1.4: Power and Participation of Mathematical Discussion

**BUMBLEBEE Pre-Reading Questions**

1. What power do you think students exercise when they are able to ask a question in class? Likewise, what power do you think is lost from not being able to ask a question?

2. Why do you think having mathematical discussions is important for all students and why do you think it is essential for EBs?

3. What is the teacher’s role when EBs are engaged in mathematical discussions with their peers?

“We are striving for… equity in our classrooms and schools, but often failing to genuinely interact with each other in ways that support this goal”

– Zacko-Smith & Smith (2010)

Have you ever asked your students a question only to then be surrounded by silence? Or have you experienced this yourself as a student? We can give three seconds of wait time, which should be at least five seconds for EBs, yet even after 30 seconds go by we might still be met with silence. What do you think is going on? Is prolonged silence a positive part of the learning process? Or is prolonged silence a negative sign? It is impossible to tell what the silence means without knowing the context, so we will focus on dialogues happening during mathematical discussions. Of course, there is no one absolute way to have all of our students answer all of our questions instantly. In fact, as we will see, this is not even ideal.

What we can do is create a classroom that welcomes and encourages participation. A classroom built on culturally sustaining pedagogy (CSP) is one way to help foster productive communication between students or between students...
and the teacher. The former focuses on participation for EBs to engage in discussions, and the latter reflects on the power that you, as a teacher, have. Thus, we started this chapter with a quote from Zacko-Smith and Smith (2010) because the heart of equity appears in and through dialogue. At the same time, mathematical discussions allow students to have meaningful interactions with their peers in solving rich mathematical tasks. In this chapter, we will focus on the importance of having our students engage in mathematical discussions, and in the next chapter we will focus more on mathematical languages. This leads us to the question of how we can guide a discussion that advances student learning, which is briefly addressed by former NCTM President, Diane Briars.

Watch this 3 minute YouTube Discussions that Advance Mathematical Learning video below.

In this video, Diane mentioned that providing sufficient time for discussion is important and recommended not asking students, “Who wants to share?” because your student’s replies may not go along with the learning objectives. If we do not ask students to randomly share what they’d like to share, how should we initiate and continue a discussion with students? Sharing time is also part of your instruction time, so it should be carefully planned to maximize students’ learning and participation. One way we can accomplish this goal is through the 5 Practices for Orchestrating Productive Mathematics Discussions.

5 Practices for Orchestrating Productive Mathematics Discussions

Smith et al. (2008) provided five practices for orchestrating a productive mathematical discussion, which are:

1. anticipating
2. monitoring
3. selecting
4. sequencing
5. connecting
Specifically, for EBs, the first step, **anticipating**, is key for addressing language concerns before they engage in mathematical learning. Without anticipating what EBs will be doing, the rest of the steps will be difficult for teachers to help EBs engage in, similar to the role of Act 0 in the 5 Act Task. Some of you may be familiar with *Illustrative Mathematics*, a digital mathematics textbook. Illustrative Mathematics is a non-profit organization that provides guidance and support for improving mathematics education, which has a blog on *the 5 Practices for Orchestrating Productive Mathematics Discussions*, along with many other resources for teachers. Use this link to access the blog: [The 5 Practices: Looking at Differentiation Through a New Lens](#).

When you think you understand the 5 Practices, use the following task, which is from nctm.org, to check your understanding of one of the practices, sequencing. Try to solve the problem by yourself first and then carefully monitor the students’ progress. Then, decide the sequence for what you want each student to share while considering your objectives.

Problem (adapted from nctm.org): In the movie “Pay It Forward,” a student, Trevor, comes up with the idea that he can change the world. He decides to do a good deed for three people and with the hope that each of these three people would do a good deed for three more people and so on. He believed that before long, there would be good things happening to billions of people. At stage 1 of the process, Trevor completes three good deeds.

1. **How does the number of good deeds grow from stage to stage? Describe the pattern in a sentence.**
2. **How many good deeds would be completed at stage 5?**
3. **Describe a function that would model the Pay It Forward process at any stage.**

Student groups’ solutions:

An interactive H5P element has been excluded from this version of the text. You can view it online here: [https://iastate.pressbooks.pub/teachingmath/?p=68#h5p-12](https://iastate.pressbooks.pub/teachingmath/?p=68#h5p-12)

**Mathematics and Language**

Hierarchical modes of learning a language, where learning is a linear logical chain, is a classical view of language and mathematics, sequencing teaching language first and mathematics later (Gutiérrez et al., 2010). As teachers, we know that if we wait for students to master a language before we teach mathematics, then our students will fall behind their peers in mathematics. Take the example of being in a foreign language class and only learning the rules of a new language and not practicing speaking the language until you master the rules. Are you learning that language when you are only learning the rules? It makes more sense to learn the rules along with getting practice speaking the new language. This example is similar to mathematics and language in that when we practice both together, they build and support each other.

Yet, for students who are practicing English, answering their teacher’s questions may not be enough. We need to ensure that students are practicing the target language by engaging in dialogue with each other. The best way to do this in mathematics classrooms is to learn both English and mathematics through mathematical discussions. As recommended by Moschkovich (2010), we need to consider language in multiple settings and pay attention to how language does and does not manifest itself when EBs are engaged in a mathematical discussion. As stated by Gutiérrez (2018), “powerful learning is oftentimes a communal endeavor, not an individual one” (p.142). With mathematical...
discussions, EBs will not only hear their teacher but will hear how other students communicate while being immersed in the language.

