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ABSTRACT

This paper describes some aspects of a collaborative project between elementary school teachers and university faculty in anthropology, bilingual education, and mathematics education. The project goal is to develop classroom-teaching experiences that make use of the resources and experiences of students and their families. Most of the students were Mexican Americans. Teachers in the project visit the homes of some of their students to uncover their funds of knowledge by finding out about household activities, family structure, labor history, and parents' views on child rearing and schooling. Teachers and university researchers then come together to share their ideas and findings. The paper briefly describes the household visits, study groups, and classroom implementation, with an eye on mathematics, giving examples of themes that the teachers chose to develop based on their findings. The specific focus is on the development of a module on games in a fifth-grade class. The paper also illustrates some of the difficulties encountered in trying to develop mathematics classroom learning that builds on students' everyday experiences. (Contains 29 references.) (SLD)

Connecting the Home and the School: Funds of Knowledge for Mathematics Teaching and Learning

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Abstract

This paper describes some aspects of a collaborative project between elementary school teachers and university faculty in anthropology, bilingual education, and mathematics education. Our goal in this project is to develop classroom teaching experiences that make use of the resources and experiences of the students and their families. Most of these students are Mexican American. The teachers in this project visit the homes of some of their students as learners to uncover the funds of knowledge by finding out about the household activities, the family structure, their labor history, and the parents' views on child-rearing and schooling. Then, teachers and university researchers come together to share their ideas and knowledge about classrooms and the findings from the households. We collaborate on the elaboration of learning modules based on these findings.

The paper briefly describes the three components of this project--household visits, study groups and classroom implementation-- with an eye on mathematics. The paper presents examples of themes that the teachers chose to develop based on their findings from the home visits and the mathematics potential in these themes. For example, a second grade teacher and her class developed a learning module around the theme of construction. Another second grade teacher developed a theme around the topic of games based on the clapping games her students played during recess. For the last three years I have been collaborating with a fifth grade teacher. The paper will focus on our more recent work--the development of a module on games.

The paper also illustrates some of the difficulties we have encountered in trying to develop mathematics classroom learning that builds on students' everyday experiences. Some of these difficulties are related to the diversity in these experiences. Another source of difficulty is the resistance to change in the way mathematics is taught and learned. These difficulties keep us re-evaluating our work constantly and have led to changes in our approach.

Introduction

The work reported here is part of a larger research project that has as its goal to develop teaching innovations that use the students' (and their families and community) funds of knowledge as the basis for instruction (Moll, 1992; Moll, Amanti, Neff, & Gonzalez, 1992). Funds of knowledge are "the essential bodies of knowledge and information that households use to survive, to get ahead, or to thrive" (Moll, Vélez-Ibáñez, Greenberg, Andrade, Dworin, Saavedra, & Whitmore, 1990, p. 2). In this project, teachers working in schools with a large language minority student population collaborate with university faculty in anthropology, bilingual education, and mathematics education. We reject the concept of a deficit model in school teaching, that is, a model that assumes that students, especially language minority students, lack adequate experiences and background for formal schooling. Instead, "our claim is that by capitalizing on household and other community resources, we can organize classroom instruction that far exceeds in quality the rote-like instruction that these children commonly encounter in schools" (Moll, et al., 1992, p. 132). Most of the teaching innovations in our work have centered around aspects of biliteracy viewing children as "active learners using language and literacy, in either English or Spanish, as tools for inquiry, communication, and thinking" (Moll, 1992, p. 21). But recently, we have begun to incorporate mathematics to these learning communities. This will be the focus of this paper. Our goal is to develop a mathematics classroom community that builds upon the children's resources and experiences.

I first present the theoretical framework for this research. Then I turn to a brief description of the three main components of our work--household visits, study groups, and classroom implementation. I illustrate each of these with examples that have implications for mathematics instruction. The third section describes our initial work towards the creation of a mathematics classroom community by focusing on the development of a learning module around the theme of games in a fifth grade class. The last section raises some questions in relation to our work in trying to change mathematics teaching and learning in this class.

Theoretical Framework

As described in the background section, the work presented in this paper draws upon a sociocultural framework (Forman & Carr, 1992; Moll, 1992; Moll, Vélez-Ibáñez, Greenberg et al., 1990). The children's and their families' experiences and practices are brought to the foreground of the classroom teaching and learning. Instruction is centered around students working on meaningful (to them) tasks, sharing their ideas, defining the issues, and devising the ways to approach them. The classroom is seen as a potential learning community where its

members can contribute their expertise in different areas and where learning takes place through exchange and cooperation.

