Creating cultures of participation to promote mathematical discourse

This article examines strategies for increasing engaged student learning in math classes by ensuring classroom norms that invite active learning from all students.

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Introduction

As a former eighth grade mathematics teacher, I was aware of the impact discourse had in shaping students' thinking and thus often implemented strategies that supported these efforts. However, a reality became clear when pursuing these National Board Certification, which demanded a 15-minute unedited video of me facilitating a whole-class discussion. While recording the lesson, which centered on an introduction to irrational numbers, I thought students were engaged in lively discussion. However, analysis of the video-taped lesson revealed that I was doing almost all of the talking! The perceptions of my practice were not aligned with my actual practice. After this revelatory experience, I was curious to learn more about how other teachers perceived the use of discourse to support adolescents reasoning in mathematics and particularly how they created cultures of participation to support equitable discursive interactions with adolescent students from diverse backgrounds.

Consistent with my own experience, equitable access to mathematically rich and meaningful learning experiences continues as a critical need in the classroom (Cobb & Hodge, 2011; National Middle School Association [NMSA], 2010). Rich learning experiences also are fundamental in supporting and developing students' mathematical reasoning and sense making (Chapin, O'Connor, & Canavan Anderson, 2003), which is of particular concern during the middle grades as the level of abstraction in mathematics increases greatly. As a means of openly engaging in understanding meaningful and rich mathematics, discourse offers one avenue for teachers to create equitable and mathematically rich learning environments and interactions; this article demonstrates why an emphasis on mathematical discourse should be a common practice within the middle level classroom (Bartolini Bussi, 1998).

Discourse requires students to evaluate and interpret the perspectives, ideas, and mathematical arguments of others as well as construct valid arguments of their own. That is, students develop deeper understandings of mathematics when they engage in meaningful social interactions such as whole class discourse (Cobb, Yackel, & Wood, 1992). Both the National Council of Teachers of Mathematics ([NCTM], 2000) and the Common Core State Standards Initiative (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) emphasize the importance of incorporating mathematical discourse into curricular and pedagogical frameworks of the classroom. While some adolescents feel as though it is too great of a risk to participate in whole-class discourse (Wormeli, 2009), all students are capable of engaging in and learning challenging mathematics when caring teachers set high expectations (NMSA, 2010).

The norms and cultures of the classroom also are highly necessary elements in establishing meaningful interactions that support mathematical discourse among students (Cobb et al., 1992; NCTM, 1991; Rigleman, 2010). The adoption of the Common Core State Standards in many states reinforces the importance

of creating classrooms that focus on reasoning, deep conceptual understanding, and the communication of mathematics (Larson, 2012;NCTM, 2000). In addition, the teacher's efforts and attitudes in creating a caring and well-structured classroom environment with high expectations for all students are more likely to increase student engagement (Klem & Connell, 2004), which can lead to greater achievement (Smith, Rook, & Smith, 2007). Such classrooms exemplify cultures of participation. With that said, knowing that discourse can support student learning and creating the structures to help discourse come alive are not the same thing. Creating a classroom culture of participation is a necessary first step in implementing meaningful discourse and creating equitable learning experiences.

What follows is a compilation of strategies and classroom structures from 13 middle level teachers from highly urban communities with tremendous cultural, linguistic, and ethnic diversity. It should be noted that these strategies are not a comprehensive list of effective strategies, but teachers frequently used these strategies as foundations for success in engaging their students in discourse to develop reasoning. If implemented together, these strategies have the potential to create a strong and steadfast culture of participation to support all students' learning of mathematics.

