Mathematical Discourse in the French Immersion Classroom

Lisa Sauder

Math class begins, and I ask my students questions, trying to encourage dialogue or discourse as we attempt to solve a problem. "Je ne comprends pas" ("I don't understand") and "Je ne sais pas comment dire" ("I don't know how to say") are often the first comments out of my students' mouths.

I'm frustrated. Mathematical discourse helps students extend their thinking, link mathematical concepts, and develop language skills and vocabulary (Alberta Education 2007). However, as an elementary French immersion teacher, I know that creating an atmosphere that encourages mathematical discourse can be challenging.

I often find myself rushing to the aid of my students, giving them not only vocabulary but also strategies. I habitually end up doing much of the work for them, which has driven me to search for strategies that will help me facilitate mathematical discourse in my elementary French immersion classroom. Finding strategies specific to French immersion is no easy task, but much research has been done on the importance of mathematical discourse and on its characteristics, as well as on second language acquisition (SLA) (Hufferd-Ackles, Fuson and Sherin 2004; Moschkovich 2012; Yackel and Cobb 1996). We will examine these aspects as we consider how French immersion teachers can promote mathematical discourse in the classroom.

According to the National Council of Teachers of Mathematics (NCTM 1991, 34), *discourse* refers to "the ways of representing, thinking, talking, agreeing and disagreeing." The NCTM's communication standards place importance on students being able to organize their thinking through communication, to communicate clearly and coherently (with the teacher and with peers), and to evaluate the thinking and strategies of their peers.[1]

Creating effective mathematical discourse in a classroom setting requires skills and knowledge related to student learning and how to effectively teach mathematics. This task can be complicated by the fact that students in French immersion are learning a second language and often lack the vocabulary and confidence needed to participate in discourse.

Alberta Education's (2014) *Handbook for French Immersion Administrators* states that a successful French immersion program includes ongoing development of French-language skills, such as speaking and listening, in all subject areas. Developing these language skills in mathematics is not always a priority for teachers because of the challenges it presents. Discourse, however, is clearly an important part of Alberta's mathematics program of studies (Alberta Education 2007). Three of the seven mathematical processes outlined in the program of studies expect students to "communicate in order to learn and express their understanding," "connect mathematical ideas to other concepts in mathematics" and "develop and apply new mathematical knowledge through problem solving" (p 4). While French immersion teachers may see the value of using discourse in mathematics, it is not always something that comes naturally to teachers and students.

The NCTM process standards recommend that students communicate with each other, not just with the teacher. Communicating with peers allows them to organize and justify their thinking. The teacher's role as a facilitator means that he or she must guide discourse and create meaningful opportunities for students to share and justify their mathematical thinking, and students need to actively listen and respond not only to the teacher but also to their peers.

There are, in fact, many strategies French immersion teachers can use to promote mathematical discourse. First, they can help students connect mathematical understanding to language, especially in the SLA classroom. Second, it is imperative that social and sociomathematical norms be established from

the beginning of the school year, in order to enrich mathematical discourse. French immersion teachers can also use strategies such as creating activities that require output from students and using revoicing to help students share their understanding. After discussing these strategies, I will share tools I have used in my own elementary French immersion mathematics classroom as I strive to promote and increase mathematical discourse.

Connecting Mathematical Understanding to Language

A significant dilemma in creating mathematical discourse in the French immersion classroom is that students come to class with varying levels of language skills and prior knowledge. Adler (1997) discusses the participatory-inquiry approach, in which students are expected to take responsibility for their learning by working together in small groups to solve engaging mathematical tasks. According to Adler, it is important that teachers withdraw from helping students too much and that they use mediation, which is "essential to improving the substance of communication about mathematics and the development of scientific concepts" (p 255). French immersion teachers struggle to find a balance between withdrawing and mediation, but it is important to find ways to link mathematical understanding to language as students participate with each other through discourse to help support their communication.

