Listen to each other: How the building of norms in an elementary science classroom fosters participation and argumentation

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Abstract: The present study explores and documents the process of building social and argumentation norms in a combined third- and fourth-grade science classroom and examines how the processes regulate students' participation patterns, including the students' roles. This study also investigates the positive potential of negotiating norms and taking on intellectual participatory roles for fostering scientific argumentation. The analysis focuses on how one norm, *listening to each other*, contributes to distributing participation rates and forces students to take more critical audience and intellectual roles. Students also show improvement in argumentation in terms of frequency and epistemic quality.

Introduction and Background

Argumentation is one of the central discursive practices of science, and has been highlighted as an essential part of science instruction (Driver, Newton, & Osborne, 2000; NRC, 2007). This emphasis stems from recently articulated views of science that underscore the deeply social aspects of knowledge construction in science. Due to this growing importance, a body of research has developed about student argumentation and how to support it(see Eduran & Jimenez-Alexaindre, 2008). In this research, scholars do not always make clear what they mean by argument or argumentation. We use the argument here to refer to any "text" (written or oral) that involves one or more claims and justifications for those claims. Argumentation is thus the process by which such texts get produced. We also view learning to argue as an important goal in itself for science education, as Driver et al. argue, as opposed to arguing as a particular method of learning concepts (Andreissen, 2006).

From this body of research scholars agree that learning to argue well requires more than just acquiring cognitive skills. Argumentation, by definition, is a social practice (van Eemeren et al.,1996). Consequently, student argumentation has a complex relationship with other social aspects of the classroom culture. Hence, learning to argue well involves the mastery of a complex discursive practice governed by a set of norms that has been refined over a long period of time. Fostering argumentation in the classroom community requires a fundamental shift in classroom culture, in particular, an innovative change in discourse use (Duschl, 2008).

Among the issues in the typical classroom culture, teacher-dominated IRE types of discourse and the vertical relationships between teachers and students have a long history of being nominated as fundamental issues that hinder students from engaging in active dialogical argumentation (Driver et al, 2000; Dushl, 2008) Recent research also reports that such discourse patterns and vertical power relationships are often mirrored when students interact with each other. That is, academically high-achieving students tend to take on the teacher's role as the evaluator/answerer/clarifier in small groups and reproduce IRE types of discourse (Webb et al, 2006). For instance, when a group member asks for help, smart students simply give the answers to the student. Hence, the reproduced discourse among students may prevent students from voicing different opinions or arguments. Research also indicates that vertical power relationships among students result in unequally distributed participation rates. A stratified pattern of participation tends to be found: some students often dominate the classroom conversation (Cornelius, 2008).

To overcome the problems of traditional classroom discourse, some researchers point out that a teacher's adoption of a new discourse can be the key to improving classroom discourse (Driver et al., 1994, 2000; Erduran, Simon, & Osborne, 2004; Osborne, Erduran, & Simon, 2004). In addition, many studies across disciplinary areas have explored participant structures in which teacher and students re-define their roles to improve their discourse. For example, studies have documented how teachers can newly position themselves as a facilitator, and/or negotiator, rather than as an evaluator, or answer the student so that students take the main role as knowledge co-constructors. Brown and her colleagues (Brown & Campione, 1990; Brown, 1992; Brown et al., 1993) facilitated the engagement of students by encouraging them to take specific roles in a jigsaw, and the students generated, manipulated, and discussed their ideas in a public forum. Herrenkohl and Guerra (1998) highlighted three practices, including monitoring one's own comprehension of another's ideas, coordinating theories with existing evidence, and challenging the claims put forth by others. They found that students were more likely to coordinate claims and evidence by taking an audience role that encouraged the students to provide clarifying and monitoring comments associating with taking intellectual roles. The researchers argued that students can participate in a social practice common to scientists by having students engage in episodes that

request coordination between theories and evidence. In the study, an important aspect of dialogical argumentation—ideas and perspectives are exchanged, refined, and evolved—was highlighted by asking students to take the role of an audience that is actively involved in initiating engagement rather than simply taking on the role of passive intellectuals. Van Zee and Minstrell (1997) found that the teacher's use of the "reflective toss," pushed students to elaborate on each others' and their own ideas, and become more active participants in whole-class discussion. These studies illustrate the kind of classroom community and culture may promote students' argumentation. As Roseberry et al. (1992) argued, students not only take on new roles and more actively participate in classroom discussion, but they also are more likely to provide better scientific explanations that relate evidence to claims.