Along this concept of learning community, the research on the development of classroom communities where mathematics is socially constructed (Cobb, 1991; Lampert, 1986; Schoenfeld, 1991) is particularly relevant. Some characteristics of these mathematics classroom communities are:

- students and teacher engage in mathematical discussions (Lampert, 1986).

- communication and negotiation of meanings are key features of the mathematical activity (Bishop, 1985; Cobb, 1991).

- students work in small groups and are encouraged to use and demonstrate to others their informal knowledge of mathematics.

- mathematics activities are academically challenging to encourage students to develop and share their own solving strategies.

Based on our work in the Funds of Knowledge project, I will add the following characteristics to our vision for these mathematics classroom communities:

- mathematics activities are contextualized on the knowledge, skills, and experiences that students bring to class.

- parents (and other household members) are invited and encouraged to participate in this learning community.

Finally, the work presented here also draws upon research documenting the apparent lack of connection (and of transfer) between school learning and life outside school (Bishop & Abreu, 1991; Brown, Collins, & Duguid, 1989; Lave, 1988; Resnick, 1987; Saxe, 1991; Schoenfeld, 1987, 1991). As Brown, Collins, and Duguid (1989) write "success within this culture [school] often has little bearing on performance elsewhere" (p. 34). People appear to perform differently on similar tasks, depending on whether the task is in a school context or as part of their everyday experience. This is certainly the case of mathematics tasks as several studies have reported (Carraher, Carraher, & Schliemann, 1985; Lave, Murtaugh, & de la Rocha, 1984; Saxe, 1988; Schliemann, 1984). In many of these studies the subjects performed virtually error-free arithmetic in situations that they viewed as relevant to themselves and pertaining to their everyday activity. Yet, when given pencil and paper to solve similar tasks, their performance was much lower. School tends to discourage the use of "informal" knowledge and strategies. Maier (1980) argues for making school mathematics look more like folk mathematics. By "folk mathematics" he refers to "the way people handle the mathematics-related problems arising in everyday life " (p. 21). Similarly, Nunes (1992) asks, "how can teachers identify and capitalize on mathematics learned outside school?" (p. 557). Our work presents an effort in this direction.

Lave (1988) gives several examples of the lack of transfer across situations in the area of mathematics. Of particular relevance to our project is the work by Herndon (1971) (cited in Lave, 1988). Herndon, a junior high school teacher realized that several of his students exhibited very accurate arithmetic outside the school context, in activities such as scoring for a bowling league, shopping, delivering newspapers. He developed problems based on these activities as an attempt to make school mathematics more related to these students' experiences. However, his attempt did not work out. The students obtained nonsensical answers (at least from a real life point of view), and kept on turning to the teacher for validation of their work.

Boaler (1993) cautions against the use of mathematics tasks in school that are presented as having a real life context, but remain school tasks in the constraints and method of solution expected. Boaler writes "individual meaning will be achieved not through the presentation of 'real world' contexts but through the recognition of students' own cultural values in the mathematics classroom" (p. 15).

Overview of the Project

How do we work towards reaching our goal of developing classroom teaching that builds on students' experiences and backgrounds? There are three key components towards this goal: household visits, study groups, and classroom implementation[1].

Household Visits: The teachers receive instruction in ethnographic interviewing. They then visit the homes of some of their students to learn about the funds of knowledge in these households. Questionnaires on the family structure, parental attitudes towards child-rearing, labor history, household activities are used to provide some structure to these home visits. For example, through her household visits, a second grade teacher found out that her students' families had a wealth of knowledge about building and construction in general. This was the basis for the development of a theme around construction (Civil, 1993). Another household visit found us learning about budgeting and the active participation of the fifth grader in the bakery business that his family had before coming to the US.

Study groups: these reflect the collaborative nature of this project. Here, teachers and university faculty come together to share their ideas and knowledge about classrooms, teaching, learning, and the findings from the households. These sessions lead to the development of learning modules that build on students' experiences and that promote their active participation in the learning process. Some recent learning modules, which have included a mathematics

[1] See Moll, Vélez-Ibáñez, Greenberg, et al., 1990, for a detailed description of these three components in the context of biliteracy.

component, have been on themes such as clothing, horses and ranches, music, foods and cooking.

