In this report we explore language practices when learning and teaching mathematics in a classroom with bilingual learners and a bilingual teacher. We focus on data from the analysis of the whole class discussions in seven lessons. Up to eight episodes distributed in five of the lessons reveal the fragility of switching languages as a reiterated finding, particularly experienced by those learners whose dominant home language is not the language of instruction. Each time a student “dares” to switch languages there are more or less subtle reactions which affect the course and contents of the discussion. We conclude that individual positions and language practices are resources for research in that their study informs of interpretative and action frames that can be mobilised to explain shifts in the direction of mathematical interactions.

INTRODUCTION AND RATIONALE

For many years now, we have been examining (non-) participation trajectories of students in mathematics classrooms in our two geographically and linguistically different research contexts. In Civil and Planas (2004), we reported cases of students with diverse recognised statuses and “disadvantages” on the basis of socioeconomic issues, all of them with home languages different from the language of instruction and histories of recent immigration in their families. We have come to know that none of our respective school systems are properly supporting mathematics learners whose home languages are not dominant in the class. Our situated use of the terms (non-) participation draws on the idea of participation as a shifting collective activity of individuals oriented by identity work (Cobb & Hodge, 2011). Prior results from numerous lessons and interviews raise the value of this approach to participation as an activity that keeps shifting (Civil & Planas, 2012; Planas & Civil, 2013).

In this report we address individual positions and language practices as two of the interconnected reasons why students whose home language is not official in their school system may resist mathematical participation and challenge monolingual practices. The notions of positions (Wagner & Herbel-Eisenmann, 2009) and practices (Setati, 1998) put the emphasis on different aspects of mathematics teaching and learning (i.e., positions are more oriented to identity work, while practices are more oriented to action). Nevertheless, these two notions are resources for research in that their study leads to interpretative frames that can be mobilized to explain situations of mathematical (non-)participation in the classroom as well as shifts in the direction of mathematical interactions. To illustrate how we work with the notions of individual positions and language practices in the analysis of the bilingual mathematics classroom, we take an episode where a bilingual student code-switches in the middle
of a mathematical explanation to the whole group and the bilingual teacher translates
the switched term into the language of instruction.

FIGURED AND PARALLEL WORLDS

We claim that a double focus on positions by the learners and the teacher and language
practices is necessary for understanding the way mathematics participation is
performed and may shift in particular classroom interactions. Along with the study of
how positions and practices are actually experienced by some participants, we also
claim the relevance of examining how they are alternatively experienced, intended or
imagined by some others. This view is informed by the constructs of “figured worlds”
(Holland, Lachicotte, Skinner, & Cain, 1998) and “parallel worlds” (Jorgensen, Gates,
& Roper, 2013). They are complementary constructs that overlap in many senses but
come from the elaboration on different types of data.

The anthropological construct of “figured worlds” was introduced by Holland et al.
(1998), on the basis of individual narrative accounts, to refer to sites where (future)
identities are produced in ways that are not completely determined by the social and
cultural dominant conditions. People modify and develop identities in figured worlds
under the strong influence of their individual positions and the movements in the
relationships with other people who are participants in those same worlds. It may
happen that some of the practices coming up point to alternative forms of relationships
and practices with little significance in other simultaneous intersecting worlds.

Similarly to Holland et al. (1998) but contextualised into mathematics education and
on the basis of lesson accounts, Jorgensen et al. (2013) take a sociological perspective
to frame conditions for participation and success in mathematics classrooms with
working-class and culturally diverse students. These authors examine structural
circumstances with an influence on the social practices taking place within the micro
context of the classroom, some of them working to marginalize certain students while
preserving the participation of others. What interests us from that work is the idea of
the students and the teacher creating “parallel worlds which are structured quite
differently inside and outside the classroom” (p. 221). Thus it makes sense to imagine
forms of resistance in the mathematics classroom that challenge the status quo in ways
that would not be possible or predictable in other contexts. This is a perspective that
leaves room for identity work among participants toward the continuous creation and
implementation of new forms of mathematical participation.