However, many issues about how a teacher's discursive practice with students (the establishment of specific discourse norms that can help students to reorganize and regulate their roles, and how these things may work together) can foster students' argumentation remain unexplored. We don't really know how teachers create these classroom communities. In addition, rarely studied is how the established norms and roles, guided by the teacher may influence students' power dynamics. In this context, I address the following three questions.

1) When a teacher initiates social norms in the context of the elementary science classroom, what participation and argumentation norms seem to emerge and become negotiated?
2) How does the process of initiation and negotiating norms help students to reorganize/regulate their roles in small group discussion?
3) How do the negotiation of norms and the taking on of participatory roles foster scientific argumentation?

Setting and Participants

This study took place in a combined third- and fourth-grade classroom in a laboratory elementary school at a large public university in the western United States. The population of the school approximately mirrors its state's population in ethnicity and socioeconomic class. The class included 21students: 12 third-graders (6 boys and 6 girls) and 9 fourth-graders (5 boys and 4 girls). Ethnically, there are 18 Latino students, 2 Caucasian students, and 1African-American student because this class is part of a dual-language (English and Spanish) immersion program at the school. There were three one hour periods of science each week. For a unit consisting of four or five weeks, students began by creating big ideas and questions. In this science class, students were asked to research science topics, often by reading books and websites. The students also conducted investigations and collected data. For example, students investigated the characteristics of magnetic force by putting magnets into the sand box on the playground of the school, by observing the number of washers required to break two magnets, and by drawing graphs and comics about the magnets. The students were then asked to represent their findings and present them to other students. As they worked, students were encouraged to participate in discussions by presenting one another's opinions and by resolving disagreements.

Students spent 65% of their time, on average, in small groups, rather than together as an entire class. In a small group, students are assigned to one of various roles, such as a starter (who explains the group's goal and plan), recorder (who records the data and presents them to the class), helper (who asks for helps from the teacher if the students have questions or need other help), or a gatherer (who prepares the materials for the experiments). Once a week, the teacher assigns students new roles. The teacher, Ms. Green, had been teaching 38 years at the time of the study. Ms. Green originally majored in English, but she had more than 20 years of experience teaching science at the elementary school level.

Data Sources and Methods

A qualitative case study design was used in this study. A case study design was employed because it provides an in-depth description of a particular activity and situation (Creswell, 2003; Meriam, 1994; Miller & Salkind, 2002) that verifies how the norm is developed in a classroom (natural context) and examines students' roles and power dynamics.

I used a combination of classroom observation (field notes and video data), teacher interviews, and student interviews to answer my research questions. Videotaping and taking field notes were essential because this study requires fine-grained analyses of student discourse use and interaction. The video record enabled in-depth micro-analysis of interaction (Erickson, 1992). Brief field notes were also recorded in order to capture classroom contexts that might occur outside the camera's range. The video data for this paper include 18 science lessons (approximately 20 hours) from the first six weeks of the school year. The video data were first logged, and episodes determined to be of analytic interest were fully transcribed. The transcription included partcipants' speech, gestures, facial expressions, and behaviors. To analyze the data, a text management program, Atlasti, was used to investigate the frequency of incidents and to categorize similar incidents together.

The purpose of the interviews was to address the teacher and students' recognition of norms, and their position (alignment) with the norms. The teacher interviews consisted of one semi-structured interview, conducted during the second week of the school year, and multiple informal interviews. The interviews included

questions such as which norms are important and why, how the teacher wanted to initiate and operationalize the norms, and which norms the teacher thought were sustained and appropriated. The students' interviews consisted of a semi-structured small group interview, conducted during the sixth week of the school year, and informal individual interviews. The interview supposed a situation in which the group was asked to help a new student, named Jenny. Questions included "Jenny wants to know some of the rules of your science class so that she can actively contribute to discussion. What are three rules? About the norm that you guys just mentioned, do you think that you are doing well or not?," and "Why do you think that the norm you've just introduced to Jenny is important to make discussion better in your science classroom?" The interview data were fully transcribed.

