From "School" to a Unique Learning Environment: The Evolution of an After-School Math Club

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Introduction

In the spring of 2005, CEMELA (Center for the Mathematics Education of Latina/os) started an after-school mathematics club at a local elementary school. This "pilot" semester then informed the creation of a math club and research location for the following academic year. The Math Club and research site began in its current form in the fall of 2005, undergoing many changes and evolving into the bilingual and project-based setting it is now. Of course, the program is constantly changing and dynamic, and will continue to be so as we develop our pedagogical approach.

This paper will attempt to outline in detail the evolution of the after-school Math Club during the 2005 to 2006 school year, with a brief description of the pilot semester. We will begin with a description of the setting and participants, continue with a description of the theory behind our approach to pedagogy and then provide detailed descriptions of activities and occurrences in the Math Club that illustrate how the Club has evolved over the year. Through this description we will outline our major challenges and findings related to the creation of a community-project and dialogic learning-based after-school mathematics club for Latino/a students.

School and Neighborhood Context

The Math Club takes place in a primarily Mexican/Mexican-American neighborhood of a Southwestern U.S. border city. Many of the Latino residents of this neighborhood are recent immigrants from Mexico, while others have lived here for generations. The neighborhood is characterized by its similarities to Mexico, containing small bungalow-style houses, signs in Spanish, and local businesses selling Mexican products, reflecting the history of the area as being a part of Mexico (Gonzalez, 2001).

The Math Club takes place as a part of Agave[1] Elementary School's regular after-school program. The school has a warm and welcoming environment, with walls decorated with changing displays of student work, photographs and other school projects and programs. Fliers are in English and Spanish and all of the administration and staff as well as many of the teachers speak Spanish and/or are Latino/a. In the hallways and the main office, you often hear Spanish being spoken more than English, reflecting the primarily Latino/a student body (90%). The annual school Fiesta and other school events reflect the Mexican heritage of most of the students, with students learning and performing traditional Mexican folk dances and decorations consisting of paper flowers and piñatas.

At this particular school, 97.1% of the students qualify for free or reduced lunch and 38.4% of the students are classified as English Language Learners (ELL) (District Stats). The school has been affected by recent legislation in the state concerning bilingual education calling for ELL students to be placed in Structured English Immersion (SEI) classrooms rather than bilingual classrooms with the idea that students will be systematically immersed in the English language if they test below a certain level on an English language test. It is important to consider that the students enrolled in the Math

[1] All names are Pseudonyms

Club come from classrooms where their native language is not frequently used as an academic language and enter a setting where bilingualism is encouraged.

Participants

During the school year, the Math Club met for two hours twice a week, every Monday and Tuesday after regular classes. The participants were (approximately) eighteen students, four undergraduate facilitators, a teacher leader who helped plan content and facilitate and three participant researchers. Our videographer was also present on most days and as his presence influenced the dynamic of the Math Club, we include him in the list of the participants[2]. The students were almost all Latino (some part-Native American), mostly Spanish-English bilingual, with some exceptions: a few students were Spanish monolingual and a few spoke little Spanish. The environment itself was bilingual, though there was not much code-switching: most interactions took place either in English only or Spanish only, and the students often chose partners in an activity based on language preference. Many of our students are related: we had a pair of siblings, a pair of step-siblings, and at least one pair of cousins. Relatives often chose to work closely with each other.

The Math Club first began in the spring of 2005 with a pilot program. Only one of the current undergraduate assistants and one of the researchers were involved in the project during that phase. The intent for the Math Club during its first semester was to form a relationship with the school and the students with no research being conducted at the time. There were approximately eight students who attended the Math Club regularly and a few others who only came occasionally; the students were recruited from the third,

[2] The students are often prompted by the videographer to explain the problem or activity they are working on. They are also curious about the camera and like interacting with it.

fourth and fifth grades. They were mostly opposed to working in groups and as the two coordinators (one of the current researchers and another CEMELA fellow) were both English monolingual, there were fewer interactions in Spanish. The overarching theme was geometry but the activities changed daily; there was only one long-term project, which was also the most successful activity of the semester. This was the collage project, in which the students took pictures of mathematics in their everyday lives and then made collages using these pictures and photographs from magazines. The students took great pride in the cameras they were given, and were far more involved in this activity than in all the others. This was a lesson that helped inform content planning when we restarted the after-school in the fall.