Classroom implementation: what are the pedagogical implications of the household visits and the study groups? What is taking place in the classroom? How can the findings from the household visits, the ideas from the discussion groups be implemented in the classroom? This component has been my focus in this project. In a second grade class we developed a theme around construction that integrated the different content areas in the curriculum (Civil, 1993); another example comes from my work in two classrooms (third and fifth grade) on a learning module around the theme of money (Civil, 1992). Although at the planning stage, the two teachers and I devised several mathematically rich activities, the implementation did not always capture the mathematical potential. Lack of time (it was late in the school year) and the fact that this was our first collaboration are two reasons for the limited mathematics.

Also, in connection with the classroom implementation is the task of classroom analysis. Documenting what takes place has proven to be a very hard endeavor. We have field notes, a copy of students' work, a record of our conversations with them and videotapes of some of the events. Do we want to look at the class as a whole and focus on one or two themes? Do we want to focus on one small group of children, and then do a case study on them? We have yet to resolve these questions.

At this point in our work, most of the teachers have been in the project for over three years. Different teachers have developed different areas of interest on which they want to focus. Some wanted to do more work in the household visits component, others seemed more interested in the classroom implementation for a specific content area. This is the case of the fifth grade teacher with whom I have been collaborating for the last three years. She expressed a specific interest in changing the way she teaches mathematics. She wanted her students to be a part of the "making of mathematics" by engaging them in discussions on open ended problems, very much like they may do in their reading groups. Thus, our goal became to develop a mathematics classroom community in her fifth grade class by building on students' experiences and by making connections to their home and their world. This is the focus of the rest of the paper.

Working Towards Changing the Mathematics Classroom

Setting the Stage

This section presents some of the steps we took towards changing the mathematics classroom norms to create a learning community in a fifth grade classroom. Besides the classroom teacher and myself, one more researcher collaborated in the endeavor-- Rosi Andrade, a doctoral candidate in Education, whose area of interest is children's social worlds.

Our first task was to work on getting to know the students, and in particular to learn about their ideas about mathematics. For this:

- We started by having students web around the term mathematics. This gave us a very vague idea about their concept of mathematics, or rather school mathematics (are these the same for them?). The reason for this vagueness, I suspect, was the novelty of the activity and the fact that students were still getting used to us. Some of the entries in the web had to do with mathematics as computation; others gave us an insight into their attitudes towards this subject.

- They filled in an attitude / beliefs survey and an open ended questionnaire. The questionnaire asked questions such as "in what ways do you use mathematics outside the classroom?" Most answers referred to shopping or games; "Give an example of a math problem that is easy /hard for you; " Most answers gave an addition or subtraction sentence as an example of an easy problem, and a multiplication or division sentence as an example of a hard problem; "a young friend of yours is entering kindergarten, how would you explain to this friend what math is?" Most answers mentioned counting and numbers.

- Rosi interviewed each student individually to develop a profile of each children's interests, and some background information (family structure, language(s) used, preferences for school subjects, "professional" goals). The children's questionnaire originally developed for the larger project gave us the general format for the interview.

Meanwhile, I started working with the whole class on developing a discussion approach to the learning and teaching of mathematics. I presented them with problems especially chosen to promote cooperation and dialogue in mathematics. I used problems such as the typical "handshakes question"; exploration activities with the calculator; an investigation task on writing numbers as the sum of consecutive numbers. Throughout all these tasks we emphasized explanations of the process and not just writing an answer on a piece of paper. We tried (with varying degrees of success) to promote cooperation by having students taking different roles and by constantly walking around the room trying to engage all the members of the group into the conversation.

Our goal is to develop a working atmosphere in the classroom, one that reflects some of the characteristics of outside-school life (Resnick, 1987). Whether this is a realistic goal is not always clear to me. But, I do know that I would like to see a classroom situation where the students become responsible for their own learning (Whitney, 1985). My sense is that often in school we (adults in the classroom) end up doing "too much" for the children: we tell them what and how to do things, we provide them with all the resources, and we often give in to their requests for "the answer," and end up accepting poor explanations and statements without justification. We help develop a set of rules and expectations about the way things are supposed

to be in school. This way is quite different from the way things are in most children's outside-the classroom life, as one can see by observing them in their community, in the playground, or even in the classroom when we let go and let them take charge.

