CAPITILIZING ON LATINAS/OS LINGUISTIC AND CULTURAL RESOURCES: A CASE STUDY OF MULTI-GENERATIONAL MATHEMATICS PARTICIPATION IN AN AFTER-SCHOOL SETTING

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Abstract

This paper examines the nature and process of Latinas/os constructing mathematical meanings in an after-school setting where multi-generational participants (i.e., students, undergraduate students, and parents) engage collaboratively with high-level mathematics. The aim is to investigate how multi-generational participants create a unique learning community that shares cultural knowledge and meaning-making. Specifically, we provide an example of how multi-generational mathematics participation in an informal setting contributes to students' mathematical engagements, linguistic behavior, and participation patterns.

Introduction

Research in mathematics education has focused on some of the issues and challenges of Latino students constructing mathematical knowledge, negotiating meanings, and in general, participating in mathematical communication in classrooms (e.g., Khisty & Chval, 2002; Morales Jr., 2004; Moschkovich, 1999b). However, Latinas/os' language and culture tend to be discounted, thus, creating a distance between what Latino students *and parents*[1] know and classroom mathematics (Moschkovich, 1999b). Essentially, current school practices continue to marginalize Latinos, and not privilege their linguistic and cultural learning capital (Moll & Ruiz, 2002). This discussion suggests that collaborative multi-generational participation makes apparent how cultural language, shared knowledge, and communication are integral aspects of learning mathematics. This discussion also demonstrates how multi-generational participation contributes to the development of students' mathematical identities, that is, how one sees him or her self as a doer of mathematics.

The study presented here draws on current work carried out by the Center for the Mathematics Education of Latinas/os (CEMELA)[2] that focuses on the research and practice of the teaching and learning of mathematics for Latino/as in the United States through the integration of sociocultural theory, language, and culture. CEMELA has created after school projects (*Los Rayos de CEMELA* and *After-School Math Club*) at two of its sites, one of which is the source of the present study. Both after-school projects are designed to investigate the linguistic and cultural resources that support bilingual

[1] Italics added.

[2] CEMELA is a Center for Learning and Teaching supported by the National Science Foundation, grant number ESI-0424983.

Latino/a students' mathematics learning. They are general adaptations of the work of the Fifth Dimension (Cole, 1996) and are guided by other similar projects (e.g., Gutiérrez, Baquedano-López, & Alvarez, 2001) including *La Clase Mágica* (Vasquez, 2003). These works have utilized the after-school as a way of understanding literacy; CEMELA has extended the work to consider mathematics (Morales, Díez-Palomar, Vomvoridi-Ivanović, Khisty, 2007).

The purpose of this paper is to report a study designed with the intent to investigate the following questions: 1) What linguistic and cultural resources do students use as they engage in standards-based non-remedial mathematics? 2) What role do multi-generational networks and interactions with undergraduate students and parents play in the development of students' mathematical identities?

Theoretical Framework

The theoretical orientations that have guided our research are those that place culture and interaction at the center of human learning and development (McNamee, 2006). We assume that learning is less of an individual internal phenomenon; instead, it is a social activity involving interaction and specific environmental contexts (Vygotsky, 1978), in this case, students actively engaged in doing mathematics informally in an after-school context. After-school settings actively promote cognitive and social development through collaboration and meaning-making among multi-generational and diverse participants (e.g., Cole, 1996). Collaboration is a process in which culturally, linguistically, and academically, heterogeneous participants acquire knowledge—in this case, mathematical--through assisting one another in making sense of, discussing, and solving challenging tasks (Gutiérrez, Baquedano-López, Alvarez, & Chiu, 1999). After-school participants draw from various practices and repertoires from both formal and informal settings and create new repertoires and practices. These new practices occur in learning spaces that are hybrid meaning that the practices are at times in conflict and reflect multiple points of view. In turn, these diverse and hybrid repertoires and practices promote zones of development, as they become tools for learning (Gutiérrez, Baquedano-López, & Tejeda, 1999; Morales, Díez-Palomar, Vomvoridi-Ivanović, Khisty, 2007).