Moschkovich (2012) makes five recommendations for linking mathematical understanding to language. These recommendations are particularly helpful for teachers of students learning a second language, and they can help French immersion teachers develop strategies for supporting students' mathematical thinking, as well as facilitating discourse in the SLA classroom. It is important that French immersion teachers understand that although language can be a barrier to sharing understanding, it can also be an effective tool to help students make connections and justify their thinking and understanding. Moschkovich's five recommendations are as follows.

First, teachers should focus on the mathematical content of what students are saying, not the accuracy of their language. Teachers should try to understand students' mathematical thinking by asking questions and rewording what students have said.

Second, teachers need to shift their focus to mathematical discourse practices and move away from simplified views of language. During mathematical discourse, the focus should be on explaining, justifying and expanding ideas, rather than on simple vocabulary and definitions. Teachers can use a variety of tools to help students share their understanding, such as asking students diverse questions that require different levels of thinking, modelling brainstorming for students and allowing students to work in groups.

Third, teachers should recognize and support students as the complexity of language increases. Discourse should incorporate

- a variety of modes that will meet the different needs of students, such as oral and written communication, as well as the use of rewording and gestures;
- numerous representations, such as graphs, symbols, pictures and words;
- a variety of written texts, including word problems and student and teacher explanations;
- exploratory and expository talking; and
- various audiences, including the teacher and other students.

Fourth, teachers should see students and their growing language skills as resources. It is important for teachers to remember that as students begin to make sense of mathematical concepts, they will begin to make connections between their understanding and their language.

Fifth, it is crucial that teachers uncover the mathematics in what students say and do. Teachers should use a variety of strategies to understand how their students are thinking mathematically, which may include rewording what students have said, conferencing with students one-on-one, and using scaffolding and other supports as means of differentiation.

Establishing Norms

Establishing norms in the mathematics classroom is an important part of discourse (Cobb 1999; Cobb et al 1992; Yackel and Cobb 1996). This is especially true in a French immersion setting as students learn what is expected of them, as well as how they can respond to the teacher and to each other. Teachers must monitor student engagement to ensure that all students are actively participating. They must also be patient and have effective classroom-management skills if they are to be successful in creating mathematical discourse in which all students are active participants and listeners (Fraivillig, Murphy and Fuson 1999).

When establishing social norms for mathematical discourse in the classroom, it is important to distinguish between social norms and sociomathematical norms:

> The understanding that students are expected to explain their solutions and their ways of thinking is a social norm, whereas the understanding of

> what counts as an acceptable mathematical explanation is a sociomathematical norm. Likewise, the understanding that when discussing a problem students should offer solutions different from those already contributed is a social norm, whereas the understanding of what constitutes mathematical difference is a sociomathematical norm. (Yackel and Cobb 1996, 461)

In mathematical discourse, students are required to give different solutions for the same problem. Yackel and Cobb (1996) refer to this as mathematical difference. If teachers require their students to share different methods for solving problems, it is important that they first establish what is meant by *mathematical difference*. Through discourse and the exchange of ideas, students begin to see how their solutions are mathematically different, and the teacher begins to understand how to guide students to offer mathematically different solutions. In a French immersion setting, it is especially important that students share mathematical differences for problems, because this task not only extends their understanding but also exposes them to a variety of vocabulary and language models.

One of the teacher's most important roles during mathematical discourse is to facilitate rather than lead (by avoiding doing all the talking and presenting all the strategies and solutions); however, teachers are also participants who can help students decide if strategies and solutions are valid (Yackel and Cobb 1996). Hufferd-Ackles, Fuson and Sherin (2004) found that teachers must help students move through various trajectories, from being primarily teacher-led to student-led in the areas of questioning, explaining mathematical thinking, source of mathematical ideas and responsibility for learning. Teachers should ask open-ended, high-level questions, and students should be encouraged to share their ideas, even after the correct answer has been provided. This allows students to share their strategies with the entire class, thereby allowing all students to learn new strategies from each other, as well as to increase their language skills.