The Games Module

Based on another project teacher's work around the theme of games in her second grade class, this fifth grade teacher had expressed an interest from the start in developing a module on this topic with her students. She viewed games as a way to connect with her students' world. Games give us access to the children's real world. As Ainley (1990) writes, "games are one way of providing the mathematical equivalent of children's books and comics" (p. 86). Ainley points out that many suggestions for examples of everyday mathematics to use in the school are examples from an adult world (see also Boaler, 1993, on this point).

One of my main research interests is to look into how students make sense out of mathematics situations by finding out what their ideas are and developing tasks that allow me to probe more into these ideas. Games provide a context for exploration of the children's mathematical ideas.

The students reacted very favorably to the idea of looking at games. They were particularly excited by the prospect of their making their own game that would then be shown to other students in the school.

We began by webbing around the word games. A couple of incidents are worth pointing out:

1) Prompted by one of the entries on the web, "math games," a student raised the point of whether these were games. So, I asked them: What makes a game a game?

2) At this point another student asked "what does all of this have to do with math?"

For the first question, students suggested: Fun; need more than 1 person (usually); involve pieces, a ball, dice; have instructions, rules. For the second question, I asked for games where they thought they had to use math. One student suggested Bingo, but several students said that "it's just numbers, you don't do any math." The more mathematical examples seemed to be games involving money (Life, Monopoly, Poker).

Students were also asked to interview someone in their family to find out what games he/she played when he/she was the student's age. Finally, students were also asked to explain a game they knew how to play. One student said that she knew no games and played no games at all.

Then we had students play games and analyze them. We chose games such as NIM variations, probability based games, and variations of Tic Tac Toe. NIM was a good opener given that there is a winning strategy. Students became intrigued and gladly took on the challenge of finding out the strategy. The first version of NIM that we played involved 12

pieces, two players, each in turns can take 1, 2, or 3 pieces. The player who takes the last one is the winner. Students were eager to challenge me, and after a few games, most of them had caught up onto the strategy. The next day I had planned a more systematic analysis of this type of game. I wanted them to play with the same rules but looking at various initial number of pieces (3, 4, 5, 13, 15, 26). Very soon, too soon, students were already asking for the 26 pieces because "they were done" with all the others. Yet, as I challenged them to play me with 13 pieces, I kept winning.

What are the issues here? First, the concept of strategy is difficult. As one student put it, "my winning strategy works with C. [her partner]." Students were playing a few games and describing one way in which one player may win, but that is assuming certain moves on both parts. A second issue is related to the classroom norms and students' interpretation of the task in view of these norms. Students wanted to reach the 26 pieces part and "be done with the task." Analysis, spending time on ONE question, were foreign behaviors for most students in this classroom.

The fact that the concept of strategy is a hard one became more evident in the probability games. Many students rejected the idea of an strategy for these games, on the basis that dice were involved and thus "it's just chance." Although analysis of the games showed "best arrangements," many students appeared to ignore this information as it did not provide an absolute winning strategy.

What were our goals in having them looking at different games and analyze them?

- We selected games that were mathematically rich to give us an insight into the students thinking in a mathematics environment. We were interested in their explanations as they for example, verbalized strategies, or decided whether games were fair or unfair.
- We had them look at a diversity of games for two reasons:
    - to enlarge their pool of ideas for when they started thinking about the game they wanted to make.
    - to expose them to a variety of approaches and strategies to tie it in with our previous work with them on different problem-solving strategies.
- We used these games to keep working on developing cooperation behaviors among their groups. They did regular self assessments of how their group was working out.

A constant throughout our work is to work on developing a critical approach to learning. Hence, in their looking at other games, we focused on their being critical evaluators of those games. Saying "it's boring," "I don't like it" were not enough. Students started to develop an awareness for this critical approach, and if fact, on some occasions, they were the ones who

raised questions such as "why do you think it's boring?" Below are three different groups' write-ups on "a game they liked; a game they did not like":

Group 1:

We liked this game [20 questions] because it is a thinking game and we love thinking and guessing.

[they didn't like PIG] because it doesn't have much of a challenge as 20 questions and it's not a guessing game and we like guessing games. We like guessing games because we like to take a chance at the answer.

Group 2

We liked KO NO because it was very challenging, it was also fair. You have to have skill to win it.

We didn't like Race to the top because it was an unfair game. The odd player won more often than the even player.

Group 3:

We liked race to the top because it's fun and exciting. And it's a fair game, because everybody has a chance to win! It doesn't matter if you're the even person or odd person because you could take turns being the even or odd, well what we mean is that if even always win you could change the person to odd and you can win!