### Teacher Authority and Power

When we say “teacher authority,” we are talking about the balance between teacher-centered and student-centered learning. At the same time, what is the teacher’s role during a student-centered mathematical discussion? As teachers, it is our duty to actively listen to students, to ensure that EBs have an opportunity to participate in discussions. It could be as simple as reminding students that they can draw figures and make tables that can help EBs better communicate. Or reminding students that they are allowed to speak in any language they choose. At this point, teachers should also remember that they are listening to mathematical meaning-making and not correcting EBs’ language and grammar use. Remember, comprehension of language and mathematics is continually built through dialogue because no one person can know everything.

Additionally, it is the teacher’s role to ask meaningful questions that help students dive deeper into their mathematical discussion. Here is where the power of a teacher lies – if a teacher can examine a task and anticipate what is needed to encourage EBs to exchange of ideas during a mathematical discussion, then these ideas, whether they include drawing pictures or using tables, can be built into the discussion, allowing for deeper engagement and communication between all students. Encouraging EBs to draw pictures and use tables is helpful because they now have the means to help mediate their mathematical discussion with the teacher and other students.

Teachers may not realize that selecting a problem’s context is powerful. For EBs, we need to make sure the problem’s context is void of any cultural bias because the last thing we want is the problem to force EBs to shut down, disengaging them from learning. Teachers can change the context to remove any cultural bias or prepare to pre-teach any unfamiliar cultural aspects before students start solving the task. Furthermore, problems grounded in the real world that reflect the identities of our students may be more engaging and motivating for all students because using these contexts places value on students’ real-world, not an artificial or ideal world.

Everything mentioned in this section highlights the political power of teachers. Once again, we do not mean political in terms of political party affiliations, what we are referring to is the actions and choices that teachers make that impact students. For example, choosing to incorporate EBs’ home culture in the classroom is a political act in that by seeing their home culture in school, students may feel more comfortable in the classroom. Choosing not to incorporate EBs home culture in class is also a political act because the potential benefits of doing so are lost. Teachers are charged with educating students; thus, all teacher actions have political consequences.

### Mathematics and Multiple Interactions of Language Engagement (Math-MILE) Tool

It is important for all students, especially for EBs, to have opportunities to speak, write, read, and listen in mathematics classes, with teachers providing appropriate linguistic support and encouragement. Many teachers think they should reduce the number of words and the amount of reading for EBs because of the language barriers and extra time needed. We have often heard this kind of saying, “This is EB-friendly because there are no words.” No doubt that these teachers have good intentions, helping EBs. However, if EBs do not have any exposure and experience with the target
language, how can they learn the new language? Here is Walqui and van Lier’s (2010) advice:

**Amplify, don’t Simplify**

Again, amplify, don’t simplify. Our roles, as teachers, are not in controlling or removing students’ learning opportunities because we assume what they can or cannot do. Rather, we create opportunities and conditions in which learners can develop greater autonomy over their own learning. Based on this belief, we developed the Mathematics and Multiple Interactions of Language Engagement (Math-MILE) Tool by adapting the Language Demand in Mathematics Lessons (LDML) tool (Aguirre & Bunch, 2012).

The LDML tool is a lesson design tool that helps teachers plan, implement, and reflect on their mathematics lessons with five language demands: reading, writing, speaking, listening, and representing. It is important for teachers to note that students do not develop language in any modality in isolation. Hence, it is crucial to consider including both receptive (reading and listening) and productive (writing and speaking) practice, as well as literacy (reading and writing) and oral language (listening and speaking). Representations, such as graphs, figures, and diagrams, are particularly important in mathematics lessons because they help EBs express mathematical knowledge and expand EBs’ opportunities to understand and engage in a mathematical discussion. Here we provide some sample instructional questions for teachers to consider when using this tool during lesson planning (adapted from Aguirre & Bunch, 2012, p. 188.)

- Do one or two language demands dominate my lesson plan?
- What does this information tell me about how I can support my EB students?
- Are language demands in one of the modes absent from a specific interaction type or the entire lesson?
- If my lesson plan has no writing demands, how will the absence of writing affect my EBs’ mathematics learning?
- Do my EB students have enough time to interact with me and other students, both EBs and non-EBs?

The LDML tool is a matrix of the five language demands and three phases of a lesson, but we modified the LDML tool by adding interaction types instead of the lesson phases and named the modified tool as Mathematics and Multiple Interactions of Language Engagement Tool (Math-MILE Tool). The following figure is the matrix of the Math-MILE Tool.

<table>
<thead>
<tr>
<th>Interaction Types</th>
<th>Reading</th>
<th>Writing</th>
<th>Speaking</th>
<th>Listening</th>
<th>Representing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between the teacher and student(s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between student(s) and student</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our rationale behind the inclusion of interaction types is that EBs need to experience various interactions through mathematical discussions of multiple language modalities. If an EB has only individual reading, writing, and representing, the learning that occurs will be limited. If a teacher is the only one interacting with an EB, the EB’s social status in their peer group will be reduced and this will influence their learning and motivation to learn as well. Although
EBs may need individual preparation time, sometimes, just like other students, they also need to increase their confidence by participating in multiple forms of interactions, such as pair work, small group discussion, and whole-group discussions.

**Recommendations**

Mathematical discussion creates a space in the classroom for EBs to empower themselves. Through active engagement within mathematical discussions, students can move beyond simply explaining mathematics, and instead, they can generalize mathematical concepts (Hunter, 2017). It is worth noting that if the context of the problem utilizes a student’s identity and home culture, mathematical discussions can also create spaces of self-discovery. While EBs construct mathematical knowledge with their peers, they develop their identities as well. If EBs can see themselves as creators of mathematical knowledge, then they can imagine themselves as mathematicians and scientists later in life.

**Chapter 4 BUMBLEBEE Post-Reading Questions**

1. How can the 5 practices for orchestrating productive mathematical discussion further enhance EBs’ meaningful participation?
2. What does it take to have EBs lead whole-class discussions and how is that different from small group discussions?

**References**


