The Role of Cognition and Affect on Adults’ Participation in a Nonformal Setting for Learning Mathematics

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In this paper we describe some characteristics of the nature of the participation of adults involved in mathematics workshops for parents. We find that adults become more engaged in exploring, learning, and teaching mathematics when their experiences (both prior schooling and life/work experience) are incorporated in the learning process. Adult learners prefer contextualized situations and concrete mathematical concepts rather than abstract algorithms. The nonformal nature of the workshops (not for accreditation or promotion, adapted to the unique situation of the participants, voluntary attendance, and relatively flexible structure) makes them a favorable environment for learning mathematics in a participatory and reflexive manner. Our data show that personal school experiences influence some parents’ attitudes toward certain forms of participation. We find that creating spaces for dialogue among participants is key in a pedagogical practice with adults as they learn from each other.

Introduction

Mathematics education of adults takes on different forms varying in structure, goals, content, and level of students’ commitment, to name a few parameters. Some of the current questions in the field, independently of these parameters, deal with the approach: lecture versus collaboration, curriculum and curriculum ownership, and authority and power, as well as more fundamental questions such as the adults’ actual motivations for learning mathematics (FitzSimons, 2007) and the meaning of numeracy (Coben, 2007).

In terms of the academic level, adult mathematics education encompasses a wide spectrum from basic mathematics to college level. On a different classification, the range of programs goes from very informal and unstructured to formal and more structured, with varying degrees of formality and flexibility combined. A quick survey of publications in the Adults Learning Mathematics: An International Journal (ALM-IJ) shows such a variety. A common setting for looking at adults’ mathematical knowledge is the workplace (Kent, Noss, Guile, Hoyles, & Bakker, 2007; Martin, LaCroix, & Fownes, 2005); another setting is in the context of college or university education (Gill & O’Donoghue, 2007; Hauk, 2005; Viskic & Petocz, 2006). A few articles explore the education of adults at the secondary level or the equivalent to the level of a traditional 16 year old student (Díez-Palomar, Giménez Rodríguez & García Wehrle, 2006), and that by Knijnik (2007) that addresses the concept of different mathematics through her analysis of the mathematics of peasants in the Brazilian Landless Movement (MST).

With this paper we add to the conversation of lifelong mathematics learning but in a nonformal setting. In particular we consider the role of lifelong mathematics learning as something that “can also be valuable for personal development and fulfillment” (Schlöglmann, 2007, p. 9). We use the term nonformal in the sense argued by Etllng (1993, citing Kleis, 1973, p. 6) as “any intentional
and systematic educational enterprise (usually outside of traditional schooling) in which content is adapted to the unique needs of the students (or unique situations)” (p. 73) and more aligned with what Kalantzis (n.d.) calls semi formal learning:

**Semi Formal Learning** involves partially institutionalised settings focused on particular life or workplace learning. It generally does not involve accreditation but aligns with learner’s aspirations. Indeed the idea of self-directed learning became an important feature of adult education, particularly in relation to workplace and community learning. (p. 2)

For an expanded characterization of the different categories (formal, non-formal, informal) of mathematics adult education we refer the reader to Coben (2006). More specifically and in the context of the mathematics workshops around which our work takes place, what we refer to as nonformal education is the type of education that is systematic (in that it happens regularly, according to a schedule, and with some thematic coherence) but not for accreditation or promotion, is adapted to the unique situation of the participants, has voluntary attendance, and is relatively flexible in structure.

Although we have done research in the specific area of adult mathematics education in nonformal settings (Civil & Andrade, 2003; Civil, Díez-Palomar, Menéndez, & Acosta-Iriqui, 2007; Quintos, Bratton, & Civil, 2005), in this paper we expand on this work by making an explicit connection between the characteristics of nonformal education and its impact on adult mathematics education. We look into issues related to the pedagogical approaches to the teaching of mathematics to adult learners, in particular at their forms of participation in nonformal settings and what shapes these forms of participation. We draw on data from a current study with parents and we build on prior work exploring issues related to pedagogy and content when working with parents. In our next section we discuss the methodology used to collect and analyze the data; then we present a few examples that illustrate some elements that characterize the participation of adults in the workshops; and finally we discuss some implications from our observations to the practice of adult mathematics education in nonformal settings.

