MATHEMATICS FOR PARENTS: FACILITATING PARENTS' AND CHILDREN'S UNDERSTANDING IN MATHEMATICS

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The study examines ethnically and linguistically diverse parents' learning in an eight-week Math for Parents course on fractions, decimals and percentages. Analysis of classroom observations, interviews, focus groups, written feedback, videotapes, and task-based/clinical interviews provided rich data yielding findings about both parents' affective and cognitive learning as well as their understandings of how to support their children's learning of mathematics. The research points to an appreciation among the parents for the importance of learning mathematics with understanding. It also raises some questions concerning the goals of mathematical learning experiences for parents.

Context

Our research takes place in the context of a large parental involvement project in K-12 mathematics. MAPPS[1] (Math and Parent Partnerships in the Southwest) is a four-year long project that focuses on parental involvement in mathematics. It is now in place at four sites: in Tucson since 1999 and at the other three sites since 2001. The implementation at the different sites varies somewhat according to local needs, but overall we share some common goals. One such goal is to develop leadership teams (parents and teachers/administrators) that will help in the mathematics education outreach effort throughout the districts involved. We have three main types of activities related to our goal: a) Leadership development sessions for the members of the Leadership Teams; b) Mathematics Awareness Workshops (MAWS) ranging over key topics in K-12 mathematics and open to all the parents and children in a given district; c) Math for Parents (MFP) courses in which parents in the Leadership Teams and other parents have an opportunity to explore mathematical topics in more depth and to learn about reform mathematics and its implications for their children's education.

In this paper we consider our work in Tucson where we have three leadership teams in place and have offered a total of five Math For Parents courses. All the "Math Awareness Workshops are currently facilitated by members of the Leadership Teams. In particular here we look at the experiences of an ethnically and linguistically diverse group of parents (all women) in one of the Math for Parents eight-week courses that was being taught for the first time. We discuss the affective and cognitive impact of the course that centered on developing an understanding of concepts related to fractions, decimals, and percentages. We also examine parents' reflections on their roles in their children's learning of mathematics (K-12) as they participated in this course. Research on the effect of experiences such as these MFP courses on the participants' understanding of mathematics and on how they bring these experiences home to their children is particularly relevant for those of us concerned with equity issues.

Theoretical Framework

Mathematics educators often stress the importance of involving parents as we embark on reforming school mathematics. These calls are predicated on the assumptions that parents have great potential to influence children's mathematics learning (Ford, Follmer, & Litz, 1998; Epstein, 1994; Henderson & Berla, 1994; Kliman & Mokros, 2001) and that parental support is necessary for successful implementation of reform mathematics programs (Kliman & Mokros, 2001). Researchers (Lehrer & Shumow, 1997; Peressini, 1998) have documented, however, the frequent mismatches between the aspirations of reformers in mathematics education and those of parents and other community members in the communities where reforms are being implemented. Peressini (1998) has observed "in both the larger arena of general educational reform and the subset of school mathematics reform, these calls for parental and community involvement have been at an abstract level and have not been closely examined" (p. 557).

We argue that in order to move beyond the abstract level in working with parents in mathematics, educators and researchers must begin by interrogating deficit models of parenting (Henry, 1996; Vincent, 1996) and question prevailing assumptions about the necessary skills base for parents' work with children in mathematics (Merttens, 1993). Our work reflects an awareness that, as Weissglass and Becerra (n.d.) write, "often classes or programs for parents are one-way transmissions of information and materials from school to

parents. Rarely do parents, particularly those from groups underrepresented in mathematics, have an opportunity for their beliefs, ideas and concerns to be heard. … All parents need a safe place to share and explore their early experiences with schooling, their thoughts about their children's learning, and their attitudes toward mathematics" (p. 2). Beyond discussions about learning, schooling, and mathematics attitudes, we have suggested in previous work that parents also need opportunities for meaningful learning of challenging mathematics content (Civil, 2001).

In addition to research literature on parent involvement, research on adult education, especially that grounded in critical pedagogy (Benn, 1997; Frankenstein & Powell, 1994) has been valuable in broadening the view of potentials for parent involvement in mathematics education. One of the key premises in this research is to view parents as intellectual resources. These researchers stress that there are different forms of mathematics and push us to reflect on what we count as mathematical knowledge, while suggesting pedagogical approaches that seem to be quite powerful when working with adults who have often been marginalized.