In the fall, we recruited students from the three fourth- and fifth-grade combination classrooms. We distributed fliers during the beginning of the school year open-house event, as well as in all of the classes. Because students moved away or stopped coming to the after-school, we occasionally re-recruited and new students joined us throughout the school year, repeatedly changing the dynamics of the Math Club. For example, for a while a boy attended who would occasionally contribute greatly to the activities we were working on, and who was much more engaged in the after-school than in the classroom. At the same time he had difficulty interacting with other students in a non-hostile way, which caused the atmosphere to sometimes be strained and unpleasant. On the other hand, the students who joined us at the beginning of the spring semester were more studious and enthusiastic about mathematics and developed a playful and friendly relationship with each other as a group. These circumstances, along with changes

in the nature of the activities, made the Math Club more conducive to inquiry and in-depth mathematical discussions.

The number of students attending on any given day varied. The total number hovered around 18 throughout the year, but many students attended only occasionally, with around ten regulars. Attendance was typically highest when a new project was beginning or if there was a celebration planned (the end of the semester piñata-making, for example). Although we have not determined all of the factors that affect attendance, we have been able to identify some, such as that some students instead chose to attend the regular after-school program at the school, during which the students get to play for an hour, as well as others, which vary from weather (fewer students on cold days), time of year (numbers dwindled as the end of the semester approached), homework demands, or even failure to remember to come to the after-school, to family dynamics. The latter has probably been the most influential: students could not stay for the after-school if they had to take care of their siblings or cousins, if nobody was able to pick them up later, or if they could go work for a family member instead. Similarly, some family concerns have a higher priority than the Math Club, such as the arrival of a family member from Mexico. There has also been at least one case of an interpersonal conflict, which caused the student to permanently leave the after-school. We have also considered the possibility that some students simply did not enjoy the Club, although none have explicitly stated this as a reason for not attending. Because we are trying to place the Math Club within the school and broader community, it is important for us to be aware of these circumstances.

Four undergraduate assistants worked with the Math Club and on most days there were two present at the site. Their after-school duties included (but were not limited to) facilitating most of the activities with the students, writing field notes, and attending weekly planning meetings. Three of the undergraduates are female; two are pre-service teachers (one elementary, one secondary) with a mathematics focus, and one is a mathematics major. One is from Mexico, one is a native Portuguese speaker with solid knowledge of Spanish, and one speaks Spanish well enough to work with non-English speaking students.

The roles of all of the participants constantly shifted. Initially, the role of the undergraduates was to facilitate the activities, and the role of the researchers was to plan the content and observe. It soon became clear that this arrangement was severely limited. It was especially impossible for the three of us (researchers) to remain sole observers; instead, we have been actively participating in the activities of the club and have developed relationships with the students. The reason for this is that we initially felt that the pedagogic approach of the facilitators was too reminiscent of school and thought it appropriate to model the behavior we desired. Having created the content we had certain expectations of how we wanted it executed, while the undergraduates felt no ownership over the activities they were facilitating. Although the situation regarding the undergraduates' pedagogical approach then changed, we did not wish to restore the initial set-up, as we found that the relationships we built with the students and the participation of all involved to be in accord with our theoretical assumptions and expectations for the Math Club.

Over the course of the year, the undergraduates became increasingly involved in planning the Math Club content. While in the beginning they were acting according to our directives, not taking initiative, sometimes even in difficult situations, by the end of the year, they had embraced the Math Club as their own and took a more active role in its organization. Their relationship to the students has also changed and as a result, the roles of the students in the Math Club have changed. Rich descriptions of the activities will illustrate these transitions and the changing dynamics of the Math Club. The following section will provide an explanation of our pedagogical approach in order to outline the theory behind the activities.