**Methodology**


Our study occurs in the context of “Tertulias Matemáticas” (tertulias13), which are mathematics workshop for parents14 of middle school children (ages 11 to 13) in Tucson, Arizona. The participants are working-class parents; most of them are of Mexican origin and many of whom are in fact recent immigrants. We invited parents to participate in the workshops through members of the community and the school administration. All sessions were carried out in Spanish. To gather the data we videorecorded all the meetings and conducted interviews that focused on the participants’ perceptions of teaching and learning mathematics.

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13Tertulia is the Spanish word for a regular gathering of people for conversation; sometimes it has an artistic connotation. We have used this term in prior research (e.g., Quintos, Bratton, & Civil, 2005) inspired by the work of Flecha (2000) and his literary circles (tertulias) with adults.

14By parents we mean any adult in a parental role, being the actual mother or father, a grandparent, aunt or uncle, etc. Most participants have children at the particular school.
The first author facilitated the tertulias with the assistance of one or two undergraduates and one mathematics education graduate student. The second author and one other researcher attended some of the workshops and also contributed to the data collection.

From the fall of 2006 to the spring of 2008 we facilitated five sets of workshops; the interviews took place during the fall of 2007 and spring of 2008. The workshops took place at a middle school, and they were delivered in blocks of about seven sessions within two or three months; each block of about seven sessions constituted a module with a thematic unity. Two modules were held during the first semester and one module per semester after that. Each session ran for 1.5 hours and its structure contained a brief introduction to the mathematical concept to be studied, some problems to be worked out individually and in small groups, followed by a group discussion of the solution to the problems. A few sessions were more discussion focused; parents would share their perceptions of teaching and learning mathematics, their experiences around the school system, or their processes as learners, for example. We interviewed a total of 14 parents. Most of the interviews were individual visits to their homes but we also had a focus group and a paired interview. Without counting those who attended only once, the participants’ formal education training varied from 2nd grade to college degrees, with a median of 10th grade. The school is in the south part of the city with 94% Hispanic or Latino students; 87% of the student body is eligible for free or reduced-price lunch program, and 25% are classified as English language learners.

The mathematical content of the first two modules followed the school curriculum but, as per parents’ request, for the last three modules we studied fractions. Another modification was the meeting time: from early in the morning, after the parents had taken their children to school, to the evening. Mothers who suggested this change argued that it was more likely that their husbands would be able to participate if the workshops were held after work hours. Also, as per parents’ request, children started to participate in the workshop sessions in spring of 2008.

**Vignettes and Discussion**

The vignettes we showcase below touch several topics that emerged from our data analysis, such as making connections to their work and everyday life and the effect of prior schooling experiences.

Vignette 1. Luisa’s daily energy level: reading graphs from her life

The first module of the series dealt with algebraic reasoning; the topic at hand was reading and interpreting graphs. For this activity, the facilitator asked parents to form small groups to work on a story related to some aspect from their daily life experiences. Just before the task was proposed, the facilitator had given an interpretation based on a friend’s consumption of gasoline each day of a week. The task was for the parents to come up with an alternative interpretation based on their daily life. After about thirty minutes, one of the mothers (Luisa) came to the front of the classroom to present her group’s work (Figure 1).

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3 Hispanic or Latino refers to “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race” (Office of Management and Budget, 1997).

15 All participants’ names are pseudonyms.
The connection to her daily life seemed quite natural to Luisa, and the connection between a line graph and the progression of a phenomenon over time was readily grasped. Luisa explained how that line represented the energy that somebody spends in a week. On the horizontal axis the group wrote the days of the week, from Monday to Sunday. Then, on the vertical axis they represented the energy level, from less energy at the bottom to more energy at the top. Luisa narrates her group’s explanation in the next quote:

Luisa: That’s the level of energy we have daily. So, there are times when we wake up with a lot of energy, there are times when we wake up with less energy (pointing at the levels on the graph, on Monday and Tuesday with a pen). There are times when we go up, we are going up (pointing on the high point on Wednesday) and down (going down with the pen on Wednesday). On Thursday we wake up so-so, with less energy (pointing at Thursday), on Friday with less (she points going down on Friday with the pen), on Saturday energy is going down (points with the pen) and Sunday we are exhausted (turns to look at the class). Yes, and on Monday we start all over again, that is how I understand it.