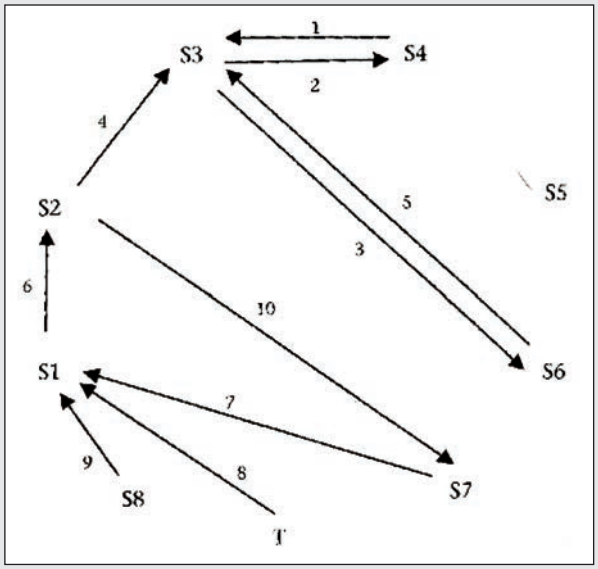
Defining discourse

Meaningful discourse includes an element of debate and is an interactive, dynamic, and inclusive strategy with the intent of developing particular mathematical concepts or practices. Mercer (2008) states that discourse develops more creative and independent thinkers while simultaneously strengthening procedural knowledge. One way to view discourse would be through Kuhn's (2005) model (see Figure 1). In this model the nature of the discussion can be mapped; arrows indicate to whom a question or comment was asked and the numbers next to the arrows indicate the order in which they were posed. In this model the teacher is involved in the discourse, but is not the center of the classroom interactions as might be seen in a traditional teacher-driven discussion. This is not to say that the teacher's role in classroom discourse is diminished. In fact, teachers should contribute to the discussion especially when necessary to probe student thinking, clarify questions or statements, or interject with specific content knowledge to help guide the students in their reasoning. Teachers are the content and pedagogical experts in the classroom, but this sophistication does not mean that they should hold the intellectual authority within the classroom. Again, Kuhn's model is a beautiful representation of a dynamic and discursive interaction, but what needs to happen to make this come alive in the classroom?

Cultures of participation

Cultures of participation are diverse and can look very different from classroom to classroom. However, many of the teachers in this study shared similar elements. For example, classrooms were inclusive, all individuals' comments and ideas were valued and respected, contributions from all students were expected, all students engaged in the open sharing of ideas at some time, and the students collectively shaped understandings with guidance from the teacher as needed. These different elements were described or observed within three different areas that supported the creation of cultures of participation. These areas focused on classroom norms, classroom procedures, and diversifying discourse—all of which help define the teacher's role in creating a culture of participation. While each of these three areas was evident in some fashion, not all were evident in the same way. Still, each element had a critical role in creating a classroom culture of participation for these teachers.

Figure 1 Kuhn's Discourse Model



Establishing classroom norms

The first few days of school are no doubt important in establishing classroom norms, procedures, and expectations. The message conveyed should be clear: we are mathematicians and we work together. This means that everyone will contribute to the culture of the classroom and active participation is expected.

By the time students reach the middle grades, many have wavering self-efficacies and question their ability to be successful in mathematics (Pajares, 2005). One of the teachers in this study had posted by her door a bulletin board that said, "Great Mathematicians" (see Figure 2). On this board were the names of well-known mathematicians such as Al-Khwarizmi, Fermat, Ramanujan, and Euler. Also included on this board were the names of every student on the teacher's roster. While not enough in and of itself to influence students who had low self-efficacy, the message conveyed a positive belief that all students were mathematicians; they would all be active in doing and discussing mathematics.

Classroom rules play an important role in the nature of the classroom. One of the teachers in this study put the responsibility of establishing rules on the students' shoulders. Each student received one sticky note and had to write one rule he or she needed to blossom into the best learner possible. Without talking, the students rose, posted their rules on the board, and returned to their seats. The teacher then asked them to rearrange the sticky notes, again without speaking, so that the notes were grouped into common themes. Next, the teacher read all of the notes in each group and asked the class to create a name for each group; the names of these groups became the classroom rules. After seeing this done, I used the same process to generate rules in my own classroom (see Figure 3). The rules were: (1) Be responsible for your learning, (2) work in groups, (3) create a comfortable work environment, (4) respect the speaker, (5) respect others, (6) have fun while learning, and (7) display creative and good teaching. The last two serve as profound reminders of our responsibilities as teachers.