For students who are marginalized due to issues of status and home languages,
participation in the mathematics classroom needs additional effort in comparison to
other students whose home language is the language of instruction and whose social
group represents or is closer to hegemonic knowledge. The metaphor of parallel
worlds, which geometrically suggests worlds that never get in touch, is indeed an
exaggeration as all contexts of social participation are connected. This metaphor,
however, is useful in that it focuses on the development of different positions and
practices in different scenarios. Also, it enables us to view classrooms as unique
organizational alternatives where participants reconstruct (future) conditions from other worlds by means of particular positions and new improvised practices.

Various authors have examined innovative language practices in the multilingual mathematics classroom from the perspective of their contribution to the increase of mathematical participation. Code-switching, for example, has been documented as a tool for the benefit of Latina/o bilingual students in their learning of mathematics (Moschkovich, 2007). More generally, in the work with Latina/o bilingual students in the US, Gutiérrez (2002) enumerates a number of successful pedagogical practices like group work and relates them to the use of the students’ home language. Gutiérrez states that practices of switching languages help to develop alternative worlds in the classroom by encouraging the mathematical participation of students from socially underrepresented group whose home language is not the language of instruction. This author, however, anticipates the issue of tensions and contradictions between counter-hegemonic bilingual practices and mainstream monolingual discourses.

Tensions coming from the dominance of monolingual practices and the needs for the learning of mathematics, for which the use of and the competence in the home language and the language of instruction are instrumental, point to the many challenges of teaching and learning mathematics in the bilingual classroom.

METHODS FOR INTERPRETING DATA

For the last fifteen years, we have conducted small-scale qualitative work in multilingual classrooms with lesson observations as well as individual and group interviews. We have focused on the obstacles and affordances to the participation in whole class discussion for learners whose home language is different from the language of instruction. Our analytical approach concentrates on the significance and impact of particular mathematical interactions from the perspective of how the participants involved seem to be interpreting these interactions, either individually or collectively, and with a critical eye on the role and use of the students’ languages.

We argue that it is critical that we look at whole class interactions guided by the bilingual teacher, where the course of student mathematical participation tends to be dominated by those whose home language is the language of instruction. For this purpose, we have been examining moments of whole class interaction by means of episodes. To conform what we call an episode, we group consecutive turns of a lesson in which more than one language is used or referred to with respect to the resolution of a mathematical task. This procedure leads to episodes of various sizes, sometimes with several turns in between those for which we have detected explicit uses of more than one language. Moreover, we have often conducted interviews with teachers and students afterwards, to hear their interpretations and explanations of concrete events in a lesson (what happened in that part of the lesson, who did what, how and why); this method has allowed us to match diverse interpretations for one episode (as multiple positions, relationships and practices can be outlined) and from there to elaborate explanations that are consistent with what is prioritised in the analysis.
In an episode of a given lesson, for the identification of individual positions with respect to a language practice, we search for turns that introduce the use of or reference to that practice and the related positions by the teacher and by at least a learner whose home language is not the language of instruction. The episode becomes somehow the context of mathematical activity in which positions toward public language practices are manifested. In order to consider the emergence of parallel/figured worlds, we explore distinct and apparently opposite meanings between what is done through the actual practices in the episode and what is intended by means of other suggested or explicitly recommended practices. We refer to a pair of opposite language practices (with some distinct opposite meanings) when one of them promotes the use and value of the students’ languages while the other promotes the exclusive use and value of the language of instruction. Consequently, we concentrate our study on classroom practices involving references to or uses of the students’ languages during instances of whole class mathematical interaction. Although the episode is the primary source for the analysis, interviews are important in that they help to confirm some interpretations and may reveal insights which the videos and transcripts of the lesson could not show.

In what follows we focus on one mathematics classroom that the first author observed for seven lessons in Barcelona, Catalonia-Spain. The students were in their first year of secondary school (12 years old). This author also conducted audio-taped interviews with the teacher and some of the learners. All students and the teacher were bilingual because they could speak Spanish and Catalan, though they were not equally fluent in their two languages, particularly those from Latin American families whose parents did not speak Catalan. The teacher, with ten years of teaching experience, was dominant speaker of Catalan, the language of instruction in that part of the country.