(Tertulia, Sept. 2006)

In Luisa’s explanation the notions of increasing/decreasing were apparent and dealt with in an intuitive way, based on the steepness and direction she gave to each line segment in her graph. The progression of her narrative as she was reading her graph from left to right and the group’s labeling on the graph gave room to talk about notions such as axes, function, coordinates, slope, direction, decreasing and increasing functions. We consider this as an example of “situated learning” (Lave & Wenger, 1991). Adults go back to their daily life experiences to understand formal mathematics, putting them in context (thus context becomes part of the cognitive process of learning). Our data seem to be consistent with this analysis. Luisa also turned to her everyday knowledge to understand what that line graph meant.

All transcripts are translated from Spanish.
As time went by and we learned more about Luisa, this episode becomes more meaningful as we observe Luisa’s increasing expression of her resistance to go up front to the board: Luisa started to request privately to the facilitator not to be asked to go to the board. Yet, during this activity, it was not the facilitator who requested her participation. We will go back to this topic in the last vignette.

Vignette 2. Celia’s “horchata”17: proportional reasoning

At the end of the last module on fractions, the content of the workshops had switched back to try to stay closer to the curriculum: a daunting task particularly when trying to incorporate content from the middle school grades. At this point, the focus was on applying fractions to proportional reasoning. In previous sessions, the group had worked a few contextualized word problems where multiplication of fractions arose. They had also gone over a few exercises on the mechanics (algorithm) of multiplying fractions. For this activity, the facilitator wanted to try something that reflected the parents’ funds of knowledge (González, Andrade, Civil, & Moll, 2001), that is the knowledge and experiences that exist in any household. The facilitators knew, from interviews and casual interactions with the parents, of personal experiences with recipes. In the meeting previous to the episode described below, the facilitator had given an example of a recipe with the list and amount of ingredients and the directions. Next, the participants, parents and children, had the task of writing down one recipe, specifying the number of servings that the amount of ingredients used would yield. The homework assignment was to modify the recipe for a different number of people, given by the facilitator on case-to-case bases.

At the beginning of the following session, the facilitator asked the participants to write on chart paper the list of ingredients for both the original and the new number of servings. Celia had missed the previous meeting. The facilitator contacted Celia to let her know that she should bring a recipe. Celia came to the tertulia with a recipe, but she had not adapted it to a different number of people. As everybody else was writing down on chart paper their solution, Celia and her daughter had to grapple, for the first time, with this task. Before we peek at the recipe and the exercise on proportional reasoning, meet Celia: Celia is a grandmother of one of the students at the school. She came from Mexico not many years ago. As a child all she was allowed to study was barely up to second grade, due to her family’s economic condition and her father’s opposition to his children attending school. Celia’s motivation for coming to the tertulias was first and foremost to be connected with the school as a way of supporting her grandson. As time went by and Celia continued to participate in the workshops, she revealed both her frustration for having had her opportunities for learning cut short as a child and her satisfaction in her role of a learner; yet seldom would you see her picking up the pencil to work on the mathematical tasks. At the point where the conversation is shown, Celia and her daughter Martina (in her twenties and probably with at least high school education) had written down the original list of ingredients for four people and had determined the first ingredient (from 1L to 1½ L of water) for six people. Norma, an undergraduate assistant, is working with them at the same table. So, here is Celia, with second grade formal education and a life of experience, adapting her horchata recipe from four to six people:

Martina: And one liter of milk is the same [as water], right? And of rice, if it is one fourth [for four people] that is... it is half a kilo.

Celia: No.

Martina: No?

17Horchata is a rice-based drink popular in Mexico.
Norma: Why not?

Celia: Two more people.

Martina: It is your fault. It will no longer be the same (laughs)

Celia: One fourth (pause)

Martina: So then it is going to be three fourths (she laughs). Even worse for him to understand. (Meaning the facilitator).

Celia: For two people it is going to be, it is going to be one fourth and (brief pause) and half. In four people is one fourth...

Martina: That’s right then.

Celia: Then it is going to be half of a fourth for two more people.

Martina: And if you put all that together, how much is that? Three fourths.

Celia: OK, three fourths (not quite convinced, she takes a pencil and gets ready to do the calculations on a piece of paper).

Martina: Three fourths, how much is that? 750 grams.

Celia: No...

Martina: Do the calculations. You are smart.

Celia: No, it is not seven hundred because two...

Norma: How much is one fourth?

Celia: One fourth is 250 grams. Then, half of 250 grams? (talking to Martina) that is one hundred (pause)

Martina: twenty-five.