Teachers should not assume a passive role during discourse, especially in a French immersion setting, where students may not have the necessary vocabulary to participate (Moschkovich 2012). Rather, teachers should assume an active role. According to Yackel and Cobb (1996, 466), "The increasingly sophisticated way [teachers] select tasks and respond to children's solutions shows their own developing understanding of the students' mathematical activity and conceptual development." This is an important characteristic of the role of the French immersion teacher. Teachers must guide their students to deeper mathematical understanding by using a variety of tools and strategies that will meet students' needs as their mathematical understanding grows and develops.

Teachers must also create a safe environment for their students, enabling them to respectfully argue and justify their mathematical thinking and understanding (Cobb et al 1992). Teachers must make it clear to students that it is safe to make mistakes and that mistakes allow people to learn (McCrone 2005; Wood 1999). This is especially important in a French immersion setting, where students need to feel safe as they share their thinking, even if their language use is not completely accurate. The more that students see the classroom as a safe place to learn and share, the more they will be willing to take risks by actively participating in mathematical discourse.

Krussel, Edwards and Springer (2004, 308) contend that "traditionally, discourse analysis has been concerned with the rules and norms in the classroom, but little attention has been paid to the relation of discourse to the development of mathematical objectives themselves." Teachers should focus not only on how students share during discourse but also on the "nuances and subtleties of the discourse" (p 308) in relation to mathematical objectives. Establishing norms that tie mathematical objectives to discourse is an important element that is often overlooked in the French immersion classroom.

Creating Activities That Require Multiple Representations

The goal of French immersion is not only to help students acquire a second language but also to ensure that they can use their new language to explain their thinking and understanding in all subject areas, including mathematics. Students learning a second language must participate in extended discourse in order to process the language (Swain 2000). During discourse, students must be required to somehow participate, such as orally or in writing. This is especially true in the French immersion classroom, and teachers must ensure that they create activities that require students to represent their thinking in many different ways. As students share their understanding, teachers can help them increase their vocabulary and check for understanding. As well, when students speak, other students are given an opportunity to respond through the use of collaborative dialogue.

Collaborative dialogue is "dialogue in which speakers are engaged in problem solving and knowledge building" (Swain 2000, 102). It allows students

to explore their own thinking and their peers' ideas as they work together to solve problems. As students participate in discourse, they begin to internalize their learning, and their language skills develop and grow. As students actively work together and use collaborative dialogue to solve problems, they use language to explain and clarify their mathematical thinking.

Output is an important part of mathematical discourse, both in small groups and as a class, especially as students are learning a second language (Swain 2000). It is important that students feel comfortable, respected and supported as they actively share their mathematical understanding and strategies. They should also feel comfortable with saying that they do not know the answer (Manouchehri and Enderson 1999). In a French immersion setting, students must be allowed to say that they are not sure how to explain their thinking, and they must be given opportunities to help each other and to get help from the teacher as they expand their language use and vocabulary.

It is vital that all students understand that they are part of a mathematics community in which their knowledge extends through sharing their understanding by using output. This type of discourse creates "meaningful collaborative math-talk" (Hufferd-Ackles, Fuson and Sherin 2004, 91). In a math-talk community, it is the role of students to actively direct their questions and ideas to each other, not only to the teacher. Teachers must set clear expectations for students to be active participants. French immersion students should understand that they have valuable information to share that can help their peers learn, even if they have not yet acquired precise vocabulary. As French immersion teachers, we must develop and encourage mathematical activities and discourse that require output from students in order to allow them to share their understanding, as well as to help them increase their vocabulary.

Using Revoicing

Teachers will often repeat, or revoice, what students have said in order to clarify students' thinking and understanding. *Revoicing* is defined as a linguistic structure that "affords the teacher the tools to coordinate the elements of academic task structure and social participation structure, while simultaneously bringing students into the process of intellectual socialization" (O'Connor and Michaels 1993, 319). Revoicing gives French immersion students a model they can follow for sharing their own mathematical thoughts and ideas. By restating what students have said, teachers give them the opportunity to explain and justify their thinking. Teachers can also ask students to summarize or restate what another student has shared. Revoicing is an effective tool for mathematical discourse in the French immersion classroom because it allows students to share their mathematical thinking while being supported by the teacher or their peers.

