REALIZATION OF A LANGUAGE-AS-RESOURCE ORIENTATION IN LANGUAGE IMMERSION MATHEMATICS CLASSROOMS

José Manuel Martínez
Michigan State University
mart1580@msu.edu

Researchers have argued for an orientation to language as a resource that values bilingualism in mathematics classrooms. However, little is known about what mathematics teachers can do to translate a language-as-resource orientation into productive classroom practice. In this study, I analyze video data from two language immersion classrooms to understand pedagogies that are possible in contexts where bilingualism is seen as a resource. I argue that teachers' purposefully devised discursive practices used students' languages in ways that enhanced mathematical learning opportunities. I provide examples from the classrooms and discuss implications for research in bilingual classrooms where a language-as-problem orientation dominates.

Keywords: Classroom Discourse, Equity and Diversity

Mathematics teachers in bilingual classrooms deal with competing language-related orientations. While some orientations regard bilingualism as a problem to avoid or overcome, others regard them as a resource. Mathematics education researchers have drawn on what Ruíz (1984) called language-as-problem and language-as-resource (Planas, 2014; Planas & Civil, 2013; Setati, Molefe, & Langa, 2008). An orientation toward language as a problem creates a hierarchy, namely, one language dominates communication while devaluing other non-dominant languages. This orientation emphasizes lack of proficiency in the community's dominant language as a handicap and, ultimately, marginalizes users of non-dominant languages. In contrast, an orientation toward language as a resource questions language hierarchies by valuing and encouraging bilingualism. Mathematics education researchers have analyzed implications of a language-as-resource orientation to mathematics classrooms (Planas & Civil, 2013; Planas & Setati-Phakeng, 2014). These studies have focused on student-student interactions, describing the benefits of allowing students to speak in their preferred languages. Less is known about what else, besides allowing students to use more than one language, teachers can do.

In language immersion classrooms, learning a language other than the community's dominant language is regarded as useful, and learning mathematics in such language is seen as possible. Therefore, language immersion classrooms provide opportunities to observe discursive practices that are possible when teachers look pass limiting language orientations. In this study, I explore different ways in which teachers translate the language-as-resource orientation in which their classrooms are embedded into specific discursive practices. I argue that teachers purposefully devised discursive practices that used both students' languages in ways that enhanced students' mathematical learning opportunities. I ask the following research question: What discursive practices do teachers in language immersion classrooms enact to enhance mathematical learning opportunities? Understanding this question may illuminate what teachers in bilingual classrooms embedded in contexts that hold a language-as-problem orientation can do to disrupt restrictive language practices.

Theoretical Framework

Instead of regarding discourse as a stretch of speech, Peirce (1989) viewed discourse as guiding what is considered possible:

> Discourses, in a poststructuralist theory of language, are the complexes of signs and practices that organize social existence and social reproduction. In this view, a discourse delimits the range of

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possible practices under its authority and organizes how these practices are realized in time and space. (pp. 403-404)

Besides regarding language as part of discourse, this view also sees it as a mechanism to create, reproduce and enforce discourse. Language delimits and is delimited by the practices that a discourse organizes as possible. Those who participate in such practices are privileged while those who do not are marginalized, since "when participants cannot find subject positions for themselves within a particular discourse, they may be silenced" (Peirce, 1989, p. 405). Peirce (1989) proposed that teachers engage in a *pedagogy of possibility*, that is, a pedagogy that encourages teachers to reconsider which language discourse practices are possible. For the purpose of this study, the notion of a pedagogy of possibility draws attention to creative teacher practices that are consistent with a language-as-resource orientation. Attending to instances of intentional productive use of languages may support teachers in bilingual mathematics classrooms to develop pedagogies that are consistent with a language-as-resource orientation.

Teachers' regulatory role may silence students' use of their preferred languages, potentially muting all contributions from particular students (Planas & Civil, 2013). Alternatively, teachers may enhance learning opportunities through the strategic and intentional use of students' languages. Following previous research on language-as-resource in mathematics classrooms, I focused on learning opportunities: "By referring to learning opportunities, we avoid fundamental claims about whether or not mathematics learning has actually taken place, but instead put the focus on the opportunities for communication and participation created by learners as well as by teachers" (Planas & Civil, 2013). I define *bilingualism-as-enhancer* as the strategic use of more than one language to enhance learning opportunities.