Celia: One hundred twenty-five. Then that is (pause)

Norma: A hundred twenty-five and two [hundred] fifty. You add them up, right?

Martina: That’s why I was saying three fourths.

Norma: How much is it two hundred fifty and...?

Celia: (Doing the calculations on a piece of paper) Three hundred seventy-five.

Martina: That’s why I told you: three hundred seventy-five.

(Tertulia, May 2008)
Prior to this interaction, Martina was very confident of modifying the recipe from one liter to one and a half liters, but when it came to adjusting the rice, Martina was not too sure how to adjust the one fourth of a kilogram for four people to the amount needed for six. She makes several suggestions (three fourths) but Celia does not buy into that. Even though Celia has not calculated the correct amount she has a sense that it is not three fourths or, as Martina suggests later, 750 grams. It is interesting to note that in the group Celia is the one who finds the correct answers and Martina wants to take credit for it: “That’s why I told you: three hundred seventy-five.” We point out briefly that the level of engagement of all the participants in this activity was quite high. However, in this conversation we observe that, although the problem in hand was designed to be dealt with in terms of fractions, and that Celia is captured as posing the solution to the amount of rice in kilograms as “to be half of a fourth for two more people,” the actual solution relies on Celia’s prior knowledge. We conjecture that the context of the problem enables her to make the transference to a more familiar territory: break down the kilogram into grams and operate with whole numbers. In contrast, and just as a point of reference, one of the contextualized word problems given previously (by the facilitator) was stated in terms of ounces. More than one group of parents felt the need for understanding what an ounce was in relation to something else (a pound or a kilogram) although, for the “mathematical” exercise, that piece of information was irrelevant. On a different note, the practice of bouncing off of each other’s ideas and posing questions to one another is quite a natural activity that happens in these small group discussions. In working with adults, this not only comes spontaneously, but it is recognized and valued in the debriefings. To be fair, we need to point out that one mother inquired about this pedagogical practice, which relies more on the participants working on the problems and making sense of them in their groups and less on direct instruction by the facilitator:

**Susana**: Well no, I really liked it now what we were doing with the, with the system, the only thing I would like is, well she helped me a lot, Laura [an undergraduate research assistant], explaining the, the equations and everything, the fractions, but I would like it that you taught us more, a bit more.

**Facilitator**: Regarding what?

**Susana**: Whatever, in what we are studying.

**Isidoro**: A little more explicit.

**Susana**: Yes, for example if you gave us a problem, or give us an example, for example, for example right, you gave us a problem and you answer it, you tell us how to follow the steps and give us the rest so we can solve them.

(Interview 1, Nov. 2007)

This excerpt, though, seems to be the exception to the rule, at least overtly. There are many more parents’ comments that value the inquiry and group work approach, as Isidoro, commenting on working on a problem, had said previously:

I do like it, when we are working on a problem, I look at it first when I’m working with my wife, and if I think it’s difficult, [I tell her:] “you know what? Help me, I don’t understand this.” But if I see that it’s easy, I do it and I explain it to her, or she’ll ask me. And then we work with the group.

(Tertulia debriefing, Apr. 2007)
Parents recognize they have different experiences and life paths and that one can help the other in some cases and vice versa, as Emilia, one of the participants points out:

We are all wonderful because we don’t make anybody else feel inferior. I mean maybe you don’t know this right now but maybe you [referring to another mother] know this now. I don’t know. There are things that maybe I didn’t get and for example maybe she did, and she can tell me well it’s like this. So then nobody, we don’t feel, nobody feels inferior to anybody else. And we help each other. That’s what we notice. If the gentleman knows something that I don’t he teaches us or we teach. We all help each other.

(Tertulia debriefing, Oct. 2007)

Vignette 3. Isidoro’s wrenches: comparing fractions

In the spring module of 2007, a few meetings were devoted to comparing fractions. A couple of sessions prior to the one in which the following episode takes place, the participants had been working with contextualized word problems. However, for this session the goal was to develop strategies to compare fractions by just looking at the relation among numbers: different numerators with the same denominator, equal numerators and different denominators, and between the numerator and denominator. The problem at hand was to compare three fourths and six eighths and determine if they were equal to each other and, if that was not the case, which one was larger. Isidoro was up in front of the group explaining his solution:

Facilitator: How did you do [solve] that [problem]?