Findings

Classroom norms: participation and argumentation norms

Classroom norms were identified inductively first, and then categorized by referring to Cobb et al.'s work (1996, 2001) on classroom norms and participant structure. For example, a candidate norm was labeled a norm when the candidate norm appeared more than three times. In addition, I looked for instances indicating violation of norms as evidence of established norms for the classroom (Cobb et al., 2001). The classroom norms are basically divided into two categories: participation norms and argumentation norms (Table 1).

Table 1: Emerged participation and argumentation norms

Category	Norm	Description	Example (T: teacher, S: student)
Participation norms (PA)	Listen to each other	Ask students to listen to what other people are saying	T: We need to be able to listen. It is very important. When you work in groups, you also need to listen very carefully so that you can really understand what your friends are trying to say. S: Listen. We are supposed to listen in science class. S: Tell me what I just said. S: You've got to listen.
	Talk aloud	Ask students to state their opinions aloud	T: Not everybody may hear important questions and answers if you talk like this. Imagine when you are yelling at your dog. How would you call the dog? Really project your voice so that others can hear.
	Attention behaviors	There are short phrases used to turn the class's attention to the teacher.	T: Raise your hands to hear my voice. One, two, three, eyes on me.
	Hold for a minute	Often the teacher blocked a few, more available students' answers right after the questions or comments in order to give others opportunities to talk.	T: Now let's just hold for a minute so that others have a chance to think.
	Call on others to help you	When someone wants to continue, or dominate the discussion, the teacher asks her/him to call for others (from the class) to add comments.	T: Why don't you ask for help from your group? Are there any comments from Group 2 about Maximo's comments?
	Talk to your group/ class, not me (Talk to us, not just one member)	Some students tend to talk to the teacher, not to the class. Then the teacher asked the students to talk and explain their opinions to the class.	T: You talk to me; that is not good. You should talk to the class.
Argumentation norms (AR)	Think, talk, and act like scientists	The teacher highlights that 'we are scientists.' She frequently used this phrase, especially when students conducted experiments.	T: As scientists do, we fill out sheets to record our data. Scientists like measuring. S: We did that three times because if we just did once, we wouldn't know whether it was accurate. So we did it three times like scientists.
	No right or wrong answer	The teacher also highlighted that there is no right answer in science.	T: I heard something interesting because we did not hear that before. I'd like to you to continue. There is no right or wrong answer. We want to hear what you think and believe.
	Feel free to have other opinions (what do you think)	Encourage students to disagree with others and provide alternative ideas	T: Isn't this an issue if there is just one person for one opinion? Do we have to be embarrassed if we make a different choice from the others? No, we don't have to.
	Back up your claim with evidence (why do you think what you think)	Encourage students to explicitly explain how evidence is related to claims	T: Don't forget. You also need to think about how you convince the rest of your group, so you need to give them some evidence about why your idea is a good idea.
	Convince others of your opinions	The teacher explained several ways of convincing others and then encouraged students to convince others	T: We'd like to let others know what we know. How do we convince others?

Because the teacher has a proactive role that introduces and initiates norms in the classroom, I interviewed Ms. Green, and asked her which norms she thought were important for fostering argumentation and how she planned to initiate and operationalize the norms. She reported her aim was to emphasize norms to evoke broad participation, especially for the first two months. The reason for this was her acknowledgment of the existence of unequal participation and power dynamics among students. As a mixed-grade class, five or six of the fourth-grade "oldtimers" dominated classroom talk and work in their groups. She expected that the stressing of participation norms might contribute to encouraging other members, especially those who were new to the class, to talk and participate more. For example, when she was asked to introduce the most important classroom norm, she chose "listen to each other." According to her, the norm not only focuses on the importance of listening to others' opinions but also helps students to ensure understanding of others' opinions and equal distribution of opportunities among students by encouraging them to ask for others' opinions. She felt this enabled the broadest student participation.