Figure 2 Great Mathematicians

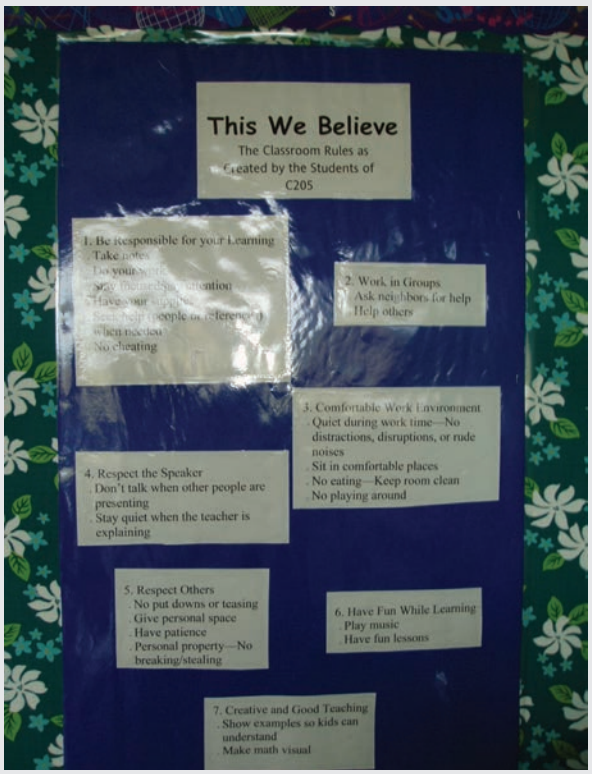
Arranging the desks in small groups was another method used to establish classroom norms. Adolescents sometimes feel intimidated or unsure of themselves when speaking in front of the class. By using small groups, the teacher created situations wherein ideas could be openly discussed and thus all students could contribute to the discourse because they now had, as one teacher put it, "More meat to talk about." Mathematics is a social endeavor, yet many adolescents are reluctant to discuss ideas in a whole-class setting, and too many teachers turn the discipline into a solitary pursuit focused solely on "answers." Deliberately grouping desks can aid in encouraging discourse and in establishing classroom norms that lead to democratic action so crucial for successful middle level education.

Classroom procedures: Expecting participation

Many of the teachers used procedures that would sound familiar to most classroom teachers: wait time, calling on different students, or consequences for not participating. However, these teachers put a twist on traditional pedagogical approaches to learning and found ways to maintain high levels of participation.

One teacher, Emily, when talking about wait time, used the number of hands raised as an indicator of sufficient wait time. Emily would wait until she saw a given number of hands raised before she called on a student; this number was not shared with the students.

Figure 3 Student-Created Classroom Rules



So, if Emily posed a question and only saw four hands raised but wanted eight, she would wait until eight hands were up. If the given number of hands raised was not generated, then she would tell the class that not enough hands were raised, and Emily would wait. At other times I saw Emily tell the class that certain students, often those who frequently contributed, had to wait to speak until other students shared their thoughts. The message conveyed was that all were expected to participate, not just those who typically participate.

Another teacher, Caitlyn, commented that she did not want students to think they could get out of the class discussion. "Some kids will go, 'I don't know Ms.,' and then I will let them go and every day they will keep saying, 'I don't know Ms., I don't know, I don't know.'" Caitlyn was worried that if such situations continued, then the student would "learn" that they would never have to participate, "So on those occasions I will wait it out." I often observed her waiting over a minute for students to organize their thinking and respond.

Many of the teachers believed that the classroom discourse would be richer if several students contributed; randomized participation was a common method used in nearly every classroom I visited. Some teachers used cards with students' names on them, or some variation of this technique, to select who would participate. Another teacher used an application on his smart board, originally intended to track attendance, to also select students, while other teachers used such things as dice to roll a number assigned to a group of desks within the classroom. Regardless of the method used, these structures reinforced the notion that all students would be expected to participate. With that said, Caitlyn mentioned that at times she would draw a name from her deck but notice that a student, who was often reluctant to participate, had her or his hand up. Even though the name on the card did not match the name of this often-reluctant student, she would call on the student with the raised hand. She explained, "If I see that this quiet student has his [or her] hand up, there is no way that I am not going to call on him. So I just say his name as if I am reading it off the card."

Another teacher, Samantha, would also ask students to stay after class if they did not wish to participate during class. When first hearing about this technique, I thought it would lead to disciplining the students. Instead, she held them after class to have a conversation with them on the mathematics that was discussed in class. "I still want them to participate, and I want to know if they are really listening. Did they really take in what is going on?" Samantha said that her students quickly learned that they would have to talk about the mathematics anyway, so students quickly learned to do it during class rather than during their free time. "All my kids know that they have to participate or say something or talk about [the mathematics]; they have to be in the discussion." Again, participation was expected; procedures were put in place to support discourse from day one.

Diversifying discourse

Discourse can take many forms (Truxaw & DeFranco, 2009) including partners, small groups, larger teams, and the whole class. Some varied forms of discourse might include such things as planned student presentations or number talks wherein the teacher facilitates a discussion about students' solutions and problem solving strategies.