Isidoro: (He draws two rectangles on the paper in the easel, one above the other, and he divides them into four and eight parts, respectively) These are three eighths (shading three pieces of the top rectangle) two, four, six (counting six pieces from the rectangle at the bottom) they are six eighths.

Facilitator: Yes, but how...?

Isidoro: You are going to... the first square is divided into four pieces, OK? and from the first square we take three fourths: one, two, three. OK? From the other quarter, square, I’m sorry, we take eight pieces: one, two, three, ..., five, six, seven, eight. And that way we see that six eighths... we divide, it is the same as three fourths. Here: three fourths equals six eighths.

Facilitator: Are you convinced? [talking to everyone.]

Mother: From that point of view, it is fine.

Marcos: But [that is] not [the case with] wrenches.

Facilitator: Not what?

Marcos: Wrenches are measured differently.

Facilitator: Oh, wrenches!
Isidoro: Do you mean a mechanic’s wrenches?

Marcos: Well, on the tape they are different.

(Tertulia, Apr. 2007)

The time is up. A heated conversation between the two fathers goes on about different sizes and their equivalent measures in the metric system. The facilitator asks them to bring the wrenches to the next meeting. Both Marcos and Isidoro agree. In the background, one can hear a few comments from a woman recognizing the expertise these two men have. Rogelio in the background states, “there is no six-eighths wrench.”

Two weeks later, Isidoro has his wrench kit (part of it, he says) and lies them down on a table.

Facilitator: Let’s see, explain to us that about the two groups [U.S. standard and metric systems] and the sizes and so on, and how they are classified.

Isidoro: Well, here you have only these few wrenches (laughs) because all of them did not fit here. No, what happens is that these are the very basic ones only, those that one uses all the time. From those in standard sizes we start with the one fourth [inch] one.

Facilitator: This is one fourth of what? (Writing on the chart paper on the easel). One fourth of an inch?

Isidoro: [One fourth] of an inch.

Facilitator: Is this the smallest one?

Isidoro: No. As a matter of fact, there is one (inaudible), but the most common in—is this one.

Facilitator: And then? Which one is next?

Isidoro: (Inaudible) then we continue with the five sixteen.

Facilitator: Five sixteen.

Isidoro: Three eighths. The fact of the matter is that there are more measures but these are the basic ones. . . .

Isidoro: Fifteen sixteen and one inch. (The facilitator hesitates about what he is about to write down.)

Facilitator: And one inch.

Facilitator: (Counting the fractions on the chart paper.) One, two, three, four, five six, seven, eight, nine, ten, eleven, twelve.
Up to this point, the fractions listed are 1/4, 5/16, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 7/8, 13/16, 15/16, 1. The facilitator has noticed that the order of 7/8 and 13/16 should be reversed but does not say anything. Marcos points out that Isidoro missed one fraction:

Marcos: The three quarters one is missing.

Isidoro: The three quarters one goes here (pointing with the finger on the paper)

Facilitator: (Writing the fraction where Isidoro points to) Thirteen sixteen... which one is larger? Are they alright in this order?

Marcos: Yes, that’s the way it goes.

Isidoro: That’s the way they are in order.

Facilitator: Are you sure? Here, I don’t know. It seems to me that there is a strange thing here. Let’s see...

Isidoro: What happens is that the three quarters one was missing. That is why.

Facilitator: Ahum... (reading the fraction from the chart paper) twelve, thirteen, fourteen, hm. OK. We are going to go over that in a little bit.

Facilitator: OK, let’s see one thing. For example, honestly, I am not convinced that these (pointing at the fraction on the paper) go like this, in this order. I [say so] just because I have to believe it, because I don’t know. Or, is there a way to find out?

The group follows this conversation closely although there is not much interaction by the other members with Isidoro besides Marcos and Rogelio, the other two men in the group. A mother comments to another than that her husband told her that there is no six-eighths wrench. Ordering the fraction this way though, becomes very concrete. We have reached a point where the instructor questions the truth of the information, and the need for verification arises in this context. The facilitator seizes the opportunity to connect with the representation of fractions they had been learning:

Facilitator: How can you compare, in a way that I can visualize it, one fourth and three eighths, and let’s say seven eighths and thirteen sixteenths? (Circling on the chart paper the fractions to be compared.)