Method

We followed a phenomenological methodology (Van Manen, 1990) that relies heavily on participants' contributions to the experience. The lived experience of each parent is considered significant and thus we try to capture it in our analysis and writing. Our sources of data include observations and field notes, interviews and focus groups, evaluation protocols, and videotapes of all the MFP sessions. These multiple sources of data allow for triangulation. The course we studied was being taught for the first time by an instructor who had written the course curriculum. The area of mathematics education for parents is so new that research and understanding of how it works and what approaches are most effective are still in very nascent stages. Necessarily, then, our study incorporates goals and approaches found in formative evaluation research as we consider questions of what parents learned and how they learned it. To examine the impact of the course at the cognitive level, we report on two task-based / clinical interviews, one with two mothers (conducted in Spanish) and the other with one mother (conducted in English). The data analysis for the overall research in MAPPS follows Glaser and Strauss (1967) constant comparative method. The different pieces of data are looked at and codified and as conjectures emerge, we go back to the data for affirmation or rejection.

The Course

Most sessions of the MFP course on Fractions, Decimals and Percents started with a brief activity in which the parents were asked to make connections between the mathematical concept under discussion and their everyday experiences. The rest of each two-hour class involved activities to help parents develop or revisit concepts. About four of the sessions focused on fraction concepts (mostly around the idea of what is a fraction; very little was done on arithmetic with fractions), two sessions centered on decimals, one on percents, and the last one was a wrap-up session in which the ideas about fractions, decimals, and percents were connected. The content goals were primarily on concept development. As a college educated participant explained,

> It's not like they give you a book telling you that we're going to learn decimals, start at page one and do a whole bunch of problems about decimals. It's not really about learning how many fractions you can reduce, it's just about starting from the very basic level and developing the concept… it doesn't matter how much math you've learned or how many courses you took in college. Everyone starts at the same point and then we work and develop it together. It's not about just doing the math but understanding why it is the way it is.

Each session included a look at one aspect of the NCTM Principles and Standards as well as a handout with ideas to try at home with their children. In an exit interview, the instructor described her goals for the course as threefold: a) that the parents learn mathematics; b) that they increase their interaction with their children about mathematics and about school; c) that they have fun. She reiterated these goals often during the sessions and the participants picked up on this,

> One the biggest things [the instructor] mentioned, one of her goals was to have fun and see fun in using and doing math. I have really enjoyed it; to me that's really strange because I don't like math. I started with an attitude that I don't like math and this has been a really fun class.

Parents worked in groups, used a variety of hands on materials, and communicated the results of their investigations to the whole class. The activities were largely based on the instructor's collection of activities that she has written over the years and has used in her work with teachers and children. The 23 people who attended the course were women from a working class, largely Hispanic community. The course was conducted bilingually. The parents' mathematical autobiographies as well as comments in the interviews and in informal conversations conveyed an array of largely negative experiences in their prior learning of

mathematics. Issues of lack of confidence, of not being good at mathematics, and of feeling alienated were quite common among our participants.

The course pushed parents to revisit "elementary concepts" and in doing so, allowed us to discuss some of the typical difficulties as documented in the literature on rational number, such as the different meanings for fractions, the concept of unit, and the influence of informal knowledge (Lamon, 1999; Mack, 1993). For example, towards the beginning of the course, in an activity with the tangram pieces, some parents quickly said "each piece is 1/7." Others disagreed and pointed out that the pieces were different sizes. This led to a discussion on the meaning of "1/7" in this context. As the course went on, the participants engaged in contrasting arithmetic/algorithmic approaches with conceptual/manipulative-based approaches to the different tasks proposed. In the next sections we present some of the findings in three areas: affective impact; cognitive impact; and issues related to the parents' interactions with their children about mathematics.

Affective Component

Parents were asked, in small group interviews that were taped and transcribed, to reflect on their learning experiences in the Math For Parents course. A theme that was woven throughout their responses was their recognition that their understanding of mathematics concepts was expanding as a result of their work in the MFP course and the importance that they gave to learning with understanding. A bilingual college educated mother of a preschooler and a first grader, stated:

> I always liked math… and…. the formulas… I mean the teacher would give us a formula and I just accepted it, I didn't question I said, okay, this is it, and I applied it. But with these classes we start from the very beginning to see how they developed... How and why a fraction is a fraction, why a decimal is a decimal. So from the very basic [concepts] … *and then we have to develop our own formula, that's the biggest thing.*…yeah we develop it, and then so when you understand, okay, you can say you know why this is. Because instead of just accepting it, you know it is… Before they would just give us a formula… but now that you understand it you can use it and you'll know how to use it. Developing the concept from the very beginning, starting at the very elementary level and then developing it, that's what I like.

This excerpt is significant in terms of one of our overarching goals for the project which is related to raising parents' awareness about what reform in mathematics education may look like and about what teaching for understanding means. This mother is reflecting on how powerful it is for her to "develop our own formula, … you know why this is." She also points out how in her previous learning experience, they would just give her the formula and her comments indicate that she does not view this as being particularly powerful. We wonder, will experiencing for herself this kind of teaching that emphasizes meaning make her more likely to expect this for her children's mathematics instruction? Will it make her more likely to focus on helping her child develop meaningful understanding of mathematics concepts?