Blanton and Bremme (2006) argue that individual development essentially requires certain kinds of social arrangements and multi-generational participation. They state that "there must be a functioning social level that includes both experienced and non-experienced members and a social setting that provides everyone with goals relevant to their joint participation" (Blanton and Bremme, 2006, p. 22-23). The after-school project not only is a cultural setting where more capable others can help less capable ones learn (Vygotsky, 1978), but more broadly, where multiple cultural resources are made available and promote/produce development. Examination of the interactions and communication processes among multi-generational participants highlights what and how various resources and tools mediate mathematical development.

The Study

Description of Los Rayos

Multi-generational participants include elementary Latina/o students, undergraduate facilitators, and parents. Thirteen students, five undergraduate facilitators, four graduate facilitators, and five parents participated in *Los Rayos de CEMELA* during the academic year 2005/2006. Students, parents, and undergraduate facilitators are all Latinas/os. In addition students and facilitators are Spanish-English bilinguals and at the time were instructed to use whichever language they felt more comfortable using with the students at any given time. At the same time they were aware of the fact that one of the after-school's goals was to promote mathematical bi-literacy. The participants met once or twice a week for one and a half hours each time for a ten-week period. The meetings took place in the school that the students attended. This is a dual language (Spanish/English) school in a predominantly Mexican neighborhood in a large city in the midwest.

During the first seven weeks of the after-school, students and facilitators met twice a week and engaged in various educational activities that were organized around learning mathematics and technology skills in a playful atmosphere. Mathematical activities included problem solving and playing math games that were intended to enhance students' thinking about probability and algebraic concepts. In addition, students communicated electronically with a mathematics "wizard", El Maga, who engaged students in bilingual conversations about their mathematical experiences. Parents held separate meetings with one graduate facilitator. The parent meetings were geared towards the acquisition of basic computer skills, as parents had requested. During the last three weeks the parent group joined the student group. At this time the purpose was for the parents to collaborate with the students in order to participate in the creation of digital stories.

Data Sources

Video and audio data along with transcriptions, student/participant work artifacts, and field notes were gathered during the after-school sessions. Video recordings captured when and how various gestures and multimodal tools were used. Written student artifacts include anything students created while doing mathematics, as well as students' electronic messages in which they explained their mathematical thinking and questions. Descriptive and reflective field-notes, taken by both undergraduate and graduate facilitators, captured participants' interactions as well as the facilitators' reflections on those interactions. Data analyses focus on instances of collaboration among multi-generational participants.

Analytic techniques

Qualitative methods (Lincoln & Guba, 1985) were used to examine how Latino students construct mathematical meanings through the mutually shaping influences of interactions among multiple and diverse participants in the after-school. Analysis focuses on patterns that emerge in dialogues among participants (i.e. students, undergraduate facilitators, and/or parents) as they solve open-ended mathematical problems. Discourse between and among multi-generational participants as they construct meanings is an important source of data because "so much is constituted in and through it (discourse), that its close inspection should reveal the very constituting processes themselves" (Edwards & Westgate, 1994, p. 15). Through the lens of distributed cognitions (Cole & Engström, 1993), according to which cognition is studied as a distributed activity, discourse analysis focused on patterns related to the use of Spanish or English and other communication tools, and also related to cultural and experiential resources used in co-construction and negotiation of mathematical meanings.

Findings

In order to demonstrate how participants in *Los Rayos* collectively negotiated their roles and how multi-generational participants created a unique learning community that shares cultural knowledge and meaning-making, we have chosen to focus our analysis on one student, Rodrigo, and his mathematical engagements with various participants, including his mother Olga, and one undergraduate facilitator, Carlo[3], while playing the *Counters Game.*

The *Counters Game* activity provided us with a rich context for multi-generational participation in mathematics. Students had the opportunity to play this game during two sessions; first with facilitators and then with both facilitators and parents. Moreover, The *Counters Game* is a rich mathematical activity in itself that can potentially engage a wide range of players. Finally, we specifically chose to analyze and describe Rodrigo's, Olga's, and Carlos' participation in this activity as it provided us with a good example of multi-generational participation in mathematics where linguistic, cultural, and mathematics resources become available and are negotiated and distributed amongst participants.