**POSITIONS AND PRACTICES AROUND CODE-SWITCHING**

In the selected example, a tension comes from the experience of opposite practices around code-switching during the resolution of a task. The task in the lesson asks for rectangles with equal perimeter and area, without any mentioning of magnitudes or units of measure. The students had been working in small groups for about thirty minutes before the whole class discussion started. In two of the groups, respectively with two and three students of Latin American origin out of four, the conversation took place with frequent instances of code-switching between Spanish and Catalan, but all groups used only Catalan to produce their written reports of the task. At the beginning of whole class discussion, a student took the initiative to explain that, “squares whose sides measure four solve the problem because four times four is four squared”.

Amanda, a girl from Argentina with Spanish as her home language, reacted to it by sharing what had been mathematically discussed in her group when the same case had been considered. This is the starting point of the episode below.

00 Amanda: No pot ser perquè el perímetre és el contorno. No n’hi ha. [It’s not possible because the perimeter is the boundary. There aren’t.]

01 Teacher: Vols dir que és el contorn? [Do you mean it’s the boundary?] Contorn, sí? [Boundary, eh?] I doncs? Per què? [So what? Why?]
02 Amanda: Això… *contorn*. [This… boundary.]
03 Teacher: D’acord. Què havies dit? [Okay. What did you say?]
04 Amanda: (Silence)
05 Students: El perímetre del rectangle... [The perimeter of the rectangle.]
06 Teacher: [Looking at Amanda] Volies dir una cosa important! Endavant! [You wanted to say something important! Go ahead!]
07 Amanda: Volia dir *contorn*. [I meant boundary.]
08 Teacher: Sí, però dius que no hi ha solucions? [Yes, but you say that there are not solutions?]
09 Amanda: Perquè l’àrea és una altra dimensió i no poden ser iguals. [Because the area is another dimension and they cannot be the same.]
10 Teacher: Què vols dir amb una altra dimensió? [What do you mean by another dimension?]
11 Amanda: Les àrees volen dir dues dimensions i els perímetres volen dir una dimensió. No es poden igualar els nombres sense tenir en compte això. [Areas stand for two dimensions and perimeters stand for one dimension. You cannot equal the numbers without taking this into account]

Amanda code-switches to Spanish in the first turn of the episode, and the teacher quickly translates the Spanish term for boundary, *contorno*, into Catalan, *contorn*, in the second turn. Italics, in this case, are used for the switched term, in its two linguistic forms. This situation does not necessarily point to resistance toward the language of instruction or to any other intentional strategy of contestation on the side of the student. It can be inferred that she is behaving as a bilingual person who uses her two languages, with different levels of intensity, as resources for communication and participation with other bilinguals. In this episode, Amanda’s use of Spanish follows from her group work in which she has been alternating Catalan and Spanish to elaborate on the idea of the task not being solvable due to differences in the measured magnitudes. From the video of the lesson and field notes, it is clear how she positions herself as bilingual in the small group with two other peers from Colombia who are Spanish dominant and one Catalan dominant speaker. Her position toward the use of her two languages seems less strong in whole class discussion with the presence of all students and the teacher, but it is still there with the introduction of the term *contorno*.

The teacher reacts to Amanda’s practice of code-switching with a practice of literal translation. Literal translation can be interpreted as either removing an error or revoicing a term, with different implications for the development of participation. We regard code-switching and literal translation as opposite practices in that they consider differently the value and the use of the students’ languages in the course of the mathematical discussion. Although neither the student nor the teacher may be intending to impose, respectively, bilingual and monolingual practices, and they may not be consciously competing for specific language use, a tension in the direction of the discussion comes across when its emphasis on the mathematics is interrupted by an emphasis on the language. This shift in the direction of the discussion suggests tensions between the actual world of a classroom in a school system with a preferred language
(i.e., what needs to be done with the language of instruction), and a figured alternative world with other languages in use (i.e., what can be done with the students’ languages and why it is (not) done).