The Didactical Approach

We carried out our after-school program in a school where teachers use an NSF-supported mathematics curriculum based on the standards developed by the National Council of Teachers of Mathematics (NCTM). These standards include aspects such as data literacy, understanding of scientific thinking and processes, problem solving, evidence-based decision making, mathematical fluency, and student self-reflection on learning. The curriculum's didactical approach involves the students' use of manipulatives, calculators, and computers, as well as dialogue with peers and the teacher in a collaborative environment of mathematics learning and teaching. While we share similar didactical orientations with the school's curriculum, we believe that in order for students to truly understand the power of mathematics as a tool to create change, mathematics education must also include a critical perspective. Therefore, we chose to expand our didactical approach to include the development of the students' sense of agency based on critical pedagogy. In particular, we have incorporated the dialogic

perspective on learning created by CREA (Center of Research in Theories and Practices that Overcome Inequalities- University of Barcelona) in dialogue with participants and the principal theorists of the social sciences and education (Flecha, 2000). We have adapted this perspective to our work with young children with the idea that if they bring in their own knowledge into dialogue about mathematics, it could lead to the development of their sense of agency to change the world around them.

In our Math Club we pose and solve problems presented in real-life situations. The facilitators present ideas to the students embedded in the context of their everyday lives, and the students then engage in projects whose objective is to solve problems utilizing mathematics (for example, in the "community photo project," students took pictures of their neighborhood, from which they identified a problem to research and describe mathematically). In doing these projects, the children use and apply mathematical ideas such as establishing relationships between quantities (measurement, conversion of units, working with length and weight, etc.), using geometric approaches (drawing blueprints, dividing the CEMELA Math Club garden into plots), using tools (rulers, *unifix* cubes, balances, etc.), and thinking in a logical way (math trivia questions, and computer and board games).

Through these activities, the students make sense of formal mathematical ideas (such as addition, subtraction, multiplication, division, etc.). "To make sense" is a very important idea for mathematic educators (Skemp, 1976; Godino, 2002). Sierpinska (1994) distinguishes between "understanding" and "meaning". She defines "understanding" as an action of making sense, of gaining the meaning of something, grounded in the belief that meaning is socially constructed and exists whether the

individual learner understands it or not. She proposes the idea of "situated understanding", which is very powerful in our dialogic perspective because it relates to the idea that understanding is predicated on the context in which it is situated.

To make sense is also one of the main principles of the *Dialogic Learning Approach* (Flecha, 2000). From this point of view, teaching and learning cannot be separated from context, and individuals have to make connections between the context of their own daily lives and mathematical ideas in order to better understand them. So, we understand that "to make sense" means to make connections –or bridges- between mathematics and real life.

In addition, two of the most relevant principles related to Dialogic Learning are *cultural intelligence* and *equality of differences*. This means that everyone has his or her own way of knowing, his or her own assumptions, schemata, procedures, and so forth, and that nobody's ideas are valued over another's. Teachers that use Dialogic Learning as a didactical approach assume that everyone can learn (everyone has the capacity to learn), and different approaches to learning are valued equally. Therefore, it is the teachers' responsibility to help students develop their skills and capacity to learn and the use of *egalitarian dialogue* is a way to accomplish this. For this reason, we encourage discussions in CEMELA's Math Club, we encourage children to participate in different ways, such as showing their answers and describing their methods and ideas to other children, and we encourage students to work in small groups in order to help each other. Because our activities and the mathematics problem solving are embedded in real-life contexts and can be in the child's home language, children are more apt to describe their

thinking and methods, which might not necessarily be the traditional method of mathematics.

Finally, teaching and learning are social processes where individuals can help each other. When individuals learn in a social situation, learning is enhanced and expanded, as described in Vygotsky's (1934) notion of the Zone of Proximal Development (ZPD). Because of this, we promote a collaborative relationship amongst students in CEMELA's Math Club. This viewpoint about mathematics teaching and learning also implies that learning is a transformative process because it helps individuals become mathematically literate and gain autonomy to read, interpret and actuate in our world. The following description of the evolution of the Math Club is based on our attempt to create a learning setting in which dialogic learning is central.