Description of the game

The *Counters Game* is a game we adopted from *Interactive Mathematics Program*. Its goal is to build on students' intuitive understandings of probability. In order to play the *Counters Game* each players should each have 11 counters and a game board displaying all the possible sums of two dice (i.e., 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12). Players construct their own game board by using a strip of paper and markers. The board game looks like the figure below:

2	3	4	5	6	7	8	9	10	11	12

[3] We use this Undergraduate facilitator's real name, with his permission. All other names are pseudonyms.

Players can place as many counters as they choose on any of the numbers above. After players place their counters on the game board they take turns rolling two dice. Each time a player rolls the dice, the sum is calculated and any player who has a counter on the number corresponding to the resulting sum removes the counter from his or her game board. For example, if a player rolls the dice and gets 4 and 5, any player with a counter on 9 is to remove it from her or his game board. The player who gets rid of all the counters first is the winner. Hence, players are prompted to figure out strategic ways of placing their counters so that they have the best chance of winning.

In order to come up with a good strategy for placing the counters on the game board, one needs to understand which sums are the most likely (and which are the least likely) to come up. This is the key concept of probability. We will use P(x) to denote the probability that x, where x=2, 3, 4, 5, 6, 7,. 8, 9, 10, 11, or12, will occur as the resulting sum from any given throw of two dice. For example, P(5) is the probability of 5 coming out as a sum at any given throw. This could result from a 1 and a 4, a 4 and a 1, a 2 and a 3, or a 3 and a 2. Using theoretical probability one can see that P(2)=P(12)=1/36, P(3)=P(11)=2/36, P(4)=P(10)=3/36, P(5)=P(9)=4/36, P(6)=P(8)=5/36, P(7)=6/36. In other words, at any given throw, the sum that has the highest probability of occurring is 7 and the probability decreases as we move to greater or smaller sums. The more times the dice are rolled, the closer the distribution will approach the triangular distribution. Therefore, one can say that a good strategy would be to place the counters on the middle numbers (perhaps 5 through 9) with most counters on 7.

Description of the participants and the context

During one session in March of 2006, students in *Los Rayos* played the *Counters Game* in their groups. Each group consisted of two to four students and one undergraduate facilitator. Some groups had a graduate assistant participating as well. Approximately two weeks later, during another session in April, the parents from *Los Rayos* parent group joined the students and the undergraduate facilitators, for the first time, to play the *Counters Game* again. The purpose for merging the student and parent group together was for students to explain to the parents how to play the game and also play it, and for students and parents to think about possible math board games they could create for their digital stories being their final project in *Los Rayos* academic year 2005/2006.

For the purposes of this paper we will focus our analysis on one student's interactions, namely Rodrigo, while playing the *Counters Game* on two different sessions and with two different groups. During the first session, Rodrigo played the *Counters Game* with a group consisting of one more student, and one undergraduate facilitator. Three weeks later, Rodrigo played the *Counters Game* again with a group consisting of two other students, three mothers (including Rodrigo's mother, Olga), and a different undergraduate facilitator, Carlo. We specifically focus on the mathematical understanding and the linguistic and cultural resources that Rodrigo, Olga, and Carlo, bring to the group, allowing for multi-generational learning to take place.

The themes that emerged through the analysis of this multi-generational activity are all interconnected and hence it became difficult to create separate categories.

Nevertheless, for practical purposes we have decided to divide our findings into the following three categories: the evolution of Rodrigo's mathematical thinking; the concurrent shift in Rodrigo's language use and participation pattern; and the influence of the mothers' cultural resources on Rodrigo's digital story.

Rodrigo's mathematical thinking

All undergraduate and graduate facilitators in *Los Rayos* that have worked with and/or observed Rodrigo (a 3rd grader) consider him to be a very bright student in mathematics. He always seemed eager to engage in any type of mathematical activity and has expressed his inclination towards mathematics in informal conversations with the first author of this paper.