Methodology

Two Spanish immersion classrooms participated in this research. One was a third-grade classroom, with 14 students from middle class families. The teacher, señora Abad, is a US-born Latina, who considers both English and Spanish as her native languages. The second was a second-grade classroom, with 23 students from economically struggling families. The teacher, Ms. Griffin, is a US-born Caucasian teacher, whose native language is English. Both teachers conducted mathematics class in Spanish. All students' native language is English.

Data Sources

I draw on audio-recorded interviews with each teacher and mathematics class video recordings. While video-recording class lessons using a handheld camera, I focused on the teacher during whole class discussions, and then alternated focus on different groups during small group tasks. I video recorded eight lessons of a geometry unit in señora Abad's class, and three lessons of a number sense unit in Ms. Griffin's class. Unstructured interviews took place after video recordings. The teachers and I discussed the interplay between language and mathematics in video recorded segments. All interviews were fully transcribed.

Data Analysis

Following Powell, Francisco and Maher's (2003) video analysis model, I annotated videos to identify focal episodes. I engaged in repeated attentive viewing, which included watching the videos three time to refine interpretations and redefined episodes I interpreted as *bilingualism-as-enhancer*. Then, for each teacher I selected one lesson that seemed to provide more examples than other lessons of the role of using more than one language in enhancing the teaching and learning of mathematics. This process resulted in 10 focal episodes: 6 from señora Abad's class, and 4 from Ms. Griffin's.

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Second, each teacher and I analyzed the video of their lesson collaboratively. In-depth focus on one video is consistent with the study's purpose of illustrating possible discursive practices, without claiming that what I describe is an exhaustive list. The teachers and I discussed interpretations of the role bilingualism played in supporting mathematics learning opportunities. I transcribed these discussions and the focal video episodes. I added quotes from the discussions with teachers to specific parts of the video transcripts. Finally, following a constant comparative method (Glaser & Strauss, 1967), I coded discursive practices in the transcripts and identified emerging themes. I followed Young's (2008) view of discursive practice in language immersion contexts. This view attends to the interplay between orientations at the societal level and interactions at the classroom level: "The aim of discursive practice is to describe both the global context of action and the communicative resources that participants employ in local action" (p. 3). This definition resonates with this study's purpose of attending to societal language orientations—*language-as-resource* in particular—in relation to what teachers do to enhance mathematics learning opportunities.

Findings

There were two main teacher discursive practices that relate to bilingualism-as-enhancer: (1) choosing the language that more transparently represents a mathematical idea, and (2) supporting students' inference of mathematical terminology. In this section, I present an example from the classrooms and an interpretation of what motivated the practice that illustrates bilingualism-as-enhancer. The transcript conventions are: **Emphasis,** <Speaker slows down>, *Translation*, and --- silence.

Choosing the Language that Represents a Mathematical Idea more Transparently

As Ms. Griffin's class (second grade, Spanish immersion classroom) worked on a mystery numbers task, each student wrote a number that no one else could see. Each student wrote clues for the rest of the class to figure out the number. For one of the cards, Ms. Griffin read out loud one clue at a time. The teacher solicited guesses and explanations from students. After each clue, the class discussed whether they had enough clues to come up with one unique number. In the following example (see Table 1), Ms. Griffin had read the clue, "Tengo tres dígitos" (*I have three digits*). After discussing this clue, she read and wrote on the board the second clue, "Soy impar" (*I am odd*). She asked for examples of odd numbers. Ms. Griffin asked Dereck and Karen—two African American students who had started in the Spanish immersion program that academic year—what they thought.

Ms. Griffin and I interpreted this episode as an example of intentionally choosing the language that represents a mathematical concept in a more transparent way. The teacher tended to use English to support the participation of students new to the Spanish immersion program, like Karen and Dereck. In this episode, however, she chose Spanish to support students' understanding. She used the Spanish words par (*even*) and impar (*odd*) because she could relate one word with the other and with the mathematical concept with which the class was engaging. It seemed like rather than not knowing whether a number was even or odd, Karen and Dereck had a hard time remembering to what set of numbers the word *odd* refers and to what set of numbers the word *even* refers (lines 3-4 and 20-22). In English, the words even and odd have different etymologies, and they seemed arbitrary and unconnected. In Spanish, the words par and impar seemed related and more transparent as the prefix im indicates negation: not even.

We interpreted this example as bilingualism-as-enhancer because the use of the two languages helped students clarify and express a mathematical idea. Applied linguists have highlighted the role semantic transparency plays in communication (Bell & Schäfer, 2016). Semantic transparency refers to whether the form of a word makes its meaning explicit. For example, the word *shoemaker* can be considered transparent because parts of the word (shoe and maker) describe its meaning, and those

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parts are easily discernible. In Ms. Griffin's example, the words even and odd seemed opaque for students, whereas par and impar seemed transparent. Although there might be other ways to support students' sense making of the words and concepts of even and odd, in this case the possibility of alternating between the two languages enhanced the learning opportunity.