Beginnings

On the first day of the Math Club, eighteen students attended. Our first activity was a two-week long *ice cream project.* The students were to answer a number of questions, including: in how many different ways can one make a two-scoop ice cream cone using five flavors of ice cream, how much ice cream would we need to buy for the entire Math Club, and how much would it cost. They also collected and organized data about the students' favorite ice cream flavors in order to know what to buy. The students were to use tools: unifix cubes for the first question, and measuring cups, water and sand for the second; they would have to choose visual representations of data (tables, bar and circle graphs) for the data collection task, distinguish between combinations and permutations, measure accurately, and perform meaningful computations. The activity was very rich mathematically, yet closely resembled a classroom task. This was a

conscious decision on our part, as we wanted our first activity to be more structured, since we were entering a new environment, and did not know anything about the students, their preferences and mathematical backgrounds, nor did we know much about the undergraduates and their teaching styles.

Despite the school-like nature of the ice cream activity, many students enjoyed it: each day would begin and end on the rug, where students would volunteer to share the problems they solved and new concepts they had learned, or request explanations for things they did not understand. However, not all students were engaged in the project. Some were not following the mathematical conversations on the rug or in their groups, and we believe that when students are left out of mathematical conversations, the environment becomes reminiscent of a traditional classroom.

The school-like dynamics that resulted, such as the lack of involvement on the part of some students, demonstrates that our greatest challenge during the first weeks was how to make the Math Club *not* look like school. That this was not a class was not clear for either the students or the undergraduates. During these first few weeks, the students were quiet and behaved much like they do in the classroom. They referred to the undergraduates as “teachers,” spoke little Spanish, except for the students who had recently immigrated from Mexico, and primarily worked on activities individually. There was much focus on completing an assignment, which mirrors traditional classroom culture. Due to this fact, the students either worked very hard to solve a problem, or copied from those who solved it. The following excerpt from Maura’s [participant researcher] field notes exemplifies this:

> Many students copied from the group member that was able to produce a graph or chart. Students worked independently, and then other group members copied. The idea of teamwork does not seem to be practiced: "No, we each do our own, Miss." (Field Notes, 10/04/05)

Students were not accustomed to working with others and it seems that individual work was valued. The only "group work" occurred when some students resorted to copying from another student in order to complete the assignment. If they did not understand the problem, they would be reluctant to ask for help from their peers or us. For example, they would draw ice cream cones instead of solving problems and were quiet during the sharing time.

There were many positive experiences that began to emerge in the first few weeks as well. During the second week a student exclaimed, "We all speak Spanish and English. This is a Spanish and English class." One of the students, who has only recently come to the United States, though his English is very good, is much more comfortable using Spanish. On one occasion early on, he struggled to explain a concept in English, and another student turned to him and said, "Speak Spanish." He then started to explain the concept clearly and with ease. Another example comes from Maura's field notes:

> [A] student said, "Let's go to Guadalajara and figure this out." I asked her why and she replied, "Because my family is there and they can help us." I attempted to encourage her to elaborate on this, but she shrugged and became engaged in the problem again. Later, I noticed this student reading nutrition information on the ice cream container, and translating it into Spanish out loud, to nobody in particular. (Field Notes, 10/12/05)

This excerpt illustrates the ease with which some students refer to their immigrant backgrounds, as well as this girl's translation skills emerging during an activity related to real life.

The Semester Progresses

After the initial activity, we introduced the students to the maze. The idea of the maze is based on the Fifth Dimension model of after-school programs (Gutierrez et.al., 2001) which are in existence in several countries and sites across the world. In our loose adaptation of the maze, students navigated through rooms of primarily computer-based activities, all of which have three levels: beginning, intermediate and expert. This introduced the possibility for the students to choose tasks. Students seldom get to choose activities in their classrooms; and as the Math Club takes place in their school and in their minds was still a type of classroom, they were often unable to choose an activity or settle on it for very long. Another addition that the maze brought was El Maga Cemelín, an adaptation of the Fifth Dimension's virtual entity with whom the students communicate via email. In these emails to El Maga Cemelín, the students would explain in Spanish or English (or both) the problems they were solving in the Math Club. In these emails they also persistently tried to find out El Maga Cemelín's identity, gender, and ethnicity. For many, if not all students, this was the first contact with electronic communication.