During the first session of playing the *Counters Game*, Rodrigo participated in a group with a student, Alfonso, and an undergraduate facilitator, Miguel. While playing the game, Miguel, recommended that the students keep track of the resulting sums each time the dice were rolled and prompted them to notice if there are any sums that come up more or less often. Rodrigo noticed that the sums 2 and 12 come up the least often. He explained, that 2 and 12 are sums that are the least likely to occur because there is only one combination of numbers that would result to each of the sums 2 and 12 respectively. When Miguel asked him why he thinks that other sums were more likely to occur, Rodrigo mentioned sum of 11 as an example and said that 11 can result from adding a 6 and a 5, or adding a 5 and a 6. He added that other sums, such as 9, 8, and 7 are also more likely to occur. Miguel prompted him to consider all this when deciding on how to place his counters. After the session Rodrigo wrote the following message to El Maga:

> Subject: Counter game. We played with Miguel and Alfonso. I put my numbers in the numbers 5, 6, 7, 9, 9, 10, 10, 11, 11, 8, 8, 7. Because it is less possible to get 2 1 and 2 6. Miguel won all of the games.

In his message to El Maga Rodrigo first describes how he placed his counters on his game-board, and then justifies why he placed them in such a way. By writing "I put my numbers in the numbers 5, 6, 7, 9, 9, 10, 10, 11, 11, 8, 8, 7" Rodrigo suggests that he placed his counters, which he refers to as "numbers," on specific positions on the game-board, which he also refers to as "numbers." Rodrigo explains that he placed one counter on a position on his game-board that corresponds to sum of 5, one counter on 6, one counter on 7, two counters on 9, two counters on 10, two counters on 11, two counters on 8, and one counter on 7. Rodrigo justifies placing his counters in such a manner by explaining that "it is less possible to get 2 1 and 2 6" meaning that it is less possible to roll two dice and get two ones or two sixes, and therefore he did not place any counters on the positions on his game-board that correspond to sums 2 and 12.

Not only did Rodrigo realize that the game is not based on "pure luck", he also realized that there is a mathematical explanation for why some sums are less probable than others. Even though he did not demonstrate a deep understanding of theoretical probability, he did demonstrate an understanding of the following: the likelihood of an event is related to the number of combinations that would lead to that event; the event of rolling a 6 and a 5 and the event of rolling a 5 and a 6 are separate events; the sums 2 and 12 are the least likely to occur as demonstrated above when he wrote less possible to get two ones and two sixes.

The second time Rodrigo played the *Counters Game,* it was with two other students, his mother Olga, two more mothers, and an undergraduate facilitator, Carlo. This time, Rodrigo showed an evolution in his understanding of the mathematics; the data suggest that he understood that seven is the sum that has the greatest probability of occurring. In addition, Rodrigo won the first two rounds he played with his group. Both times he had placed most of his counters on seven and kept rooting for the seven to come out. While the players in the group were setting up their counters to play the game a third time, Rodrigo explained why the sum of seven is more likely to occur as seen in the following excerpt[4]:

Carlo: ¿Por qué tú crees que algunos salen más que otros?

[*Why do you think that some come out more than others?*]

Rodrigo: No sale mucho, porque, porque no hay mucha probabilidad para hacer uno y uno con el dos, y también con el doce.

[*They don't come out, because, because, there isn't much probability to make one with one for the two, and the same with twelve*]

Carlo: ¿Y el siete porque sale tanto?

[*And the seven, why does it come out so much*]

Rodrigo: Porque hay más posibilidades para sacarlo...

[*Because there is more probability of getting it*]

Carlo: ¿Como qué? [*Like what?*]

Rodrigo: Como el cinco y el dos, cuatro y tres [*Like five and two, four and three*]

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[4] In the event where utterances are spoken in Spanish, we will set apart the English translation with brackets [].