Everybody works individually and in groups trying to solve this puzzle. We follow Isidoro who is working with his wife, Susana. Laura, an undergraduate research assistant, sits with them as they work on the problem.

Isidoro: (Drawing a line on the grid paper and counting two squares at a time.) one, two, three; here they are (shading all the little squares he just marked). Up to here we have only one quarter of an inch (shading four little squares). And up to here we have three eighths (shading again the six bottom squares).

Isidoro: (inaudible)

Susana: What is this one? (pointing on Isidoro’s paper the end of his mark).
Isidorov: This is (pointing at the whole shaded area)

Susana: What fraction is this one?

Isidoro: This is seven eighths.

Susana: Seven eighths (writing down the number at the end of the shaded region).

Isidoro: (It looks like he is thinking aloud) Seven eighths. We are talking about (pause) three eighths (he writes down the number at the end of the bar corresponding to 3/8). We are asked [to show] thirteen sixteenths. The other one would be (pause, he looks at the chart paper) only up to thirteen. Only up to here. From here to there (pointing somewhere at the top of his sheet). From here to the [number] thirteen, only (he shades somewhere at the bottom).

Susana: How about this one? What fraction is this?

Isidoro: It is thirteen sixteenths (he writes down the number at the end of the bar and puts down his pencil on the paper, signaling that he finished the problem; long pause).

Laura: Oh, then they [the numbers] were placed in the wrong order, does thirteen sixteenths go first and then seven eighths? So that they are in...

Isidoro: No, they are (looking at the chart paper) oh, yes, that’s right: It is thirteen sixteenths and seven eighths. You are right. There. (He puts down his pencil on the paper again.)

(Tertulia, Apr. 2007)

In this segment of the conversation we see Susana occupied with the symbolic representation of the fractions, while Isidoro works on the graphic representation. Figure 2 depicts what Isidoro did on his grid paper, but this is not his actual work; instead of the ‘X’ he had shaded the little squares. In both cases they have moved away from the concrete tools, the wrenches, to a representation; the rectangles on the grid paper that become their new, yet familiar by now, concrete tool where the comparison takes place. By giving the grid paper, one could argue that we impose a representation on the participants: They counted the squares rather than measuring the fractions of an inch. They do not seem bothered by the fact that the 16 squares rectangle is not one inch long.

![Figure 2. Isidoro’s grid paper.](image)

We view the whole episode of comparing fractions by referring to the wrenches as an example of how adults draw from their life and work experiences to make sense of the mathematics. Parents
seem to have held their engagement with the mathematical task for a long time since it was related to a familiar context.

Vignette 4. Let’s go to dance: the median

As our previous vignette exemplifies, adults prefer “concrete mathematics” rather than an “abstract” one (Plaza, González, Montero, & Rubio, 2004), and they choose ways to represent mathematics closer to their everyday experiences rather than algorithms or proofs. They prefer the former because it is easier for them to understand the meaning underlying a mathematical notion when it is connected to real examples, rather than to a collection of unfamiliar symbols written on the chalkboard. This next vignette takes us to a session where the facilitator explains the idea of median. It was the second module, which was focused on statistics. The topics were data representations and data analysis. The following activity takes place during the Measures of central tendency lesson. In the previous session the concept of the median was presented with the following exercise: Each participant takes one value from the data set; places oneself in order, in relation to the rest of the group; and the two people at the extremes of the line, one from each end point, separate from the line until only one or two are left. (The facilitator uses the metaphor of “going to dance” when each pair leaves the line.) When only one person is left, the value he or she holds is the median; otherwise, they have to add up the values of the couple left at the end, and divide the sum by two. We see this technique being enacted below as parents solve the problem of finding the median of the given average house price per school district in their city:

    Marisol: How much do you have?

    Rogelio: One hundred eleven.

    Marisol: Oh, no.

    Irene: I have one hundred nine.

    Marisol: I have two hundred sixty-seven; from the largest (pointing to person to her right) to the smallest (looking towards the other direction).

    Luisa: One hundred fifty-three

    Rogelio: Who has the smallest one?

    Francisco: are we talking about quantities or …?

    Marisol: Let’s see, this is from the largest to the smallest. I have two hundred sixty-seven, who is closer to (inaudible)?

    Luisa: One hundred fifty-three? (moves to the left of Marisol.)

    Marisol: Uh huh, one hundred fifty-three and then?

    Irene: I have one hundred sixty-one.