In the beginning, we followed the framework relatively closely. We built a maze with five rooms: indoor garden, outdoor garden, computer games, board games, and jeopardy, which later became the math art room. The reason for this choice of rooms was the plot of land we were given by the school to tend throughout the year. The outdoor garden activities were directly related to this: they included planting and weeding but also

measuring the plot of land and finding its perimeter and area, finding the average depth of the soil, predicting germination, or following and plotting plant growth. The indoor garden room consisted of mathematical problems pertaining to gardens: they were mostly geometry or fraction problems and logical puzzles. As we intended computers to be another crucial aspect of the Math Club, we devoted a whole room to computer games. The maze was popular for a while, especially the outdoor garden activities, which the students always did in groups. Although group work was initially difficult to implement, after a while productive teamwork started taking place.

Eventually the maze lost its popularity, and the students were mostly choosing to go to the computer lab; at the same time, the plants were not growing as expected, and we had to move away from the outdoor garden activities. Instead, we started working on larger group projects for the first hour and playing computer and board games for the second half of the Club time. The emails to El Maga Cemelín, a huge success in the beginning, also began to phase out slowly: the students were not particularly excited about writing emails about the mathematics they did in the Math Club and found typing on their own difficult; we, on the other hand, did not think to offer typing assistance. However, they started writing to El Maga Cemelín more regularly again in the spring with the typing assistance from the undergraduates and scheduled time to write, and some of the initial excitement returned. Also, in an attempt to give them more space to include and validate their mathematical thinking we shaped the discussion of the emails by asking students to address specific mathematics prompts, such as “Explain how you found the area that each student in your classroom gets.” Briona’s response was:

> I measured how many squares there are in my classroom. And then so when I found out how many squares there were I timesed that by nine inches and nine inches is how much each square measure is. And then when I got the answer I divided it by 26 because there are 26 kids in my classroom. That told me how many inches each student gets. I liked timesing the numbers because I like multiplication. I didn't like dividing. It was hard to draw a scale drawing because the classroom is not squared so it was hard to find out how many squares there were because the classroom is like a castle.

This is an example of a student attempting to explain their approaches to mathematics problems in their emails to El Maga Cemelín. The dimensions of the tiles in the classroom were 9 inches by 9 inches, so Briona multiplied the number of tiles in the classroom with the area of each to obtain the area of the classroom. To find the area per student in the classroom, she divided the total area by the number of students.

By the time the maze was introduced, the students had gone through the initial acclimatization period and began to make the Math Club their own. Because of the personal interaction time that the undergraduates could have with students during the outdoor garden activities, the students were able to come to a deep understanding of concepts in context with the guidance of the undergraduates. For example, one student was able to walk the length of the plot with an undergraduate and compute its perimeter, gaining a deeper understanding of the perimeter formula. The outdoor activities also allowed for the undergraduates and the students to build stronger personal relationships.

The following field note excerpt demonstrates how the undergraduates were affected by the personal interactions with students:

> Trying to get to know the students better has also been personally challenging for me. The process is bringing to my attention how much I really don't know about them, the lives they lead, and how different their lives are from what I am used to. … It is difficult for me to relate and connect to their lives since it is so different from what I am used to. When I do get a descriptive answer, it shocks me so much that I have to process it and really grasp it before I can think of anything else to ask. I guess my point is that this experience is going to be an incredible learning experience for myself as well." (UG Field Notes, 10/18/05)

This excerpt illustrates how all participants are involved in the learning process together.

Students' backgrounds were permeating all interactions from the beginning. The undergraduates' field notes include the following observations:

> Maura [participant researcher] was telling the kids that they had to figure out the average depth of the rectangle in garden but it seems that the kids didn't fully understand either of the words 'average depth.' It was only after Maura said the word *profundidad* that the kids immediately knew what she was talking about. (UG Field Notes, 10/18/05)

> When Maura said something about the passports and how the kids needed to fill them out after each activity[3], Ricardo said 'pasaporte por si viene la migra', which means 'passport in case immigration comes'. (UG Field Notes, 10/24/05)

The first excerpt illustrates how the use of both languages can aid in the completion of the task, while the second exemplifies how the students bring their own life experiences to the Math Club.