In addition to directly asking students to listen to what others are saying, she also encouraged this listening norm by having students rephrase, interpret, or summarize what another student had just said. Interestingly, she also emphasized that some participation norms could provide a basis for fostering argumentation. She said that if students are not willing to listen to others' opinions, then there is no reason to argue something because they are just satisfied with their own opinions.

Regarding the argumentation norms, the norms she answered seem to be derived from her beliefs about science. She projected an image of scientific knowledge as changeable, depending on what evidence is used. She stressed that scientists explore and work hard to better understand the world. There is no such thing as a right or wrong answer; it depends on how you convince others, by using evidence. Hence, the frequently used phrase, *we think, talk, and act like scientists*, implies argumentation norms, because she thinks that the central part of scientists' work is to make a theory (claim) and back it up with evidence to convince others. Because there is no right or wrong answer, feeling free to have opinions and making an effort to convince others with your evidence was also stressed.

Negotiation of norms

Students come to understand and share a norm through ongoing negotiation, not simply by having a norm presented to them (Yackel et al., 2000). In Ms. Green's classroom, this negotiation process included clarifying the classroom's understanding of the norm, generating new related norms, and extending the meaning of the norm. In the following example, Ms. Green and students began their discussion about a norm, *listen to each other*, and continued to discuss why *what do you think?* is a good question. Then the discussion was extended, and they agreed to include "*why do you think*" questions as a new norm. Ms. Green said, "Remember how important it is that the groups listen to each other. I heard somebody say, 'What do you think?' I think that this is a really good question to encourage listening to each other." She asked the students why they thought this is an important question. Marisa answered, "In this way, we can gather what other people think. Maximo said, "It can get others involved in the discussion." He also pointed out that this question was good for opening up a discussion, so that group members can focus. Oscar added the point that scientists are really curious, so this question encourages a scientific mindset. Then Josue pointed out that this question was nicer than other questions:

Josue:	Because it is nicer, instead of screaming like "c'mon" because you don't really have a chance to talk because it is difficult to say you should participate.
Ms.Green:	It's better than an invitation. So, you think *what do you think* is better than *why don't you work*? Or *why don't you do something*? Or *you should participate*. Why do you guys think it is better?
Maximo:	I agree with Josue. Because it also very hard to make them into something by saying to them. You can also say *why do you think*, and then they would also go along with the evidence.
Ms.Green	Good. Excellent comments. That goes along with evidence and backing up claims. So we will ask, what do you think and why do you think?

As seen from this example, the importance of listening norms was related to asking the question, *what do you think?* The *what do you think?* question was related to the 'think, talk, and act,' like scientists norm according to Oscar's comments, and it seemed to enable the class to address an important argumentation norm ('go along with evidence') by including the 'why do you think' question, as addressed by Maximo and Ms.Green.

After this discussion, when Ms.Green visited a small group, she often checked whether the group members conformed to or violated this norm. She asked, "So, did you ask Camila a question, a 'what do you think and why do you think' question?" Then Josue asked a question about whether all members should ask this question of each other. She answered, "Yes, I'm strongly encouraging you guys to do that. Scientists like asking about their opinions, and they really like asking question 'why do you think that?'"

Change of participation and power dynamics, argumentation within groups

In the whole-classroom-level interaction, the distribution of the students' participation seemed to expand over the six weeks of observation. Ms. Green said in the fourth week, "It is true that there are some boys and girls who used to dominate the class, but now some other people are ready to join. Teena will pitch in. Marisa is another one. Sofia is a really good thinker." As shown below, students' participation seemed to be more evenly distributed by the sixth week, and there were some students who participated significantly more in the whole classroom discussions (Figure 1).