As the teacher uses revoicing to clarify or restate student thinking, other students have the opportunity to clarify their own thinking, and they are then more likely to use argumentation and debate, which helps them make mathematical connections and extend their thinking. Revoicing allows the teacher to point out successful participation by students, which encourages other students to participate. Revoicing also models different ways students can share their mathematical understanding.

Recommendations

Teachers can do many things to promote mathematical discourse in the French immersion classroom. Activities should be rich in vocabulary and must actively involve student participation and language use through sharing ideas and thinking, as well as using revoicing to restate the ideas of peers (Moschkovich 2012; O'Connor and Michaels 1993). Students need to use vocabulary in a variety of ways over extended periods of time, and they need to interact with each other in a collaborative manner (Savignon 1991). Tasks and activities must require student output in order for students to not only show their mathematical understanding but also build their language use and vocabulary (Swain 2000). Teachers must ensure that mathematical activities are varied and that they allow students to share their thinking in different ways. I often use games and math stations, even with my older students, to encourage them to use their language as they share their understanding with each other.

Teachers make specific pedagogical choices as they teach, including in the French immersion classroom during mathematical discourse. The types of questions asked by the teacher can encourage student thinking. The teacher has an important role in helping students learn vocabulary and terminology that will allow them to become competent communicators during mathematical discourse (McCrone 2005). Walsh and Sattes (2005) propose six norms that shape learning experiences:

- Students need time to reflect on past experiences in order to create new understandings.
- Students need time to reflect before sharing their thinking.
- Students need time to think out loud.

- Students learn best when they formulate and answer their own questions.
- Students learn best when they respectfully listen to each other.
- When students share talk time, they are showing respect for each other and their ideas.

Teachers must be thoughtful about how they ask questions, how much time they give students to think and how they ensure that all students are participating. According to Walsh and Sattes, a thoughtful teacher "creates structures that engage *all* students in thinking and responding to *all* questions" (p 5). An important shared belief is that quality questions help students learn and that all students can respond to all questions. These norms are especially important in a French immersion setting, as students must be given time to reflect on their thinking before they can formulate a new understanding. Additionally, students must understand that everyone has important ideas to add, even if they cannot share their thinking using perfect or precise language.

French immersion teachers also model different ways of demonstrating understanding and thinking, through the use of gestures, words and even writing (Hintz 2011). Writing in a journal can be a powerful tool for students to record their mathematical thinking. Students can use prompts such as the following:

- What do I already know about this topic?
- What does this question mean in my own words?
- How did I solve the problem?
- How do I know the solution is correct?

Teachers can then use the journals to get a better understanding of students' knowledge of the concepts.

Graphic organizers (such as Venn diagrams, mind maps, lists and charts) also allow French immersion teachers to highlight important mathematical vocabulary.

Conclusion

Mathematical discourse could be compared to an intricate dance, in which all participants must be actively engaged in order for the dance to be its most beautiful and effective. In the past, it was acceptable for the teacher to lead mathematical discourse, but research shows that this role should be shared with students, especially in the French immersion classroom as students learn the new language. Communication standards for mathematics continue to be updated, giving teachers the tools and strategies they will need in order to adapt to the ever-changing dance of mathematical discourse. As students build their confidence and their language skills, they will become better equipped to share and justify their mathematical thinking, and the intricate dance will begin.

Note

1. See www.nctm.org/standards/content.aspx?id=322 (accessed October 23, 2014).

References

Adler, J. 1997. "A Participatory-Inquiry Approach and the Mediation of Mathematical Knowledge in a Multilingual Classroom." *Educational Studies in Mathematics* 33, no 3 (September): 235–58.

Alberta Education. 2007. *Mathematics Kindergarten to Grade 9*. Edmonton, Alta: Alberta Education. Also available at http://education.alberta.ca/media/8775377/k_to_9_math_pos.pdf (accessed October 22, 2014).