[3] Passports were used for the students to keep track of the rooms in the maze they visited and activities they engaged in.

Incorporating Group Activities

In order to continue to build a nurturing and cooperative environment in the Math Club, we made some changes to the structure of the club approximately halfway through the fall semester. We started meeting the students in their classrooms to get them excited about coming to the Math Club, and we encouraged them to bring the snacks they get in the cafeteria after school to eat in the room where we meet, in order to interact informally before starting the activities.

After having moved away from the maze somewhat and before the end of the semester, we incorporated larger community-based group projects in order to foster collaboration and make more connections to students' lives. A photo project was our first attempt to begin a community-based activity. As we had done during the first, pilot semester of the Math Club (in spring 2005), we gave students disposable cameras, but this time told them to take pictures of an issue in their community they would like to change in an attempt to connect mathematics to their daily lives. In preparation for this, they looked at some famous photographs (by Dorothea Lange, Ansel Adams, children in Guatemala, and others) and made storyboards to plan how to use the available film. In their reactions to the photographs, they related what they saw to their own experiences.

> As Diana looked through the pictures she asked about Cesar Chavez and if the pictures had anything to do with him[4]. She also picked out one picture of a long dirt road and said it reminded her of the road she takes to Cananea [a town in nearby Sonora, México].

[4] The photograph she was referring to was Dorothea Lange's portrait of migrant workers during the Great Depression.

> Sylvia picked out some favorites from a book of photos taken by children in Guatemala. One picture was of a woman making tortillas. She said she chose it because it reminded her of her mom and grandma making tortillas. … Both she and Marisol (at different times) picked out a picture of a room with a TV reporting a plane crash and the pictures of the Virgin de Guadalupe and Jesus on the wall. They both said they liked it because of the pictures on the wall. (UG Field Notes, 11/28/05)

We believe that these reflections by the students were made possible by the environment we have created in the Math Club. The students mentioned issues such as homelessness, pollution, and crime in their neighborhood, though they refused to address some of them in their photographs because they perceived them as too dangerous; for example, they were not comfortable with taking pictures of homeless people. In the end, however, when they returned their cameras to us, it transpired that they had mostly taken pictures of their families and friends. Although the photographs were interesting, they did not lend themselves well to the kind of mathematical exploration we wished to pursue, so this project was temporarily put aside, except for a brief tutorial on using PowerPoint. At the time this paper was being written, we were revisiting the project, as described in detail later. Many of the members of the math club changed at the start of the spring semester, giving us an opportunity to start the project over with significant changes. Some of the changes include engaging in a longer discussion with the students about the purpose of the project and providing them with more guidance.

The final activity of the semester was the piñata making. The idea for this activity came from an undergraduate facilitator, who is from Mexico. The students computed how

much water and flour were needed to make a certain amount of glue, and how many strips of paper they would get from a newspaper if they ripped a page into strips one inch wide. Presumably because the students did not see the need for this activity (the glue was already made and the width of the strips was irrelevant), or because they were too eager to begin the hands-on part of the activity, they were not particularly motivated to finish it. However, making the piñatas (each student made one) proved to be a valuable opportunity for us to bond with the students as they told us more about their lives. Several students had made piñatas before when they lived in México and brought in their expertise as to how much glue to use. One student began to decorate her piñata with the colors of the Mexican flag and her mother also joined us this day, helping to decorate her daughter's piñata. On the second day of the activity (which was also the last day of the semester) we had a party. Some students brought homemade Mexican food, and in the end they broke a big piñata and after some scuffling and negotiating, agreed to share the candy, which concluded the day and the semester. We decided to recruit some new students and begin to integrate more community activities to begin the new semester in January.