Carlo: Oh..O.k, me convenciste [Oh, O.k., *you convinced me*] (laughs)

In this excerpt the evolution in Rodrigo's understanding of the mathematics as it relates to the *Counters Game* is evident as he expressed for the first time the realization that seven is the sum that is the most likely to occur. This realization is clearly not based only on his experience, i.e. his observation that seven is the sum that comes up most frequently. Rodrigo's explanation that "there is more probability of getting it (the seven)" because it can occur from rolling a "five and two" or a "four and three" is based on his realization that seven is the sum with the greatest number of combinations. In other words, Rodrigo's thinking is not based on an experiential model (experimental probability); rather it is based on mathematics (theoretical probability). Rodrigo's choice to place more counters on 7 is not based on the realization that after playing the game many times is the sum that occurs most often is 7. By explaining that there is a variety of combinations that will result to a sum of seven, "Como el cinco y el dos, cuatro y tres [*Like five and two, four and three*]" he bases his reasoning on the fact that there are various combinations that can result to the sum 7, such as rolling the numbers five and two or four and three. Though his explanation is not very elaborate – after all, when in the midst of playing a game it should not be expected that a student will provide a thorough mathematical explanation - we argue that his understanding so far of the concept of probability as is relates to the *Counters Game* is a very significant accomplishment for any student in third grade.

What is perhaps more significant is that this understanding occurred, evolved, and was mediated by his interactions with peers, parents, and undergraduate facilitators, rather than from instruction. When playing the game during the first session, Miguel, an

UG, played the role of the "expert". He made sure the students understood how the game is played, he scaffolded students' understanding of the mathematics involved by having them observe the frequencies of the occurrence of the sums and by asking them to justify these frequencies, and he placed his own counters in a strategic way so that he would win the games. When playing the game during the second session, Rodrigo took up the role of the "expert." This time Rodrigo participated in explaining how the game is played, provided mathematical explanations when prompted by Carlo, and won all the games played. This change in the participants' roles, from more capable other to less capable and vice versa, fit with Rogoff's (1994) idea of fluid reversals of student and teacher roles in communities of learners.

Rodrigo's shift in language and participation pattern

Through our observations of Rodrigo's behavior in *Los Rayos* we noticed a shift in his participation pattern and language use. While participating in *Los Rayos* after-school activities, Rodrigo spoke predominantly English and was fluent in both his written and oral command of the language. This led the CEMELA team to view him as being English language dominant. When Rodrigo played the *Counters Game* in the first session, Miguel, the undergraduate facilitator, spoke to Rodrigo in both Spanish and English. For the most part, however, Miguel used Spanish when addressing Alfonso and English when addressing Rodrigo. Alfonso spoke almost exclusively in Spanish and Rodrigo spoke predominantly in English (he used Spanish only when talking to Alfonso). Miguel had identified Alfonso as being Spanish dominant and Rodrigo as being English dominant, which explains Miguel's language choice.

When Rodrigo played the *Counters Game* during the second session, he worked with a group that was more Spanish dominant. Carlo, Margarita, and Rafael, who usually worked together in the after-school, would use Spanish and sometimes code-switch during previous after-school sessions. All three mothers were Spanish language dominant, and their command of English was limited. As a result, everyone in the group including Rodrigo played the *Counters Game* in Spanish throughout the entire session. During this session, not only did Rodrigo demonstrate fluency in conversational Spanish, he also demonstrated command of the mathematics register in Spanish. What is significant here is that when the context changed to one that privileged Spanish, Rodrigo's language use shifted as well from using exclusively English to using Spanish. In essence, this change in activity resulted to a change in Rodrigo's language practices.

At the same time we witnessed a shift in Rodrigo's language practices, we also noticed a shift in Rodrigo's participation pattern. During the entire time Rodrigo was participating in *Los Rayos,* he was very soft spoken and reserved. The CEMELA team in *Los Rayos* viewed Rodrigo as being very shy - perhaps the shyest student in *Los Rayos.* This changed when Rodrigo participated in the *Counters Game* activity the second time around. This time Rodrigo displayed a very different persona. This change in behavior was captured in one graduate assistant's field-notes from that day:

> …Miguel and Carlo's group combined into one. Margarita, Rafael, and Rodrigo played the Counters Game with Rodrigo's mom, Rafael's mom, and another mom. Rodrigo was very loud and laughing a lot; he kept saying that he hoped they wouldn't roll a 4; to me, it seemed that the way they

> were all talking and the arrangement of the table and the counters/chips, it looked that they were at a casino ☺ …I don't think I've ever seen Rodrigo so animated or so talkative. The times I've seen him in the all boys group they all seem very quiet, structured and not disruptive.