———. 2014. *Handbook for French Immersion Administrators*. Edmonton, Alta: Alberta Education. Also available at http://education.alberta.ca/francais/admin/immersion/handbookimm.aspx (accessed October 22, 2014).

Cobb, P. 1999. "Individual and Collective Mathematical Development: The Case of Statistical Data Analysis." *Mathematical Thinking and Learning* 1, no 1: 5–43.

Cobb, P, T Wood, E Yackel and B McNeal. 1992. "Characteristics of Classroom Mathematics Traditions: An Interactional Analysis." *American Educational Research Journal* 29, no 3 (September): 573–604.

Fraivillig, J L, L A Murphy and K C Fuson. 1999. "Advancing Children's Mathematical Thinking in Everyday Mathematics Classrooms." *Journal for Research in Mathematics Education* 30, no 2 (March): 148–70.

Hintz, A B. 2011. "Understanding Students' Experiences as Listeners During Mathematical Discussion." *Canadian Journal of Science, Mathematics and Technology Education* 11, no 3: 261–72.

Hufferd-Ackles, K, K C Fuson and M G Sherin. 2004. "Describing Levels and Components of a Math-Talk Learning Community." *Journal for Research in Mathematics Education* 35, no 2 (March): 81–116.

Krussel, L, B Edwards and G T Springer. 2004. "The Teacher's Discourse Moves: A Framework for Analyzing Discourse in Mathematics Classrooms." *School Science and Mathematics* 104, no 7 (November): 307–12.

Manouchehri, A, and M C Enderson. 1999. "Promoting Mathematical Discourse: Learning from Classroom Examples." *Mathematics Teaching in the Middle School* 4, no 4 (January): 216–22.

McCrone, S S. 2005. "The Development of Mathematical Discussions: An Investigation in a Fifth-Grade Classroom." *Mathematical Thinking and Learning* 7, no 2: 111–33.

Moschkovich, J. 2012. "Mathematics, the Common Core, and Language: Recommendations for Mathematics Instruction for ELs Aligned with the Common Core." Paper presented at Understanding Language: Language, Literacy, and Learning in the Content Areas, Stanford University, Stanford, California, January 13. Also available at http://ell.stanford.edu/sites/

default/files/pdf/academic-papers/02-JMoschkovich%20Math%20FINAL_bound%20with%20appendix.pdf (accessed October 23, 2014).

National Council of Teachers of Mathematics (NCTM). 1991. *Professional Standards for Teaching Mathematics.* Reston, Va: NCTM.

O'Connor, M C, and S Michaels. 1993. "Aligning Academic Task and Participation Status Through Revoicing: Analysis of a Classroom Discourse Strategy." *Anthropology and Education Quarterly* 24, no 4 (December): 318–35.

Savignon, S J. 1991. "Communicative Language Teaching: State of the Art." *TESOL Quarterly* 25, no 2 (Summer): 261–77.

Swain, M. 2000. "The Output Hypothesis and Beyond: Mediating Acquisition Through Collaborative Dialogue." In *Sociocultural Theory and Second Language Learning,* ed J P Lantolf, 97–114. Oxford: Oxford University Press.

Walsh, J A, and B D Sattes. 2005. *Quality Questioning: Research-Based Practice to Engage Every Learner.* Thousand Oaks, Calif: Corwin.

Wood, T. 1999. "Creating a Context for Argument in Mathematics Class." *Journal for Research in Mathematics Education* 30, no 2 (March): 171–91.

Yackel, E, and P Cobb. 1996. "Sociomathematical Norms, Argumentation, and Autonomy in Mathematics." *Journal for Research in Mathematics Education* 27, no 4 (July): 458–77.

Lisa Sauder is the assistant principal at James Mowat Elementary School, in Fort Saskatchewan. Before that, she taught Grades 5 and 6 at École Campbelltown School, in Sherwood Park. Seeing students struggle with sharing their mathematical thinking in a second language inspired her to do a master of education degree in mathematics through the University of Alberta. Helping students find their mathematical voice has become a passion for her.