Table 1: Discussing Odd and Even Numbers

Line	Speaker	Spoken utterances	Translation	Actions
1	Ms. Griffin	Dereck, ¿**im**par dice even or	*Does* impar *say* even or	Underlying im
2		odd?	odd?	
3	Dereck	Are three, five and seven even		
4		or odd?		
5	Ms. Griffin	¿Qué dice par? ¿Alguien	What does even say? Can	
6		puede explicar esto?	someone explain that?	
7	Javier	Par tienes algo que puedes	*Even you have something*	Gestures separating her
8		dividir.	*you can divide*.	hands
9	Ms. Griffin	Sí. En números iguales	*Yes. In equal numbers*	Holds two fingers
10		La clave dice soy **im**par. Soy	*The clue says 'I'm odd.'*	
11		impar dice soy **no** par.	*I'm odd says I'm not even,*	
12		¿Qué número debe de	*In what number does it*	Pointing at last of the
13		**terminar** en el lugar de uno?	*have to end in the ones*	dashes that represent
14			*place?*	each of the three digits
15	Dereck	**Im**par	*Odd*	
16		**No** par	*Not even*	Shakes head
17		Three		
18	Ms. Griffin	So, si este termina en tres, ¿es	*So if this one ends in three,*	Writes 3 on the board
19		par o impar?	*is it even or odd?*	
20	Karen	One, three and seven are		
21		something, and two, four, and		
22		six are something.		
23	Ms. Griffin	Remember, par means	*Remember, even* means *you*	
24		<puedes dividir en números	*can divide into equal*	
25		iguales.>	*numbers.*	
26		<And **im**par means **no** par>	And *odd* means *not even*	
27		Is three par or **no** par, **im**par?	Is three *even* or not *even*,	
28			odd?	
29	Karen	So two is par, and one, three,		Miss Griffin writes
30		five, and nine are **im**par		numbers under Impar
31	Dereck	And seven		
32	Ms. Griffin	And seven		Writes 7 on the board
33	Dereck	And two, four and six are par		

Supporting the Inference of Mathematical Terminology

Señora Abad's class (third grade, Spanish immersion classroom) was finishing a geometry unit focused on classifying two-dimensional (2D) shapes according to the shapes' attributes. During the final lesson of the unit, the class focused on three-dimensional (3D) figures. Señora Abad wanted the class to draw on what they knew about 2D figures to name 3D figures. Her goal was to draw attention on 3D figures' attributes, how the names of the figures represented some of those attributes,

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and the relationship between the 2D figures and the 3D figures. After a class discussion comparing and contrasting 2D and 3D figures, señora Abad projected on the board an image of a pentagonal prism.

Table 2. Naming 3D Shapes

Line	Speaker	Spoken utterances	Translation	Actions
1	Señora Abad	¿Cómo tú piensas que se	*How do you think this is*	Points at drawing of
2		llama esto? Voy a darte un	*called? I'm going to give you*	pentagonal prism
3		minuto para pensar.	*a minute to think. Maybe*	
4		Tal vez algunos saben la	*some of you know the English*	Holds a pentagonal
5		palabra en inglés. Tal vez	*word. Maybe you remember*	prism
6		recuerdas algo que aprendiste	*something you learned in*	
7		en figuras **bi**dimensionales.	*two-dimensional figures*	
8		¿Frank?		
9		Largo	*Long*	Moves hand
10	Frank			horizontally
11		Es largo ¿verdad? ¿Qué más	*It's long, isn't it? What else*	Moves hand
12	Señora Abad	ves en esta figura?	*do you see?*	horizontally
13		Cinco esquinas	*Five corners*	
14	Frank	Cinco lados	*Five sides*	
15	Gloria	Ah. Ves <cinco lados>	*Oh. You see <five sides>*	Points at 5 sides of
16	Señora Abad			the pentagonal face
17		Cinco pirámide	*Five pyramid*	
18	Mike	Tiene cinco lados. OK. ¿En	*It's got five sides. OK. How is*	
19	Señora Abad	qué se parece a una pirámide	*it similar and how is it not*	
20		y en que **no** se parece a una	*similar to a pyramid?*	
21		pirámide?		
22		No tiene triángulos	*It doesn't have any triangles*	
23	Mike	Tiene **pentágono**	*It has **pentagon***	
24	Gloria	Ah. Ah-ha.	*Ah. Aha.*	
25	Señora Abad	Pentágono pirámide	*Pentagon pyramid*	
26	Frank	Pentágono cilindro	*Pentagon cylinder*	
27	Ismael	Qué interesante. Tiene un	*How interesting. It has a*	Points at pentagonal
28	Señora Abad	pentágono	*pentagon*	face. Moves hand
29		y es larga como un cilindro	*and it's long like a cylinder*	along one edge
30				
31		¿Cómo se dice prism?	*How do you say* prism*?*	
32	Gloria	Pentágono prismo	*Prism pentagon*	
33	Frank	**Pentagonal** prismo	*Prism **pentagonal***	
34	Gloria	¿Por qué?	*Why?*	
35	Señora Abad	Tiene un pentágono y es	*It has a pentagon and it's like*	
36	Erika	como un prismo	*a prism*	
37		¿Es como un prisma?	*It's like a prism?*	Moves hands
38	Señora Abad	Como una prisma	*Like a prism*	horizontally
39	Erika			
40				

