

2000. In M. L. Fernandez (Ed.), *Proceedings of the Twenty-Second Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Vol. 2* (p. 453). Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. The research reported in this chapter was supported by the National Science Foundation under Grant No. RED 935373. The opinions expressed in this chapter are those of the authors and do not necessarily reflect the views of OERI or of NSF.

## El Mercado in Latino Primary Math Classrooms

Karen C. Fuson & Ana Maria Lo Cicero

### Summary Overview of the Project

*The El Mercado situation, a narrative framework based on students' own buy/sell transactions, was used as an on-going strand of the mathematics curriculum in a Spanish-speaking first- and a second-grade inner-city classroom. El Mercado became a shared on-going story created by each class as a social group. Teacher and students turned to El Mercado to provide meaningful contexts for a range of mathematically problematic situations involving single-digit and multidigit addition, subtraction, and multiplication including word problems. Students enacted via role-playing in pairs a variety of buy/sell situations. The use of money and the buy/sell transactions were positively charged for the students and created sustained involvement. However, children's mathematical knowledge obtained from real world practices was quite limited, and activities to support children's construction of such knowledge needed to be designed for the classroom. We identified conflicts in goals between learning through cultural practices and learning in schools, and discussed differences in the consequent scaffolding of performance. We proposed and discussed a third kind of concepts and learning to mediate Vygotsky's (1934/86) spontaneous and formal (scientific) concepts and learning: "referenced concepts" and "learning referentially."*

We sought to clarify the potential and the limitations of an ethno-mathematical perspective through an analysis of attributes of successful mathematical learning outside of school (e.g., Nunes, 1992; Saxe, 1991) and an analysis of our work in U.S. urban Latino classrooms over a 2-year period. We based much of our Grade 1 and Grade 2 mathematics work with children in Spanish-speaking classrooms on aspects of buying and selling situations (El Mercado). We sought to ascertain what previous experiences children had in this area (e.g., over half of one second-grade Spanish-speaking class had previous experience in Mexico or in the U.S. selling things with their family) and then designed classroom experiences that related to these experiences. Our theoretical perspective combined a constructivist view of learning as individual meaning-making by each participant, a Vygotskiiian view of teaching as assisting the performance of learners by adapting to the perspective of the learner while helping the learner move toward more culturally adapted conceptions, and an ethno-mathematical and “funds of knowledge” (Moll et al., 1992) view of searching for experiences in children’s lives to which school content could be related to form coherence and meaning.

We worked intensively over a 2-year period with the children in the Spanish-speaking Grade 1 and Grade 2 classes of an urban public school in a predominantly working-class Latino

neighborhood. Over 90% of the students qualified for free or reduced lunch. The teaching/learning activities were developed by the project team in collaboration with the classroom teachers. Teaching was shared between the project staff teacher and the classroom teachers. An extensive analysis of mathematical domains and real-world situations identified a wide range of topics in first and second grade. Many activities began and were based on children's stories about their own buying/selling experiences.

We collected observational, videotape, and interview data and discussed these data as we were collecting them. The analysis was undertaken by the project director, who outlined the issues identified throughout the year in the data and in our project discussions. These issues were divided into the aspects that had worked and the problems we had identified throughout our work. Team members read and suggested changes for the paper based on our classroom work.

### What worked?

We found that both first and second graders possessed robust "El Mercado scripts" that enabled them to engage in buying and selling pair activities. Playing El Mercado worked well as a classroom activity structure. Children enthusiastically and creatively role-played buying and selling and embellished with talk, objects, and physical actions the basic situations given to them in various ways to make them socially detailed and personal. The use of money was positively charged for children and also created sustained involvement even in activities outside the buying/selling pairs. Working with money allowed children to learn more about various mathematical domains and to use money as a problem-solving tool in buy/sell situations involving addition, subtraction, and multiplication. In the lunchroom and elsewhere outside of class, the second graders began talking in excited and involved ways about mathematics and about playing El Mercado. Many people in the school became interested in what was happening in the classroom to create such enthusiasm about mathematics in the children.

We were able to develop and use classroom activities that fit all topics listed in the tables. Because of this range of topics, El Mercado became in each class a shared on-going story created by each class and the teacher as a social group. Teachers and students turned to buying/selling situations to contextualize and provide meaning for a range of mathematically problematic situations or when stuck in some mathematical problem or issue. The second graders frequently used buying/selling situations as contexts for word problems they made up. The second graders became quite fluent in their El Mercado vocabulary and concepts, so that they could easily and correctly go from the mathematical operation to the real-world situation and from the situation to the mathematical operation. Even low-achieving children, who had trouble with some 2-digit aspects of the El Mercado, could produce consistent word problems that reflected both the perspective of the buyer and the seller. Students were able to experience over time each of the complementary interdependent buy/sell roles. They thus experienced the progressive effects of a single buying role (money decreases and goods increase) or selling role (money increases and goods decrease). Some students began to understand the inverse relation of these roles and of money and goods within each role.

