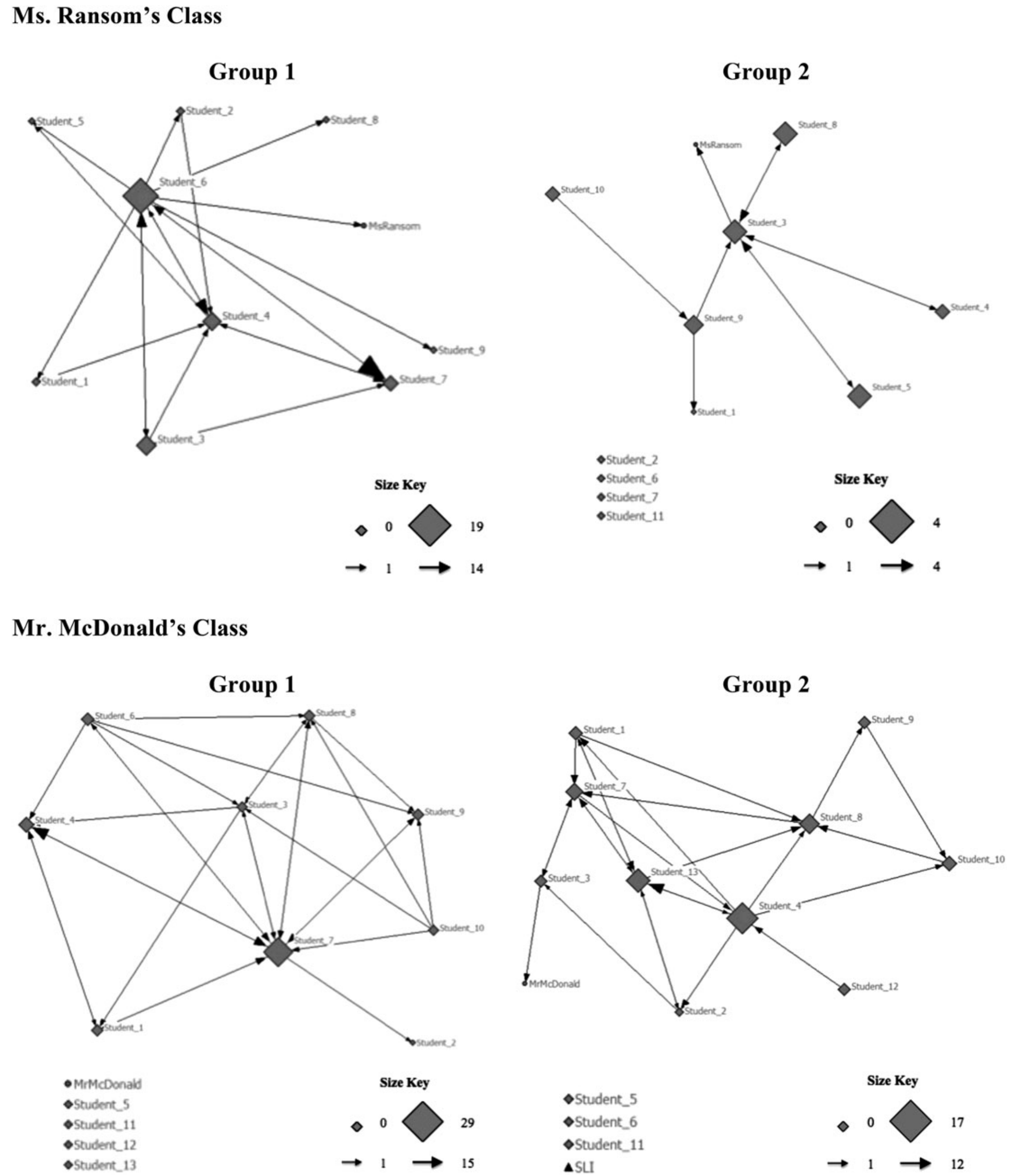

FIGURE 3 Sociograms of students building on peers' ideas across both classrooms

of this nature, these were building from comments made by three students, namely Students 4, 6, and 7. Students in Mr. McDonald's seminars, however, built on the ideas of more students; for example, Students 1, 3, 4, 7, 8, and 9 in Group 1.