Sonia, the graduate assistant that wrote the field-notes above, describes how excited Rodrigo was while playing the game during the second session and notes that he was "very loud and laughing a lot." She compares this behavior to her earlier observations of Rodrigo, who during previous sessions was "very quiet, structured and not disruptive." In fact, after watching the video recording from this session, we were struck by the fact that Rodrigo was so animated, talkative, and seemed happy when playing the game the second time. We were also struck by the fact that he displayed such a fluent command of Spanish, including academic Spanish, and that he used Spanish only during the entire session. What is significant in this shift of Rodrigo's language use and participation pattern is that it emerged naturally and was influenced by this particular context that resulted to a change in the activity.

Cultural Resources

When Rodrigo created his digital story at the end of the academic year, he utilized a variety of resources. Specifically he created a math board game, which was a hybrid of a game his mother introduced to *Los Rayos* called the *Game of Five Numbers,* another game based on probability that he played in *Los Rays* called the *Spinner Game*, the *Counters Game,* and *Bingo*. In addition, he used Spanish as a resource for his narration in his digital story.

The Game of Five Numbers. After playing the *Counters Game* for a few times during the second session, the group started thinking about possible math board games they could create. At that point Rodrigo's mother decided to share a math game she said they play at home, namely the *Game of Five Numbers*. Carlo described this game in his field-notes:

> …Rodrigo's mom already seemed to be engaged in throwing out ideas based on games we already know in order to think of new ones. She suggested a game that they play a lot at home (but that's why I think Rodrigo's excellence in math is most definitely attributable to the influence at home and the comfort he feels as a math doer because of that influence) se llama el juego de los cinco números [*it's called the game of the five numbers*]. You generate 5 random numbers with a pair of dice or with some other method like a deck of cards or dominoes, then you try to find different arithmetic operations that will lead the first 4 numbers to equal the fifth. For example you get 4, 10, 3, 2, and 8, so you need to use the first four numbers once each in any order to generate the answer 8. So you might try 4+10=14 then divide by 2 = 7, minus 3 = 4, nope try again. Ok, so 4-3=1, 1*10=10, 10-2= 8, and we have a solution. The idea is that through trial and error and using all 4 arithmetic operations you all race to see who can get a solution first. I think we need to design an activity with this game, yes it has the feel of drilling or even school, but it is so about "play" and increases comfort with math operations in an informal setting….

As seen in Carlo's field-notes, he attributes Rodrigo's excellence in mathematics to mathematical practices he experiences at home. He notes that "Rodrigo's excellence in math is most definitely attributable to the influence at home and the comfort he feels as a math doer because of that influence." In addition, he recognizes the game Olga described as being a mathematical cultural resource that other students in the after-school can benefit from.

Rodrigo's digital story. As mentioned earlier, Rodrigo created his own math board game, which was a hybrid game created from a combination of the *Game of Five Numbers*, the *Spinner Game,* the *Counters Game,* and *Bingo*. He named his game *Math Bingo* and created a digital story about his board-game which his mother helped narrate. In fact, while listening to Rodrigo's digital story, one can hear his mother in the background whispering the text Rodrigo had written for his narration.

Rodrigo played *Math Bingo* with his sisters at home and took pictures of them playing the game with him. He included these pictures in his digital story as well as an explanation of how the game is played. His explanation of the rules of *Math Bingo* is entirely in Spanish. Bellow is the transcript of Rodrigo's narration, followed by an explanation of the rules of *Math Bingo.*

> Math Bingo, starring Rodrigo. I am on the right and my sister, my…the one on the left is my sister and her name is Griselda, and the one on the bottom is my little sister and her name is Veronica.
>
> Yo hice mi nuevo juego de Bingo usando matemáticas. Hice cuatro cartas y cada carta tiene diferentes operaciones. También hice una flecha, un… un tablero numérico con una flecha en el medio para girarla. Para ganar,

tienes que hacer una línea vertical o horizontal o diagonal. Aquí, todos están tomando turnos girando la flecha y yo, y yo gané como dos veces. Estoy jugando con mi hermana que se llama Griselda y mi otra hermana que se llama Verónica. Cada quien esta tomando turnos girando la flecha y apuntado el número que salga. Fin-The End.