There was a considerable focus on students explaining their activities both orally and in written form. As children bought and sold in pairs, the classroom teacher and project

investigators would ask children to explain what they were doing. Frequently after playing El Mercado, pairs of students came to the front and described their buying and selling. Because the teacher later asked other students to answer questions about these reports, the class was attentive and students were aware of different strategies used to solve problems. Children later in the year wrote such descriptions for homework. These activities facilitated reflection on and sharing of solution strategies. Children became better at describing and explaining their transactions as well as better at carrying them out. By the end, even the lower-achieving children could describe their buying/selling activities. This was facilitated by frequently asking the lower-achieving child in a pair to explain first.

#### What was problematic?

There were substantial limitations in the buying/selling situations as sources of learning. In the full paper (see AERA, 1995, below) we will explicate these problems more fully including linguistic complications, discuss literature related to these problems, and identify ways to overcome them. Here we only have space to outline a few problems. First, many first-grade and some second-grade children did not know the values of coins or bills, and few knew the names of all the coins or bills. Complex linguistic issues and features of both coins and bills in the United States obfuscate and mislead children. Many children had trouble making quantities with different kinds of coins, which required coordinating and counting by different values, and more had difficulties adding and subtracting with coins and bills. Many first graders and some second graders had inadequate understanding of the concept of getting/giving change (*recibir/dar cambio*), an issue complicated by English meanings. Children's difficulties with this concept also stemmed from the fact that in the real world the nonmathematical aspects of buying/selling are more salient and obvious than are the mathematical aspects.

The scaffolding of learning by the children in a pair was quite variable. Some children were excellent at assisting the learning of their peers, adapting their help to their partner's needs. However, many other children ignored errors or just did a problem for their partner, not necessarily even being sure that their partner could or did watch them as they solved the problem. Some progress was made in improving these pair interactions and assistance.

#### Theoretical conclusions

We identified three kinds of differences between buying/selling inside and outside the classroom: differences in goals, scaffolding, and mathematical features. These differences must be considered and classroom experiences must be modified by their implications if school use of buying/selling is to be successful. For example, the economic goals in the real world lead to scaffolding by doing for the learner, which does not contribute to our classroom goal of learning the missing knowledge. This classroom goal is accomplished more readily by scaffolding by doing with or helping to do.

Overcoming the lack of knowledge of many children of the value of coins led to the invention and use of penny/dime strips that had ten pennies vertically on one side with a break between the top and bottom five pennies so that the ten could be seen at a glance. These pictures of pennies were the size of real pennies. On the back centered was a picture of a dime that was

the actual size of a dime. Children used these strips with the penny sides showing to count by tens and to solve addition and subtraction problems using real pennies as the loose ones that did not make a ten. Later children used the dime sides with loose pennies. We also used penny/nickel strips with five pennies on one side and one nickel (actual size) on the other side. Two nickel strips matched visually one dime strip. These strips were very powerful for helping children build concepts of tens and fives and ones (e.g., see Fuson, Grandau, & Sugiyama, 2001; Fuson, Lo Cicero, Hudson, & Smith, 1997). But we also wanted a way for children to record their thinking with visual tens and ones as well as with place-value notation as they added and subtracted. So we then moved to having children draw through the ten pennies (and just a column of ten dots) to make one ten-stick. Children then used such drawings (e.g., 42 was 4 ten-sticks and 2 circles to show the ones) to make 2-digit numbers and add and subtract them (see Fuson, Smith, & Lo Cicero, 1997, 2002).

For more details about the project see Fuson, K. C., Zecker, L. B., Lo Cicero, A. M., Ron, P. (1995, April). *El Mercado in Latino primary classrooms: A fruitful narrative theme for the development of children's conceptual mathematics*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

For more details about the penny/dime and penny/nickel strips in K, G1, G2 and the drawings of tens and ones (later extended to hundreds, and thousands), see:

Fuson, K. C., Lo Cicero, A., Hudson, K., & Smith, S. T. (1997). Snapshots across two years in the life of an urban Latino classroom. In Hiebert, J., Carpenter, T., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., Olivier, A., Human, P., *Making sense: Teaching and learning mathematics with understanding* (pp. 129-159). Portsmouth, NH: Heinemann.

Fuson, K. C., Grandau, L., & Sugiyama, P. (2001). Achievable numerical understandings for all young children. *Teaching Children Mathematics*, 7(9), 522-526.

Fuson, K. C., Smith, S. T., & Lo Cicero, A. (1997). Supporting Latino first graders' ten-structured thinking in urban classrooms. *Journal for Research in Mathematics Education*, 28, 738-766.

Fuson, K. C., Smith, S. T., & Lo Cicero, A. (2002). Supporting Latino first graders' ten-structured thinking in urban classrooms. In J. Sowder & B. Schappelle (Eds.), *Lessons Learned from Research* (pp. 155-162). Reston, VA: NCTM.

Also in this website menu click on Teaching Progressions and choose NBT1 and NBT2 to see the Teaching Progression of building and using place value concepts in single-digit and multidigit addition and subtraction.