We didn't like NIM because it was boring because you had to do the same thing over and over again. And anyway the last person who had the four last little blocks had to loose forced, I mean he or she was forced to loose.

Their Games

After a few sessions spent on their looking at games and analyzing them, the time came for the students to make their own games. This is probably the aspect that best reflects our thinking in this work. Students were given very few guidelines and were free to choose the topic for their game, what it was going to look like, etc. The game was to be a group project, and thus they had to resolve possible conflicts with their peers. Also, students were aware that their games would be tried by their classmates and then by other students in the school. This concept of public outcome made the project particularly relevant to the students. The teacher, Rosi, and I would serve as consultants and as monitors of progress.

Now comes the main difficulty in our work: how to keep track of the different issues that take place in an environment where we want children to follow their agenda. There were several issues we were interested in:

- group interaction; role assignment; conflict resolution
- nature of their discourse: we are particularly interested in looking at instances of reasoning, justification, making sense of the task in hand.
- use of mathematics in their games
- what do these games tell us about their world?
- what (and how) resources do students use in their games?

But perhaps the main difficulty is that we do not know what issues are going to emerge as we let the students gain ownership of their learning. What are they learning? How can we tell whether something "productive" is taking place? I guess my main question (and maybe it is not a fair question?) is "how can we convince someone (and ourselves) that in doing this kind of work students advanced in their learning?" Would some kind of pre / post interview help address this question? Maybe, provided we had a clear idea of what are some concepts, methods, and so on that we would like them to learn. For the time being, although uneasy with this unresolved question, we are focusing on a description of what took place and on our own learning of what these children did, who they are, how they tackled the task.

In our initial work on the module, by having them look at games, we were targeting mathematics and also giving them suggestions and tools for later use if they chose. We were also working on developing behaviors that we think would be conducive to students taking more responsibility for their learning, by letting them know that we were interested in their ideas, their justifications, and by "putting the ball back in their court" when they tried to "get us to do the work for them."

What are the results?

Overall, the students took the challenge quite successfully. All the games were quite different and informed us about some of the different interests in the class. Rather than going over each of the games, I will briefly describe four of them, and then give general observations about the module.

Wings: This is an airplane game. Students made the landing strip, and three different kinds of airplanes. Given the nature of this game, it soon became very popular and attracted the attention of other students. Yet, with one exception, the students in the other groups soon returned to their own work. I speculate that seeing this game gave an incentive to some of the students to make their game "look good," since popularity is an issue in this classroom. A lot of

their production time was spent on an exploration of how the different designs of planes affected their flight and landing. This investigation, however, was never formalized in the form of a report. It did lead, though, to the selection of the three planes.

Goof Off: This is a board game representing the classroom. Each player takes a piece (representing a student) and by rolling a dice advances on the board. The goal is to make it to the "teacher's desk" without being caught. Different things happen along the way, and these outcomes are decided by a deck of especially prepared cards. The interesting aspect of this game is that, as Rosi pointed out, it represents an ethnography of the class from these students' point of view. In fact when I asked the group leader (this group clearly had a leader) how she had thought of the idea, she looked at me and said "I just watch the class," and then added "many of these things [in the cards] have happened."

Tip Over: This is a game of balancing. It looks like a scale with one small basket at each end. Each player in turns roll a die and depending on the outcome either adds or removes beans to their basket. The goal is not to have the scale "tip over." This game was very different from the others. The main difficulty was that it involved making a scale. They went for help to the shop teacher and had to revise their design and their ideas several times, because the physical implementation was not working as they wanted. The group interaction is worth noting here. There were four girls, two Mexican American and Spanish-speaking, one African-American, and one Caucasian, who was well liked by all her peers and considered as one of the most intelligent students in the class. The two Spanish-speaking girls soon tried to form their own team and make their own game. They used Spanish between the two of them (they both speak English, too) to make a point that they wanted to break away from the group. They finally agreed to work together. In doing the game, they all went through considerable frustration because it was not working out as they wanted. This is reflected in their self-assessment write-ups. In the end, three of them decided that the fourth one should not be included in the team because she had not made any positive contributions and, all the while, she had put the whole idea down.