From our data in this classroom we could have chosen a different example of an episode with a similar tension resulting in an interruption in the mathematical participation by the learner who code switches. We have decided, instead, to select an example where the fragility of the alternative figured world is expressed in a more subtle way because, in the end and despite a brief silence, the student in question can finish her explanation. In the example, the teacher goes back to Amanda, reestablishes her participation and, by doing it, he contributes to letting her create a relevant learning opportunity around the inaccurate comparison of two numbers representing measures of different magnitudes. The situated effect of literal translation may not be mathematically severe for Amanda in the short term of this episode, but it can become severe for other students (or even for Amanda if it is a recurring practice) who may choose not to participate if they do not know or remember a word in the language of instruction. In the construction of figured present and future actions, the teacher’s reaction to code-switching informs about what language use is preferred in this class.

Up to eight episodes distributed in five of the seven lessons reveal the fragility of switching languages as a finding of the analysis of whole class interaction in that classroom. A similar pattern takes place when a learner switches to Spanish for a word or sentence, and the teacher translates it to the language of instruction (six episodes including the example with Amanda) or asks other students if they know how to say it in Catalan (two episodes). Eight episodes are not representative of a frequent phenomenon but we cannot say that such fragility is rare. After the sixth lesson, in an interview the teacher was asked to talk about learners switching languages in his class. The episode with Amanda, which had happened that morning, served to initiate the conversation on this topic:

Author 1: (...) Què ha passat amb la paraula per contorn? [What happened with the word for boundary?]
Teacher: No res. Potser l’havia d’aprendre. [It’s nothing. Maybe she had to learn it.]
Author 1: El que deia, s’entenia. [What she was saying, it was understandable.]
Teacher: Sí, esclar, s’entenia bé. [Yes, of course, it was well understandable.]
Author 1: Llavors? [So?]
Teacher: Expressar-se correctament és important. [To express oneself correctly is important.]

The teacher points to a normative lens when interpreting code-switching in the course of mathematical explanations: students have to learn to express themselves correctly and the teacher has a role in that. We do not question that the teacher used literal translation to help Amanda, and indeed we assume that his idea of students’ expressing themselves correctly is based on a mathematically strong notion of correctness and far more complex than only considering language choice. What we miss, however, is a
clear understanding of what he means by “correctly” in a bilingual context of mathematics teaching and learning, whether he would see it differently with monolingual students, and how tightly in his teaching activity he might be relating the use of the language of instruction to the recognition of mathematical correctness.

**FINAL REMARKS AND FUTURE RESEARCH**

Truxaw and Rojas (2014) stress that mathematical participation of learners who are not dominant in the language of instruction requires a position where one “dares to do it” (p. 26), that is, where one exercises sufficient power to make decisions about when and how to participate in the classroom discussion even if this implies that others are confronted with the use of a non official language. For the creation of worlds in the bilingual classroom that benefit all mathematics learners independently of their dominant language, positions like that of Amanda “daring” to publicly use her two languages are crucial, but also collective practices that reinforce such positions are necessary. In the example, Amanda draws on the language capital that serves her in other worlds of experience, but the creation of a bilingual world in the classroom is resisted in the ways that code-switching is contested. This is not a mere result of the language practices by the bilingual teacher and his modelling of monolinguism within the local context of the classroom, but something that requires the examination of the diversity of intersecting worlds (see Barwell, 2012, for a discussion on forces in competition from diverse worlds entering the multilingual mathematics classroom).

In this report we have explored the experience of a bilingual mathematics learner and a bilingual mathematics teacher in a classroom with an official language of teaching and learning. On the one hand, the strength of individual positions has offered an explanation for the introduction of bilingual practices and for the fragility of the suggested alternative worlds; on the other, the phenomenon of fragility around switching languages has been discussed from the perspective of access to recognized mathematical correctness. These are important findings for further exploration in the area of mathematics education research and language diversity with a focus on bilingual classrooms, bilingual teachers and bilingual learners. While the complexities and challenges faced by multilingual students in their mathematics learning have been increasingly studied in several countries, not many studies around bilingual students who are taught mathematics by bilingual teachers have emerged yet. This is a gap that needs to be addressed by researchers in this area of study.

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