    Marisol: No, and then?

    Rogelio: Then here.
Marisol: One hundred eleven (reading Rogelio’s piece of paper), and you?

Norma: One hundred twenty-three

Marisol: One hundred twenty-three, one hundred eleven,

Irene: One hundred nine.

Marisol: Then you go and then Ms …, you go and then

Adelaida: No, she has one hundred twenty and I have one hundred nine.

Marisol: Ah! OK, and you?

Francisco: Sixty-nine.

Marisol: OK, so we are ready then.

As soon as the eight participants were ordered in line, the facilitator started to take them aside two by two. Finally only two persons were left (in the middle of the queue). At that point the facilitator asked what to do when there are two individuals left. This was only the second time they had practiced the concept of the median. By enacting the process the first time, it seems that the participants were able to reproduce the technique easily. A by-product of this implementation was the creation of an informal reference to the process of eliminating the extreme values of the ordered set, namely the metaphor to take them out to dance.

Facilitator: OK, move a little bit over there (motioning with his hands), a little bit over there, perfect, and start dancing; come dancing, here you go,

Marisol: And then you go in front. Mr. M is going to be the one left

Facilitator: There are two left, aha, very well… What did we do when we had not just one value but two values in the middle

Luisa: We divided.

Facilitator: We divided, exactly, very good.

Marisol: We add them and divide them by two.

(Tertulia, Nov. 2006)

Parents were able to address the idea of median with an even number of frequencies, which is not an easy task since it includes three steps to solve it: first to order the data, second to split the data into halves, and then to take the values in the middle, add them and divide them by two. We do not know for sure but wonder if the dance metaphor played a role in their understanding of how to find the median as it provided them with a concrete and visual approach. As Plaza et al. (2004) suggest, adults are more likely to prefer concrete and pragmatic ways to learn mathematics, rather than abstract ones.

There was one mother, Marisol, who took the lead organizing the work of the group. Marisol’s role in these workshops needs to be pointed out, as she is not one of the participants per se. She
works at that school and is the contact who recruited the parents to these workshops and who was instrumental in their attending (she would call them to remind them and even offer to pick them up if needed; she made sure that there were refreshments for the workshop; she basically took care of many of the logistics). Marisol was a mother participant in a prior project directed by the second author and, as a result of that project, had already been facilitating mathematics parent workshops at the school prior to our work there. We want to point out that while Marisol took over the group’s discussions sometimes in this first series of workshops, she has since taken a more behind the scenes seat to allow the other parents to take a more active role.

Vignette 5. “Please don’t ask me to go to the board”

Researchers have been concerned with the link between affection and cognition, in particular the role of emotions in mathematical learning (Evans, 2000; Gómez-Chacón, 2000b). With this next vignette we bring up an example of a common practice that may interfere with the learning process.

Norberto is from Northern Mexico. He has a college degree in agricultural engineering; thus, his motivation to participate in the workshops is not for him to learn mathematics. Norberto’s nexus with the school is his nephew who at the time of the interview was in 8th grade. The following conversation was part of the first interview with Norberto. The question being discussed is “How was mathematics taught when you went to school?” Norberto had been discussing how strict teachers were, and how physical punishment was one of the most vivid memories he had.

Norberto: They were, teachers certainly were strict. Or maybe because, back then, that is how the teacher’s system was. You would (be asked by them) to come up to the board and… many times, you would forget something, so, (you would also get) the (imitates teacher hitting student with a stick), the punishment, or a pinch.

Facilitator: Physical punishment?

Norberto: Physical. So, I think one (as a result) grows somehow afraid of being in front (of people). You start getting distrustful, ehh, how do you say it?... psychologically, you start getting afraid of the public. That was, in elementary, right? It only happened, no, no. . . .

Norberto: Many times I knew, but I had fear, and one gets a mental block. And then that’s it: You move neither forward nor backward, so that.

(Interview 1, Nov. 2007)

Norberto’s comment about being punished for making a mistake when at the board seems to have conditioned him and many other parents, judging from their responses, to feeling apprehensive towards going to the board to present their work. We interpret this expression of mathematics anxiety as a learned reaction: Students were conditioned to fear going to the board. Evans (2000) addresses the relation between anxiety and performance and explores different approaches in which he calls models. Norberto reports how he experiences this connection in the previous vignette. This predisposition manifests itself during the workshops: Parents are reluctant to go to the board to explain their solution or to work on a problem in front of the rest of the group. The sentiment is so strong that during a debriefing at the end of one of the modules, parents petitioned not to be asked by the facilitator to go to the board.
Celia: … I wouldn’t like to be forced to go up. No, it has to be me who says, “okay now I am going to do it even if what I have isn’t right,” I have to feel confident that I do want to go up there.