[*I made my new Bingo game using mathematics. I made four game pieces and each one has different operations. I also made an arrow, an… a numbered board with an arrow in the middle to spin it. To win, you have to make a vertical or horizontal or diagonal line. Here, everyone is taking turns spinning the arrow and I, and I won like two times. I am playing with my sister who's name is Griselda, and with my other sister who's name is Veronica. Everyone is taking turns spinning the arrow and writing down the number that comes up. The End.*]

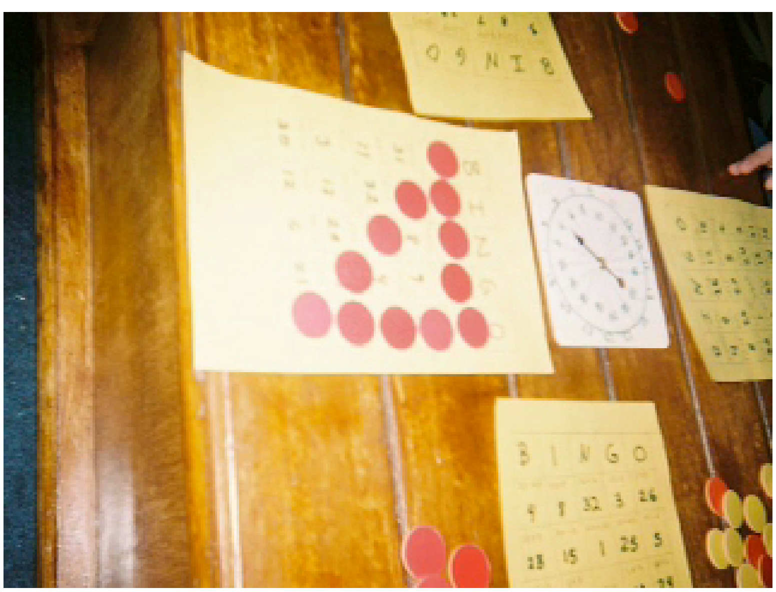

Figure 1: Photograph of *Math Bingo* taken by Rodrigo.

After introducing his sisters who played the game with him, Rodrigo describes, in Spanish, how *Math Bingo* is played. Rodrigo's explanation of his game in his narration is incomplete, so in order for the readers to make sense of how *Math Bingo* is a hybrid of the *Game of Five Numbers*, the *Spinner Game*, and *Bingo* we provide a more detailed explanation on the rules of his game.

Math Bingo is played with two to four players. The materials needed for this game are a spinner, game-boards, and counters. Each player creates a game-board with a 5x5 square grid and assigns one number from 1 to 32 to each of the 25 grids on her/his game-board. Each game-board represents one of the four operations. A spinner with numbers from 1 to 32 is spun and the players note which number the spinner lands on. Any player whose game-board includes the number the spinner landed on places one counter on the position they have assigned for that number. After that, the spinner is spun again, until a player has five counters in a row; vertically, horizontally, or diagonally. In order to win the game a player must have five counters in a row and also be able to generate one of these five numbers that the counters are placed on using the rest of the four numbers and any of the four operations (i.e. addition, subtraction, multiplication, division).

Rodrigo used a spinner similar to one that he had used in the *Spinner Game*. He also used counters as well as game-boards similar to the ones used in the *Counters Game* and *Bingo*. In addition, he drew from the rules of *Bingo* the fact that in order to win one needs to complete a row of numbers randomly generated. Finally, he incorporated the *Game of Five Numbers* in that a player must generate one number using the other four numbers from her/his row. In essence, Rodrigo drew from games previously played at home and in *Los Rayos* to create his own math board game.