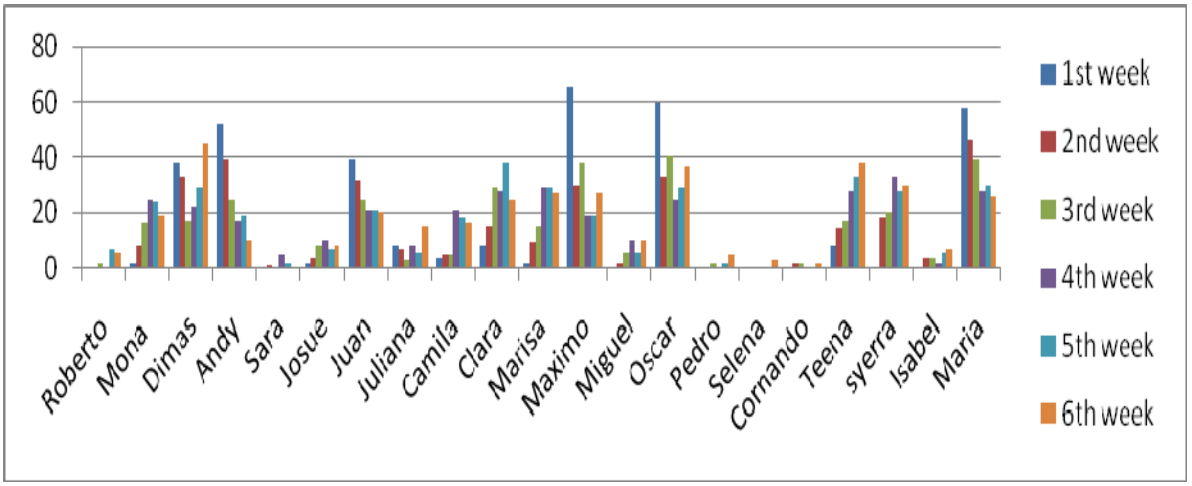

Figure 1. Distribution of individual students' participation through the first 6 weeks of class.

It must be noted that Ms. Green has distributed opportunities to participate on purpose, and often blocked the dominating students and had others talk. In other words, the improved distribution could be a result of the teacher's explicit manipulation of participation. Note that some of the frequently addressed norms, such as 'hold for a minute,' 'call others to help you,' and 'talk to your group/the class, not the teacher,' discourage students from dominating class discussions. For example, when Dimas said in the first week, "Ms. Green, I think…" in a little voice, the teacher asked him to turn around to the class and talk to the class, not the teacher only. She said, "Dimas, I know what you mean, but you should talk to your friends, not me. Turn around, stand up, and really project your voice to the class." Therefore, in order to see whether the establishment of norms enabled students to participate more, and encourage them to reorganize their norms, it was necessary to trace back to the changes in participation to small groups. The groups, organized by the teacher, are heterogeneous in terms of sex, grade, and academic achievement.

In order to see the changes in participation at the small-group level, I selected two groups for analysis. Each group included a member who showed significant improvements in participation at the whole-classroom level to see if the members who improved in whole class discussion also showed improvement in small groups. The analytical points of the group discussions included the participation frequency of each member, identifying the norms addressed during the discussion, recognition of students' roles (Herrenkohl & Guerra, 1998) and power dynamic, and counting and characterizing argumentation (Ryu & Sandoval, 2008) (Table 2).

Table 2: Analysis of small group discussion

	Group 1 (Oscar, Clara, Pedro, Camila)		Group 2 (Andy, Marisa, Teena, Juan)	
	First week	Sixth week	First week	Sixth week
Taken assigned roles (S: starter, R: recorder, H: helper, G: gatherer)	Oscar: S, Clara: R Pedro: H, Camila: G	Oscar: R, Clara: S Pedro: G, Camila: H	Andy: S, Marisa: R Teena: H, Juan: G	Andy: R, Marisa: S Teena: G, Juan: H
Taken audience/ intellectual roles (C: challenger, CL: clarifier, F: facilitator H: hypothesizer N: negotiator, S: summarizer)	Oscar: CL, H, S Clara: H Pedro: none Camila: none	Oscar: CL, H, N, S Clara: C, F, H, N Pedro: CL, S Camila: F, S	Andy: C, CL, H, S Marisa: F, S Teena: C, CL Juan: C, H	Andy: C, CL, F, H, S Marisa: C, CL, F, H, S Teena: CL, N, S Juan: H, S
Addressed participation norms (frequency)	Talk aloud (2)	Listen to each other (2) Talk aloud (1) Call others to help you (1)	Talk aloud (1)	Listen to each other (4) Talk aloud (2) Call others to help you (1) Hold for a minute (1) Talk to us, not just one member (1)