Slam Dunk: This is a board game with a basketball theme. It is a game for two players. Each player rolls two dice and moves their basketball player along a numbered strip. The strip is numbered 2 through 12, and the player can only move in that order, that is: first he/she needs to get a sum of two on the dice, then a sum of three, then a sum of four, and so on. Once one of the players reaches 12 ("if that ever happens" as one of the creators of this game said in the presentation to the class), they then have to get the total indicated by a card in their basket in order to win the game. This game immediately caught my attention because it built on the "r to the top" and similar dice games that we had been looking at during our probability games. During the presentation to the class, I asked them if they could have two people play the game for a while. They called on two boys who rolled the dice a few times without ever getting a two. B.,

one of the creators of the game said "low numbers are hard to get, it gets easier for the higher numbers." Then, to our surprise he said "maybe we should have called on two girls." The teacher asked him if he thought that whether it was a boy or a girl would make a difference in the outcome of the dice. He said that he was not sure. So, they called on two girls. The unexpected result was that one of the girls got a 2 followed by a 3 right away. Anyway, the game did slow down after that and we never went past 4. In the presentation critiques, several students wrote down that they did not think that whether it was a boy or a girl would make any difference.

What caught my attention in this game was its mathematical basis. It is not clear to me what use they made of the fact that they knew that "lower numbers are hard to get." When I probed B. on this, he seemed to know why lower numbers were harder to get (and also numbers at the high end): he was aware of the different combinations, and how for numbers such as 6, 7, 8 there were more combinations than for numbers 2, 3, or 11, 12. He said that this was the reason why they made the game the way they did. They also said that they had played games and that it had taken them about twenty minutes to finish a game. It is hard for me to determine whether they shared with me the impression that this game could be quite tedious, and that we just have different concepts and levels of tolerance for "tediousness"; or whether they had not quite made the connection between how the sums of two dice outcomes work and their effect on this game.

In having students work on projects (in this case the project was "making a game"), the three of us (the teacher, Rosi, and I) shared a common goal: we wanted students to experience a loosely defined task where they had to decide on the constraints, they had to resolve the problems that may occur, they were responsible for their work. I was particularly interested in the uses they made of mathematics in the development of their games. But several other issues are also relevant in the development of a learning community.

- In this project, students had to decide on a game and in doing so they had to face several difficulties. For example, in one case, they ended up abandoning their idea once they were, in their own words, "almost done." They tried it out and realized that the rules were not making sense. They seemed to have tried to recreate two sport-based games that would call for a video game environment, something that they could not develop in this project. In another case, the materials were not working as desired; consequently they had to revise their game, but this was preceded by a great deal of frustration. In yet another case, the group seemed to lack leadership and their resulting game lacked coherence.

The students were faced with real problems that they had to solve in order to complete their game. Interacting with each other and with us, brainstorming, testing, and revising, all of these were key to their work. These are also typical steps in everyday problem-solving.

- Most groups seemed to work out their differences successfully and managed to assign roles and tasks that contributed to the completion of the game. One group split from the start in two groups (two boys; two girls). Later in the project one girl left her group (she and two boys) to join this two girls' group. The reason was that the boys were developing sports-based games and were leaving her out of the decision making process.

- In the presentations to the class, the students asked quite probing questions of the presenters. There were many "what if..." questions that seemed to be directed at either the clarity of the rules or the consistency of these. For example, in the WINGS game, the presenters said that the score was the number that the plane landed on. Right away one of the students in the class asked, "what if the tip of the plane lands on one number and the tail on another, what do you do, do you add them?" The students contributed with a variety of suggestions for the different games and were overall an interested and active audience.

- Students used a variety of resources in making their games. The group that made the game "tip over" visited the shop teacher several times. Other groups worked with encyclopedias to develop their questions. They were also resourceful in coming up with the materials needed for their games. Some brought things from home (such as a Barbie doll house), but most of them used the resources in the room.

- The school is a bilingual (English / Spanish) school. Not all the students in this class are bilingual, though. Although most of them have some understanding of Spanish, very few of them speak it. On the other hand, they all understand English, although a few (4 / 5) of them are Spanish dominant and are at different levels in their command of English. The teacher uses both languages and works on promoting a bilingual atmosphere in the class where the English speaking students develop an interest and appreciation for Spanish. In the presentations to the class, we noted that in the three groups where there was a Spanish dominant student, both languages were used in the presentation. The rules were written (in one case, just read) in both English and Spanish. This was their decision, since we never mentioned anything about the language issue for their games.