Furthermore, by analyzing the size of nodes in the sociograms, it becomes clear that more students in Mr. McDonald's class often engaged in this type of dialogic interaction. It is necessary to consider the amount of each discussion coded as students building on peers' ideas (see Table 6), otherwise the patterns in the sociograms might give the impression that the seminars across these classrooms were very similar (e.g., Ms. Ransom's Group 1 and Mr. McDonald's Group 2), when they were not. Rather, in Mr. McDonald's class, building on students' ideas occurred more frequently, and between more individuals, which aligned with the goals he used to frame the discussion.

4 | DISCUSSION

Using the theoretical lens of a participation framework, enabled us to focus on the actions individuals take during a particular type of activity, and the intended goals that drive the activity (Goffman, 1981; Goodwin, 1990). Considering the how (e.g., teacher actions) and why (e.g., teacher goals) of the activity structures during this argumentation lesson highlighted how Ms. Ransom and Mr. McDonald framed the science seminar and the relationship with their student expectations and goals for the argumentation activity. Although both teachers emphasized the importance of students driving the conversation and interacting with peers, slight variation in their language suggested different purposes for students to do so. Although this work does not intend to make causal claims between these teachers' framing and their students' subsequent argumentation, it does highlight some nuances in how goals related to this science practice might be articulated. As such, these findings suggest the need to continue supporting teachers in developing and using rich instructional strategies to help students with dialogic interactions related to argumentation. This work also sheds light on the importance of how teachers frame the goals for student engagement in this science practice.

4.1 | 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 used by a middle school science teacher influenced her English-language learning students' engagement in argumentation (González-Howard et al., 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 et al. (2006) worked with a group of 12 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 narrow definitions of argumentation, ones 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 classroom 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, McNeill, González-Howard, and Loper (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 interact with peers. Given the difficulties teachers may experience with the dialogic components of argumentation, it is impressive that the students in this study engaged in rich social interactions during the seminars. Ms. Ransom and Mr. McDonald's framing during the introduction to the activity 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 emphasized student-driven interactions in their framings 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 in 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 toward 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. However, it is not enough for teachers to repeatedly express this idea; their actions should also reflect this message. Similar to the teacher in Berland and Hammer's (2012) study, both Ms. Ransom and Mr. McDonald physically removed themselves from the argumentation activity. This may have provided students with another visual reminder that the teacher would not direct the discussion. Reinforcing the messages conveyed through talk moves (Michaels & O'Conner, 2015) with physical moves can be important ways for teachers to frame the expectations of classroom discussions.

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 put students at ease, 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.

4.2 | 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 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 these 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 toward argumentation goals that align with familiar student expectations.

With regards to this study, we do not know the degree to which the goals Ms. Ransom and Mr. McDonald emphasized aligned with those previously established by the classroom community. It is possible, for instance, that the culture in Mr. McDonald's class was already one in which students valued working cooperatively to jointly construct knowledge about scientific phenomena. As such, it would be of value for future research to work with teachers and their students over an extended period to develop better understandings of how classroom goals are established and how these goals may change over time. Despite this limitation, this study did highlight another important aspect of framing for argumentation—the distinction between whether the goal of engaging in this science practice is individual (one that each student should strive to achieve) or communal (a goal the entire classroom community is working toward 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 has 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 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 toward both means.

As seen in these case studies, both individual and communal goals resulted in the classrooms successfully engaging in argumentation, particularly in terms of students driving the discussion and interacting dialogically with peers. However, there were differences in *how* students communicated with one another during the argumentation discussions. Specifically, students in Mr. McDonald's class built on each other's ideas much more than students in Ms. Ransom's class did. Recall that 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. His articulation focused on students working to bring together different ideas, a purpose that may have more strongly encouraged students building off each other. 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., toward 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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