Addressed argumentation norms (frequency)	Like scientists (1)	Like scientists (1) Feel free to have other opinions (1) Back up your claim with evidence (2)	Like scientists (1)	Like scientists (2) Back up your claim with evidence (1) Convince others of your opinions (1)
# of arguments	0	2	0	3
# of arguments with warrants	0	1	0	1
# of arguments with rebuttals	0	2	0	2
Power dynamic	Oscar is a dominant member, a main decision maker, and a task performer.	Clara increased her power as a challenger and facilitator.	Andy and Juan are main decision makers and performers.	Marisa and Teena's power increased a lot. With equal power, this group seems to have more arguments.

Let us look at the following example. Ms. Green asked the following question, and had the group members discuss it: what will happen to two magnets if the space between the two magnets is increased?

The second week	10/06/09
Oscar :	(He is counting the numbers of washers on the table, and is looking at the group's worksheet.)
Clara:	Camila, do you know what will happen? (She asked the question of Camila, and looked at Oscar.)
Camila:	(She does not say anything back to Clara, and turns to Pedro.)
Pedro:	Think, think, think!
Ms.Green:	Has any group come up with an idea about what will happen? Oscar?
Oscar:	It gets weaker.
Teacher:	What gets weaker? Clara, can you add some comments to Oscar's?
Clara:	(She looks at Oscar. But Oscar does not say anything and looks atMs.Green.)
Ms.Green:	Oscar, did your group discuss this?
Oscar	(He does not answer the question, and he continues what he just mentioned.) If I put one, it is still strong. But if I put two, it gets weaker. The magnetic force is then weaker.

As seen above, Oscar, a fourth-grade male student, seemed to know or had an idea about the teacher's question, but he did not discuss it with the others. Even when Ms. Green asked Clara to add some comments, and she seemed to want to ask for help from Oscar (although she did not explicitly ask for help), he did not respond to Clara, and answered the question by himself.

In this group (Group 1), there was no significant discussion among the group members for the first three weeks. When there was a question or mission given to the group, Oscar made most of the decisions by himself, and conducted most experiments, even though there were roles assigned by the teacher, such as starter, gather, helper, and recorder. While he was not very talkative, he seemed to hold a dominant position in this group because he took on the roles of the sole decision maker and the main task performer. Oscar usually provided a claim but often without backing it up. Of the other members, Clara, a fourth-grade student who made improvements in participation, did not contribute to the discussion that occurred during this time. Pedro, and Camila, both third-graders, did not make additional contributions after Oscar's claim.

The other group (Group 2) consisted of Juan, a fourth-grade male student, Teena, a fourth-grade female student new to the class, Andy, a third-grade male student, and Marisa, a third-grade female student also new to the class. The girls are newcomers in this school. Juan and Andy talked to each other, answered questions together, and did experiments. While Marisa often provided her ideas, especially when she was assigned as a starter (who is supposed to explain the goal for the experiment), the two boys did not really respond to her ideas.

The second week	10/07/09
Marisa:	How thick is different. Magnetic force is different because how thick the desk is and twenty pieces of paper are different.
Andy:	Doesn't really matter. Go get the compass.
Marisa:	Doesn't it matter how thick it is?
Andy:	It doesn't matter.
Marisa:	Fine. It doesn't matter.

Now look at the following two examples of the groups that occurred in the sixth week. The following discussion happened in Group 1 after the students generated their graphs based on their T charts: Oscar and Clara talked about whether they wanted to finish the graphs so that they could present them or just show the class the T chart showing the number of washers used to separate two magnets.

The sixth week	10/28/09
Oscar:	So, you said that graphs are better. *Why do you think* that a graph is better?
Clara:	Graphs told us information.
Oscar:	But it is the same info.
Clara:	No. It's not. This one (T chart) tells like numbers, how much it is, and the graph shows, the graph shows

	shapes, and lines like.
Camila:	So we just want to show two lines?
Ms.Green:	(Ms.Green was listening to Oscar and Clara talking.) Can you see a pattern from here? (Pointing to the T chart)
Oscar and Clara:	No.
Ms.Green:	Can you see a pattern from here?
Oscar and Clara:	Yes.
Oscar:	I see. We cannot remember information from the T chart, but we can see and remember from the graphs. I like your idea. Let's just finish the graphs. I'll get stickers so we can finish.