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Señora Abad and I interpreted this episode as an example of supporting the inference of mathematical terms and phrases. Instead of providing definitions or translations, the teacher encouraged students to experiment with language and come up with terms and phrases that made sense to them. Mathematical ideas and words students already knew informed their guesses. By making and explaining informed guesses, the class explored mathematical concepts such as the attributes and names of 3D shapes. Simultaneously, the teacher expected students to author and assess mathematical ideas, therefore enhancing students' mathematical agency. The teacher conjectured that if she had conducted the task in English, perhaps Gloria would have said that the shape was a pentagonal prism from the beginning. In that case, *pentagonal prism* might have been a memorized expression that some students in the class would not relate to the figures' attributes. Bilingualism seems to have motivated the teacher and the students' exploration of the figures' attributes and how the name of the figure represents those attributes.

We interpreted this example as bilingualism-as-enhancer because students are used to using language creatively to figure out how to express their ideas. In this classroom, the coinage of words emerged as students recurrently asked señora Abad how to say certain words in Spanish in different subjects. To raise students' linguistic awareness and autonomous use of language, señora Abad started to ask students to make informed guesses. Applied linguists refer to lexical inventions as expressions that look and sound like a word in the language, but that are not formally defined or used (Dewaele, 1998). For example, Frank's 'pentágono prismo' (line 33) sounds like Spanish, although the expression formally used in Spanish is 'prisma pentagonal'. In the example, the teacher intentionally promotes lexical invention as a strategy to reinvent mathematical ideas. The bilingualism in this classroom motivated the inference of mathematical terms and phrases, and the discussion about the connection between those expressions and specific concepts.

Discussion

Researchers have argued that an orientation of language-as-resource at the societal level plays out in classroom language use. Few studies, however, have explored teachers' role in translating a language-as-resource orientation into classroom practice. In this study, I have explored two language immersion mathematics teachers' discursive practices that seem consistent with a language as resource orientation. I have drawn on a pedagogy of possibility as a theoretical framework to focus attention on teachers' intentional efforts to devise creative ways to use languages in their mathematics classes.

I have proposed the notion of bilingualism-as-enhancer to foreground two related issues. First, bilingualism-as-enhancer focuses on the bilingual dimension of debates about language orientations. Second, it draws attention to the possibility of enhancing mathematics learning opportunities when teachers purposefully integrate mathematics and communication in more than one language. This purposeful integration requires a pedagogy of possibility in which teachers expand and explore possible discursive practices. I have focused on teachers, extending previous studies that have focused on bilingual mathematics students' language use.

I described two overlapping discursive practices that exemplify bilingualism-as-enhancer: (1) choosing the language that represents a mathematical idea more transparently, and (2) supporting students' inference of mathematical terminology. These discursive practices illustrate how teachers can enhance mathematics learning opportunities by drawing on students' languages. I have presented teachers' perspectives on the use of these practices to describe their reflective process of exploring their particular pedagogy of possibility.

This study contributes insights on how language orientations at the societal level may play out at the classroom level as discursive practices. Language orientations play a role in whether teachers enhance or silence particular languages. At the same time, classroom discursive practices also inform

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language orientations at the societal level. Examples of bilingualism-as-enhancer may inform teachers in contexts where bilingualism is regarded as a problem to explore the benefits of specific bilingual discursive practices, developing their own pedagogies of possibility.

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