- Most of the games reflected either the students' interests (sports, planes) or their experience with other games (games of life, board games in general). The games were overall less mathematical than expected. The students had to use mathematics in the building of the games, from measuring to make the board to planning and measuring again to fit everything on the

board. Writing the rules proved to be a real challenge to their logical abilities and their clarity of expression.

Or maybe, what happens is that the mathematics were not obvious. This raises the question of what we want to accept as being mathematics. I discuss this further in the conclusion section. Catching the students using "mathematics in context" is not easy to do. We cannot plan for this to happen. Yet, we would like the students to see mathematics as a tool that they can use in their decision making. One such example took place at the very beginning when the different groups were brainstorming on which game to make. In one group, the two girls wanted to make a board game, and the two boys wanted to make a maze. To settle this, one of the boys suggested to write each option on a piece of paper and then he would hide one in each hand and ask someone in the class to select a hand. Yet after a while I saw them going with a container and several pieces of paper that different classmates were pulling out. Their idea: to put eight pieces of paper (4 for maze, 4 for game board) and then have seven students take a piece of paper. This way it would be a 4 to 3 choice. They had thought of putting 2 pieces of paper (one for each option) but they had for this variation because they felt it made the process more fair.

Conclusion: Some Questions

Our work seeks to develop a participatory approach to instruction in classrooms where the cultural minority is the majority. The classroom teacher collaborates in the research and is the key to promoting the desired change in classroom norms and practices. One aspect of our work focuses on developing this participatory approach for the teaching and learning of mathematics. In this approach we try to build instruction based on the students' funds of knowledge, their experiences, their interests. In doing this, we have come across a variety of issues that lead to the questions below.

- Students come to school with very diverse experiences and interests. Is it possible to develop a learning approach that accounts for all students? Or, are we going to leave some of them out?

- Students are likely to go in a variety of directions according to their interests and approaches. We want them to follow their agenda, but will our agenda be met? A difficulty in this approach is that since we want to follow the students' agenda, we find ourselves planning as we go along. Hence, often we realize the missed opportunities for mathematics exploration after the fact (see Henderson & Landesman, 1992, for similar experiences). This idea of "our agenda" leads to a key issue for me:

- What mathematics should they be learning? Everyday mathematics is highly situated and transfer across situations is not clear (Lave, 1988). Boaler (1993) cautions against the use of

everyday mathematics contexts that often come out of an adult's perspective, rather than the children's. We are trying to work with contexts that come out of the children's world. But, although these activities may be more "authentic," I am concerned about what mathematics students are learning through these activities. In developing their games they used mathematics in the different stages--planning, building it, writing the rules. Yet the mathematics were often quite hidden in the module. In fact, I wonder whether the students thought that they were using any mathematics. I cannot help wondering, "are we helping them to get ready for the reality of the school world?" As Henderson and Landesman (1992) write:

> Thematically integrated instruction may provide an effective means of helping students to learn the skills and concepts they used in this context by connecting them to socioculturally relevant experiences. But we must be concerned whether the thematic approach affords students the opportunity to learn the full scope and sequence of mathematics content that will enable them to move on to more advanced learning of mathematics. (p. 3)

Very likely, as Heckman and Weissglass (1994) write, my concerns are the result of my own set of beliefs and values about mathematics, about what I count as being mathematics. In fact in our current work, I am constantly going back to the issues of "authentic task," mathematics in the context of the children's experience, mathematics as experienced by mathematicians. I find myself trying to combine these. This is why in our initial work with this fifth grade class, I started by bringing in mathematically rich problems. These problems are removed from the children's everyday experience. However, they lead to what I view as very worthwhile mathematical discussions, concepts and strategies. They reflect many of the current recommendations in mathematics education (NCTM, 1989; NRC, 1989). As can be seen in the theoretical framework presented earlier in this paper, my concept of mathematics classroom community would have students working on mathematical tasks that are likely to belong more to the "culture of mathematics" (Heckman & Weissglass, 1994) than to the children's everyday experience. The question is, can we find a way to combine these two "cultures"?

- I brought up the notion of beliefs about mathematics and this notion deserves special attention. In trying to promote change, we are going against the grain of classroom and school norms about what constitutes mathematical activity. By fifth grade, these students have developed a clear idea about what they should expect from a mathematics class and what should be expected from them. Our approach to mathematics instruction defies these expectations. Do the students "buy it" or do they go along, still clinging to their previous experience as what really counts as mathematics? And as we do more contextualized mathematics work, do students (and teachers and researchers) see it as a different kind of mathematics?

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