Parents cited the real-world problem solving activities in their MFP course as contributing to their own understanding of mathematics concepts and they also reported using the real world applications in helping their children make sense of the mathematics they were learning in school:

> I liked that she [the instructor] explained what her goals were going to be for the class and then tying the material that we were working with, to real life. Fractions is not just something in a math book it's everywhere.
>
> Some of the projects that we did, you know like going into the newspaper or magazine and finding the percentages, finding decimals, … So…, in a way that's relevance in the real world where … you see all these numbers all these fractions, all these decimals, all these percentages… and… you take them in.
>
> You have a lot of relevance in the outside world because you can start to see what you are doing and then apply it. You see it elsewhere, then working with your child, you know now you are in the very basic math level. Then you can also help your children see it somewhere else, that's just not in your math books or math worksheet … Math can be found everywhere…

Parents also commented on feeling more confident, but showed an awareness that they had just started scratching the surface with this course. In fact, several participants expressed a need for more classes on the course topics:

> I feel more confident to teach now.

> When I started my confidence was way down. I was ashamed of even being here. But now I even enjoy it, I come because I'm open-minded. I feel better now. I'm not going to say that I learned everything, but I learned a lot.
>
> We were getting into it, and then we changed to something else. We need more time; I hate to say this but maybe more classes.

Cognitive Component

The lessons on fractions focused on concept building. For example, in one activity the participants had to rename each pattern block in terms of what a given one was worth (e.g., if the hexagon is 1/2, then what are the other blocks worth?). In another activity, the participants explored equivalent fractions using color tiles. A few months after the course was over, we conducted two interviews with tasks very similar to the ones the participants had worked on in the course. One interview was with Georgia, who was in her first year of MAPPS. She has three children aged 5, 7, and 13. She is English-speaking and understands Spanish, is a homemaker and completed twelfth grade in Tucson where she studied basic mathematics. She explained that she had enjoyed mathematics in school until the eighth grade when she became ill, missed school and fell behind. When she failed geometry the next year, she found that she just struggled in mathematics and was placed in a basic mathematics course just so she could pass and graduate. The other interview was with two Spanish-speaking mothers, Monica and Elena. They were both schooled in Mexico, where they completed high school. They are both homemakers. Monica's experience with learning mathematics was rather negative while Elena's was overall positive. Monica has two daughters ages 7 and 9, and Elena has a boy age 7 and a daughter age 5.

The interviews revealed a tendency among the three mothers to look for connections between the questions posed to them and everyday life experiences. For example, when asked to give the percent represented by 3/4, Georgia looked at the collection of 4 tiles and said, "Let's pretend this is dollar, so each tile represents 25%, so 3/4 is 75% or 75 cents." Elena and Monica were at a loss in many of the school-like tasks. For example, when asked to make a rectangle that was 1/2 blue, 1/4 green, and 1/4 red, they reached for 2 blue tiles, 4 green tiles, and 4 red tiles. Also, throughout the interview it became clear that they were not understanding the questions: they understood the language (the interview was in Spanish), but not the mathematical language. For example, they had a particularly hard time with questions aimed at assessing their concept of equivalent fractions such as in a task where they had said that blue was 6/8 and they were then asked, "can you give me another fraction to describe the blue part?" They did not seem to understand what the question was asking.

Georgia also seemed somewhat uncomfortable with expressing herself in a mathematical context, though she was much more successful at solving the interview tasks. For example, in the task of making a rectangle that is 1/4 green, 1/3 yellow, 1/6 red and the rest blue, her first approach was to take 3 blue, 1 red, 1 yellow, and 1 green. She wanted 6 tiles "because that is the largest number" (and that had worked in a prior task). But she quickly realized that this was not going to work and revisited her work. It took her two more attempts before she came up with a collection that worked. But then she said, "It's not the biggest number on the bottom, but the number that is times all bottom numbers that give me the number." So, she seemed to realize a connection to the concept of common denominator. Georgia was quite successful at thinking through the tasks but showed little confidence in her answers. She often turned to the interviewer for validation.

We wonder to what extent these parents would be able to help their children with the typical school-type fraction tasks. But we also wonder how much of their difficulties were related to language, at two levels: the language of mathematics and in the case of the Spanish speaking parents, the fact that the course was taught in English, with Spanish translation. Our classroom observations have raised the question of whether the translations of the English instruction provided effective and equitable learning opportunities for the parents who spoke Spanish. This task-based/clinical interview, in which Spanish-speakers struggled with understanding and expressing their understanding of fraction concepts explored in the course, confirmed our suspicion that the bilingual teaching and learning environment of the math for parents courses needs to be critically examined.