In this dialogue above, Oscar conformed to the norm, asking a 'why do you think' question. When Clara claimed that graphs told us information, Oscar disagreed and provided a rebuttal that it is the same information. Clara disagreed with his claim again, and provided a further explanation of her claim, why she thought that T charts and graphs are different. Although Clara did not fully support her ideas, both Oscar and Clara understood the difference between the two when the teacher provided a hint, and Oscar accepted Clara's opinion at this time. In addition, a noticeable difference found is Oscar's use of 'we' as the subject. In the first weeks' example, Oscar tended to use "I" whenever he talked. The use of 'we' seems to reflect Oscar's newly established group membership.

Let us look at the example of Group 2. This group conducted an experiment regarding how many washers are necessary to separate two magnets. The group's members talked about whether they needed to apply one washer at a time or more than one. Marisa argued that putting one at a time was a more accurate method, and Andy argued against her, because he thought that it could waste time. While he argued that they might need to put one at a time at the last measurements, Marisa disagreed with him because it could be difficult to figure out which would be the last measurement if they applied multiple washers.

The sixth week	10/26/09
Marisa:	If somebody put five at a time, maybe the balance is five, but maybe the balance is two and if you put five, then maybe you need to pick some out, more in to see find balance, then it takes much longer than putting in one at a time.
Andy:	I disagree. Because when you put it in there, it doesn't matter how many you put in as long as you are going to put. Whether you put two or one, it doesn't matter until last time you put. So you put five at a time.
Marisa:	I don't understand. See we are doing like, by two, and then broke. And it can be seventeen or eighteen. It was seventeen? Or eighteen? Then you didn't quite know which one was.
Andy:	Look. If it breaks, then just go back to the last one. Then you need to put one at a time. Just do last time, and add one at a time.
Marisa:	One more what?
Andy:	Because it has to be one for the last time. But not for other times. It wastes time.
Marisa:	What if we broke the seventeen, but you put two? So it can't to make it, actually it wasn't seventeen, you don't know.
Andy:	But you know that it's not sixteen if you put two at a time. It is seventeen or eighteen. Right?
Marisa:	Yeah, I understand what you mean. But it is harder than putting just one at a time, then you may get the block. You know it just not accurate.

A clear difference between the first week discussion and this week's is Andy's way of talking. While he did not explain why thickness did not matter in the example from the first week, now he explained in much more detail. Marisa's behavior also differs from that of previous weeks. In the first week, she said, "Fine." In the sixth week, she said, "I don't understand," and elaborated her claim. Although these two students did not reach a consensus, the way that they talked to each other has improved.

Concluding Remarks

From the findings above, while the establishing of norms seems to work to some extent to encourage students' participation and argumentation, it is difficult to make a generalization that norm establishment can make every single student in the classroom participate more, and argue more. There are still silent students. However, for those who made improvements in whole classroom discussion such as Clara and Marisa (showed great improvement in their small group discussion), their participation seemed to enable the group to have more discussions. This indicates that the establishment of norms, guided by the teacher's discursive practice, improved the distribution of participation.

The teacher, Ms. Green, highlighted the norm "listen to each other" as a way to come up with new related norms, to interpret or extend the meaning of the norm through the negotiation process. Using this norm, students became more likely to monitor each other's thinking and ask about their reasoning to back up their claims. In other words, the students actively took audience roles. Taking these audience roles, in turn, seemed to help the students to take more intellectual roles because asking questions such as what do you think or why do think often became the same returning questions, what do YOU think and why do YOU think.

Hence, the findings suggest that paying more attention to participatory norms and roles may help students to appropriate argumentation norms and intellectual norms, and thus encourage students to have more scientific argumentation. While we often think that different opinions or disagreements are generated only from

cognitive conflicts, which lead to scientific discussion, they could be triggered by social ones linked to cognitive ones. From this perspective, dynamic power relationships caused by social and cognitive conflicts may be encouraged by asking students to take on audience and intellectual roles.

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