(Tertulia debriefing, Oct. 2007)

The individual presentations at the board by participants were intended by the facilitator as a way to showcase different strategies to solve the problem, to recognize the participants’ contributions, and to provide individuals with opportunities to exercise leadership roles and to position themselves as intellectual resources, and hence, as a learning experience for all involved. Instead, the results of asking parents to participate in this way during the workshops seem to have the opposite effect: apprehension and maybe even embarrassment. This finding is consistent with research on the role of affect in adult learning (Evans, 2000). Luisa, from Vignette 1, became progressively vocal about her resistance to go to the board. Susana, from Vignette 3, had also shared her mixed feelings. She understands the importance of that practice, yet she still feels very uncomfortable. For some of them, going to board was itself a form of punishment. The commonality of the reactions presented above leads us to agree with Gómez-Chacón (2000a) in that to understand learners’ affective relations to mathematics, and pedagogical practices, it is important to know and understand the system of values, ideas and practices of the context (the culture), since these perform the function of establishing an order which allows the individual to orient himself and supplies him a code of communication. Thus it seems desirable that in investigations on mathematics and the affective dimension, we should address the subject’s two affect structures, the local and the global. This last implies viewing the person in this situation, knowing the individual’s systems of beliefs (beliefs as a learner of mathematics, beliefs about mathematics, beliefs about the school context), social representations and the process of construction of the subject’s social identity. (p. 166)

We want to point out, however, that in prior work with groups of parents along the same demographics as in this study (in fact, in the same school district), many parents seemed quite willing to present their work to the group (Civil, 2001). We need to pursue this topic more and look at it from the point of view of environment (the room set-up), social norms, and pedagogical approach. It is the case that in the prior project many of the parents were preparing themselves to lead workshops, which is not the case in this current implementation.

Conclusion

From our experience of working with parents we have learned of the importance of the context in the learning process. Adults use their everyday experiences to understand mathematical ideas and to connect formal mathematics with life situations previously experienced, as evidenced on Vignettes 1 through 3 and supported by the literature (Knowles, 1968; Lave & Wenger, 1991). The prior experiences that adults have mediate their process of learning (Knowles, 1968); it is important to draw on these experiences not only to gain engagement but also to anchor and expand their body of knowledge. Some of this knowledge could be understood as funds of knowledge (González et al., 2001) as in Vignettes 2 and 3. Also, in agreement with Vygotsky (1978) and Freire (1970), interactions play an essential role in adult education. The nonformal nature of these workshops nurtures these interactions as community building is promoted by the frequency of the meetings and the shared motivation to take part of them. Plaza et al. (2004) affirm that adults prefer concrete examples rather than abstract mathematics. This does not mean that we should shy away from abstract mathematics when working with adult learners. The
parents in these vignettes made connections to their everyday experiences and seemed to enjoy visual approaches, such as the dance metaphor in Vignette 4, as a way to make sense of a mathematical concept (the median in that case). But we know from prior research that parents want to learn the “abstract” mathematics too (Benn, 1997; Civil, 1999; 2004). This may be the case for many adults as one of their motivations for learning mathematics may be to be able to help their children with school work; another may be for themselves to further their own learning. Once again, fulfilling the expectations that motivate parents to participate in the workshops that are adapted to their unique situation, is in agreement with the nonformal nature of the tertulias.

At the foundation of adults’ participation in these learning activities, and surrounding it at the same time, we find the crucial role of emotions. The affective component of adult mathematics education has been documented (Evans, 2000; Gómez-Chacón, 2000b) and we see it resurfacing from adults’ prior schooling experiences and manifesting itself in their reluctance to go to the board. Norberto’s account is a clear example (Vignette 5). We need to recognize and address these kinds of situations in order to overcome the emotional barrier that mathematics in particular, and schooling in general, may represent for some adult learners. Although grades, promotion, or accreditation risks are absent in nonformal education and therefore may lower the stress level, there are still other forms of emotional stress present. This suggests a possible direction for further study.

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References