The Changing Dynamics of the Math Club

By the end of the school year, our Math Club had transformed into a bilingual setting where we began to see examples in which students and facilitators alike felt they could contribute to the discussion and activities, moving away from traditional power structures that exist in most regular classrooms. We acknowledge that power structures still existed but believe that our changing approach to pedagogy caused a shift towards fostering a sense of agency in the students. Dialogic learning began to characterize the

pedagogy that existed in the Club, and we will attempt to illustrate how students were beginning to show signs of a change towards empowered learners through descriptions of the activities.

After the winter break we initiated a member recruitment effort and welcomed several new students. Older members were given the task of describing the Math Club and how the maze works to the new members, which they did with confidence and pride. New members quickly became involved and engaged in activities, with computers being the most exciting and requested activity during the second half of the Club time.

During the first half of the Club time, we started the semester off with a new project related to a book entitled *Actual Size*. This project lasted for about two weeks with students working in small groups to translate a small drawing of a large animal to a drawing of the animal's actual size. The students used transparencies of grid paper to trace the picture of the animal condensed to fit into the book and calculated a scale to use to determine the larger grid size to draw the animal in its actual size. This activity allowed two to three students to work with one facilitator in the language of their choosing to determine the scale for the final drawing. Once the drawing started, it gave time for the students to interact with the facilitators in a casual environment in which each student worked hard on the specific task they decided to undertake in the drawing and coloring of the animal. We then posted the animal drawings around the school with explanations dictated by the students as to how the drawing was done, in the language of their choosing. The following is an example of Gaby's description in Spanish with an English translation:

Como Hice el Tigre de Siberia- Por Gaby	How I Made the Siberian Tiger- By Gaby
Primero puse el dibujo pequeño debajo de papel con cuadritos para ver como cabe en los cuadritos. Despues hicimos los cuadros en el papel grande, calculando que grande deben ser para ser de tamaño verdadero. Medí lo que decía en el papel y luego medí el tamaño de los cuadros. Luego empezamos a ver en que parte del tigre va en cada cuadro. Es de tamaño verdadero.	First, I put the small picture under the paper with the small squares to see how it fit in the small squares. Then we made the big squares on the big paper, calculating how big it should be to be real size. I measured what the paper said and then measured the size of the squares. Then we started seeing which part of the tiger goes in each square. It is the actual size.

Another student's engagement with this project stands out, illustrating a positive outcome of participation in the Math Club. Veronica began the club as a shy student with little confidence. Another student remarked, "She's too shy," and Veronica's step-sister, whom Veronica was sitting behind, remarked, "She's really shy." Veronica's behavior in her mathematics classroom: not participating, looking down when the teacher is looking to call on students and always asking the participant researcher for help, also demonstrated her shyness and lack of confidence. During this and other projects in the Math Club, Veronica has undergone a transformation. She was particularly proud of the work she did on the *Actual Size* animal, primarily because she had collaborated with another student and felt that the project had been done without much help from the facilitators, which she repeatedly pointed out. During an end of the year reflection, Veronica mentioned, "I like projects because I learn more mathematics that way, and it is not like in class where it's all addition and multiplication." We believe that being able to complete the activity on her own or with her partner and feeling that she really was in control of the activity helped her to gain confidence in herself academically. In addition, her behavior in the mathematics classroom has also changed; she is much more engaged,

is eager to answer questions posed by the teacher and often will look at the participant researcher observing in her classroom and smile when she does so.

In completing the actual size activity, we initiated an activity related to grow creatures. Marisol had been asking us if an activity of the club could be to grow the grow creatures (small rubbery creatures that grow when placed in water). We organized a math measurement activity related to the creatures and were able to follow her interests in introducing this activity. The students were very engaged and excited about the creatures. They were to measure the creature (weight, length, perimeter and area) before it grew and each day for a week after it was placed in water, to track its growth (which meant taking the creatures and measurement materials home and measuring them there). Students were able to explore the materials available in the room in order to decide what method they wanted to use to measure each of the characteristics of the creature. For perimeter, students used string, as suggested by one facilitator, traced the creature on centimeter grid paper and then counted the lines as one centimeter each, used flexible measuring tape as well as used their hand and fingers to surround the creature followed by measuring that distance on their hand with a ruler. Students consulted each other, introduced their own methods and tried methods suggested by the facilitators. Several new students arrived on the second day of the activity and so students who had been there the first day assisted the new students by explaining the procedures and techniques. The following transcript of a videotaped session illustrates these interactions:

> Maura (graduate student facilitator): explain what you did and you can just explain one part and then other people can have turns too, ok? So explain the first thing you did.