Interactions with Children

This MFP course was modeled after content taught to children in grades K-6. Parents engaged with the material as adult learners, but one aspect of our research is how what parents learn makes its way into the home. The topics of this course were particularly relevant in that they span over all grade levels and are often perceived as difficult to learn. At this point what we have is self-reported data in which the parents comment

on how these experiences are impacting (or may impact) their interactions with their children. For example, several participants commented that they could now help their children with their homework or at school:

> It has helped me to be able to help my children with fractions, in their homework.

> Today I worked with one of my daughters, and I learned more in this year with MAPPS. So I'm happy because I can help my daughter with the work. I can understand more if I practice more and more.

> This has helped me a lot. Now that I go to my child's classroom, it's easier for me to teach them when I sit with them at their table.

Another important aspect that our research shows is the effect that these experiences have on the nature of the interactions between the mothers and the children. It is not only whether they help them with their homework, but it has more to do with how the children view their parents as a result of their attending classes (Brew, 2001):

> And then taking the course helps you reinforce the idea that you're your child's first teacher. We were their first influence, so it empowers us. We are also their teacher and we can help them. They go to school and there's a teacher, and they do their homework and learn. But at home we're their teacher also, then we can help them. They look at us differently.

> I have learned ways to interact with my children and also it's fun to have them showing the games to their friends and visitors.

Although these courses are for parents only, some of them occasionally bring their children. Several mothers have commented on the fact that they enjoy sharing their learning with their children,

> It's very helpful for the kids to come in and see what they're teaching.

Parents' comments indicate they feel they are gaining both knowledge and confidence regarding mathematical concepts such as fractions that translates directly into confidence in working with their children to understand similar concepts.

Conclusion

Parents' experiences with the teaching and learning of mathematics for understanding are the focus of our study. Others (Lehrer & Shumow, 1997; Peressini, 1998) have shown that the theoretical assertion of the importance of understanding in learning mathematics can be a confusing and controversial one for parents. Our study illustrates an approach that appears to support parents in bridging mathematics pedagogical theory into their own practice of mathematics learning and their own work with their children in mathematics. The parents in the MAPPS program have enthusiastically embraced the idea of the importance of understanding in mathematics; no controversy on this point has been evident.

The study reported here of parents' experiences in a Math for Parents course adds to the small body of literature examining the impact of intervention programs with parents in mathematics (Kliman & Mokros, 2001; Lehrer & Shumow, 1997; Merttens, 1993; Morse, 2001). Our findings suggest that giving parents opportunities to actively construct their own understanding of mathematics concepts provides a critical foundation for their work with their own children. Furthermore, as parents themselves learn mathematics with an emphasis on understanding rather than rote memorization, they become quite vocal about the importance of understanding for their children's mathematics education. As one mother very eloquently said, "I don't want them [teachers] to teach to the test. You have to be versatile in many things. If you don't understand, what's the point?" A key aspect of mathematics reform is the goal to ensure that students understand the mathematics they are learning (rather than memorizing procedures). Yet, this important aspect is beginning to be left behind as the testing pressure increases. In our study, parents reported working with their children to develop mathematical understanding. They talked about incorporating strategies that they had learned in their MFP courses in exploring their children's understanding of concepts in their schoolwork.

This MFP course provided opportunities for parents to engage as adult learners of concepts related to fractions, decimals, and percents. It also provided links to what their children may be doing in school. In a sense there seemed to be several goals for the course, as the instructor captures very insightfully in her reflection,

> When teaching children, the goal is mastery as demonstrated on tests and other measures. When working with teachers, the goal is that they understand the material well enough to explain it to students. I felt the goal for the parents was fuzzy. Were they learning fractions, decimals, and percents for their own personal knowledge? Should I have "tested" and "retaught" to make sure they

were mastering it? Were they there to get a "glimpse into a classroom of today" and see what learning is like for their children? Were they there to learn enough to be able to assist their children with homework and studying? I know that all of these are goals of MAPPS, but I wonder which one should be the primary one for a MFP course. If the goal is content mastery, then the course probably needs more than eight sessions.

Our findings corroborate that, indeed, in order for parents to be able to help their children with school tasks in these topics, one course like the one we just described is probably not enough for many of the participants. The nature of the interactions about mathematics that these parents developed with their children may be even more relevant and crucial than their actually being able to help them with specific content. Our future plans are for more case studies of parents and their children utilizing both open-ended interviews and task-based clinical interview methods. In addition, a number of questions to guide future research have arisen. How do parents' reported growth in confidence and embracing of reform mathematics pedagogy such as a focus on understanding translate into actual support for their children's understanding in mathematics? How can bilingual instruction for parents in mathematics best be structured to support full participation and learning for Spanish-speaking parents? And finally, what are we learning about appropriate goals and realistic and wide-ranging outcomes for mathematics education programs for parents?

Endnotes

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