Furthermore, Rodrigo narrated the description of his game in Spanish. This choice in language appears to be influenced from his mothers' involvement in *Los Rayos* during the last few weeks of the academic year. Rodrigo incorporated the *Game of Five Numbers* he plays at home, where the privileged language is Spanish. Furthermore, Carlo's recognition of the *Game of Five Numbers* as a mathematical resource could have contributed to creating a context in which Rodrigo saw his home resources, including his mothers' insights, as being valuable. In turn, this might have led Rodrigo to incorporate the particular game to his own game and privilege Spanish in his narration.

Conclusion

In this paper, we have aimed to do is provide an example of how multi-generational mathematics participation in an informal setting contributes to students' mathematical engagements, linguistic behavior, and participation patterns. *Los Rayos* participants draw from various practices and repertoires (as cultural resources) from both formal and informal settings and create new, hybrid, repertoires and practices. In turn, these diverse and hybrid repertoires and practices promote zones of development, as they become tools for learning (Gutiérrez, Baquedano-Lopez, & Tejeda, 1999). Participants in *Los Rayos* created a unique learning community by relating after-school activities with mathematical activities in other settings (e.g., home). Parents shared mathematical examples from home; likewise, undergraduate facilitators offered their own understandings and approaches. Since this information was put forth in a collaborative context, a very rich learning environment was created with multiple ways of thinking about mathematics. Some researchers have argued that beyond what teachers do in class, they need to involve students' families in order to support students to their fullest (Gutstein et al., 1997; LoCicero et al., 1999; Civil, 2000). The example of the contribution of multi-generational participation in Rodrigo's mathematical engagement, contributes to this body of literature.

Throughout the research on Latinas/os in mathematics, the use of students' first language is stressed (e.g. Bustamante & Travis, 1999; Cardelle-Elewar, 1990; De La Cruz, 1999; DeAvila, 1988; Doty, Mercer, & Henningsen, 1999; Fuson, Smith, & Lo Cicero, 1997; Garrison & Mora, 1999; Gutstein, Lipman, Hernández, & de los Reyes, 1997; Hernández, 1999; Khisty & Viego, 1999; Khisty, 1995; 1997; Lo Cicero, et al., 1999; Moschkovich, 1999a, 2000; Ramirez and Bernard, 1999; Ron, 1999; Secada, 1991). Even though this body of research points to how students' home language is a resource for learning mathematics, discussions of improving Latinas/os' performance in mathematics are still embedded in English only. We speak of how to use mathematics to help students learn English or how to make mathematics taught only in English comprehensible to students. Nothing in the public dialogue suggests teaching mathematics bilingually, or using Spanish to teach mathematics, or that there is even a need to consider students' home language and what that means for what they know or the parental and community resources they draw on. This kind of language ideology has many consequences for Latina/o students' mathematics achievement which includes creating the impression that Latina/o students are un-knowledgeable thus creating a distance between school knowledge and their own knowledge simply because their home language is Spanish (Moll, 2001).

In *Los Rayos,* a variety of linguistic and cultural resources were available and were distributed amongst multi-generational participants. These resources became tools that students used in the mathematical meaning-making process. Rodrigo's understanding of the mathematics involved in the *Counters Game* grew through his joint engagement with multi-generational participants. Rodrigo drew from various math games he played at home and in the after-school and utilized them as tools to create his own math board game.

Moreover, Rodrigo negotiated varying roles with persons of different generations, and this negotiation of roles is related to the way he communicated mathematically. The different perspectives generated from various participants created a context whereby everyone had an "equal' voice and where meanings had to be negotiated. In turn, multi-generational participation impacted Rodrigo's participation pattern. We observed him transform from a shy, soft spoken boy into someone who was quite animated and enjoyed sharing his mathematical reasoning and being the "expert." Additionally, Rodrigo demonstrated a variety of ways to communicate mathematically and made more references to informal knowledge and experiences in mathematics. He used Spanish as a resource to communicate his mathematical thinking when parents were present.

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