Marco: I'll go up to here [describing which part he would explain].

Priscilla: ….Right here we had to grow growing creatures. We have to do the length, the height, the perimeter and the area. Well mine is about 2 grams, or something like that.

Maura: About 2 grams?

Priscilla: Uh huh

Maura: Ok

Priscilla: And then the length was one inch and three centimeters [referring to having used both systems of measurement]. The perimeter was three wholes [referring to having used square centimeter grid paper to trace and measure perimeter] and 3 inches and the area was 2 and a half [referring to square centimeter grid paper].

Maura: Ok, so you did different things to figure out all of those measurements.

Priscilla: (nods)

Maura: Marco wants to add something. Do you want to add something Marco?

Marco: (hand up) No.

Maura: Ok, how did you do the length?

Marco: We get to measure it with the ruler.

Maura: Ok

Marco: Like in inches or in centimeters and mine was 8 inches or in centimeters it was, no point 8 inches [or] 2 centimeters. [Marco corrects his mistake, saying he meant .8 inches was the same as 2 centimeters, rather than 8 inches.]

Maura: Ok

Marco: and then the perimeter is 261 miler, millimeters

Maura: Ok, now how about area? How did you figure out area?

Vanessa: We got this paper (shows cm grid paper) and then traced it; counted the squares that were in, were in the, inside and so if there was one that had just half of a, a square, we put it, we put two of them together and that makes one whole, one-

(Videotape Transcript, 01/15/06)

This example demonstrates the nature of the pedagogy that occured frequently in the Math Club by the end of the year, moving from a teacher/facilitator-directed approach to a more dialogic learning approach. Although a facilitator initiates this discussion and the prompts, the students are freely describing their various methods for measurement in this transcript, demonstrating the shift towards an environment in which students' voices, knowledge and particular approach to mathematics are central.

The final activity of the Math Club was a community photography project, with the idea that the photos would serve as a springboard for discussing a social justice mathematics project. In order to begin to understand how numbers can illustrate injustice, we used a book entitled *If the World Were a Village* to spark some discussions about poverty, immigration, etc. This excerpt from field notes describes one discussion that came about:

We read the page on schooling and education. The book said that of the school-age children, not all went to school. Rebeca said that that wasn't true. We asked her where and she said "here." Maritza pointed out that there are poor families where they need the kids to work, so they don't go to school. Rebeca explained that she

> thought that was a thing of the past and that it didn't happen any more. The discussion then turned to immigration and Rebeca discussed a news show she had seen talking about the low wages that immigrants to the U.S. are willing to work for. (Maura's Field Notes, 02/28/06)

Through this community-based activity students were able to bring in knowledge they have about injustices they know about as well as contribute their real life experiences.

After this discussion, we took trips in the neighborhood to document what the students are proud of about their communities as well as what they might want to change. Students focused on community icons such as tiled murals reflecting the Mexican American heritage of the residents, the books in Spanish and the computers at the public library, the local store, and the fire station. For what they would like to change, they focused on things such as garbage and grafitti.. We have learned about activities such as boxing that students are involved in outside of school, as well as knowledge of the "WICK" office where a student's mother went when she was pregnant. At the time of this writing, we planned to use these discussions and photographs to conduct a mathematics-based social justice project with the students, centered on an issue that they identified through their photographs and group discussions.

Concluding Thoughts

As we move towards more community-based projects centered in dialogic learning for the following school year, we hope to continue building a setting in which students feel their knowledge is valued and central to learning. The examples described above illustrate the journey we are undertaking in creating this kind of learning space, as well as the struggles that we have faced and will continue to face. Our most important

observations so far relate to the difficulty in carving out a learning space that is different from students' regular classrooms, as well as the rich environment that exists when children are empowered to contribute whatever knowledge and language occurs naturally to them in learning.

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