Some teachers used a variation of a strategy that I call Four Corners, where a question or statement is posed by the teacher with several possible responses—similar to a multiple choice problem. The teacher assigns one

possible response to each of the corners in the classroom and students move to the corner they believe is the most accurate. For example, the teacher might state that when the side length of a square is doubled then the area is: (1) Also doubled, (2) larger but not doubled, (3) four times larger, or (4) doubled only if the square has a side length of one unit. Students would then move to the corner they believed best represented the solution. Next, groups would hold their own discussions on the validity of their beliefs. After a few minutes the teacher would then call on a student from each group to justify the group's collective answer. Even if students were not initially able to articulate their thinking, they were able to do so afterwards because they engaged in small group discourse. As a result of this process, the students had to take a stance regardless if they were certain of the solution or not. In turn, this required students to reflect on their beliefs or assumptions, which often resulted in students identifying misconceptions in their thinking.

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The Teachers' Role

Teachers play a crucial role in supporting students' reasoning during classroom discourse, and every teacher in this study described her or his role as being a facilitator. While important, a facilitator cannot exist as the only role of the teacher. In fact, it should not be the first role that comes to mind. Rather, teachers must first fulfill roles in creating a classroom culture that promotes the type of discourse in which the teacher can act as a facilitator. While some strategies teachers use to create classroom cultures of participation have been shared, other strategies that should be used during discourse include such things as valuing all responses, teaching students to focus on process not just solutions, and using purposefully chosen open-ended problems that have more than one solution. With that said, one area in which middle level teachers need to be mindful deals with students' affective development.

Adolescence is obviously a fragile time of significant emotional, social, and cognitive development. Many students may be reluctant to share their thinking, but this averseness does not mean that their ideas should not be heard. Every teacher in this study was aware of the unique developmental needs of adolescents, but most of them also believed, at least initially, that the "quiet" students should not be called upon. Emily, who initially held this belief, eventually came to understand that part of her role was to encourage participation from all students. She said, "Every student has something to contribute and every class has a few who are more than willing to dominate the discussion. It is so tempting for the teacher to buy into this [undemocratic hierarchy] since it helps move the discussion along." Jerry strongly believed that he should not call on quiet students because, "I get this sense that they are not comfortable; they are not able to speak; they need another year to build up their confidence." Such beliefs are troubling. Imagine the experience for such a student if every teacher held a similar belief. The student would rarely speak in class and thus not have opportunities to develop her or his skills in mathematical reasoning. Roberts and Billings (2009) remind educators, "The simple lesson that teachers sometimes forget is that learning to communicate is learning to think" (p. 82).

Discussion

Students' ability to engage actively and autonomously in meaningful discourse—the interpretation, evaluation, and construction of valid mathematical arguments—is imperative to their learning. Mathematics is a social endeavor and this means that teachers need to first create cultures of participation in order to promote meaningful and rich classroom discourse. Building students' trust so they believe they can be successful (Van Hoose, Strahan, & L'Esperance, 2001), strengthening their self-efficacy (Pajares, 2005), and establishing classroom norms that foster a sense of community (NMSA, 2010) are important whenever implementing strategies to promote learning. Furthermore, discourse has the potential to empower students in their learning (Hull, Balka, & Harbin Miles, 2011) and establish social equity within the learning environment. In essence, by deliberately implementing strategies and using structures that create a culture of participation, students recapture the intellectual authority of the classroom that is rightfully theirs to

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begin with. Structuring the culture of the classroom begins on the first day of school and is reinforced each day thereafter.

Classroom discourse as a means of creating equitable and rich learning environments needs to be a standard element in the classroom. Expecting participation in learning, the shared and open access to all students' thinking and ideas while simultaneously respecting and acknowledging individuals' needs, is good teaching; the intellectual authority in the classroom belongs with the students. Getting students to openly talk and engage in the social construction of mathematical learning takes time and patience, for students and teachers. Initially, not all adolescents may want to talk about mathematics in a whole-class setting but all of their ideas matter and their voices deserve to be heard. Creating a culture of participation, wherein students feel safe to openly discuss their thinking, can begin from day one.

While time is a highly valuable commodity in the classroom, creating a culture of participation and being patient as all students learn to interact in a respectful, caring, and intellectually challenging environment is imperative. Nurturing young mathematicians, developing creative thinkers, and supporting each student on this path begins with a strong culture of participation. It may not be an easy path at times, but it is well worth it.

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