

LOOKING BACK, LOOKING AHEAD: EQUITY IN MATHEMATICS EDUCATION

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Drawing on the conference theme of looking back and looking ahead, in this paper I first look at the placement of equity throughout PME-NA as a way to set the stage for where to go next. I then focus on aspects of my work on the affordances and tensions around out-of-school and in-school mathematics to discuss equity as opportunity to participate in mathematically rich and socio-culturally grounded experiences. I argue for the need to develop classroom environments where students' mathematical funds of knowledge are brought to the forefront but also where students can use their cultural ways of being and acting as resources for their learning of mathematics.

Keywords: Equity and Diversity

At the suggestion of the conference organizers we (Laurie Rubel and I) decided to collaborate on the elaboration of the plenary and discussion / response papers. While we each wrote our own paper, we exchanged drafts and had online discussions on what we wanted to convey. We share some common interests and concerns in terms of equity and mathematics education, yet our personal histories, trajectories and approaches are different. In particular, in one of our first conversations I remember telling Laurie that sometimes in my own work I felt a tension between socio-cultural and socio-political approaches. I can see my work clearly fitting the socio-cultural framework, and I am aware that I am working with political issues (e.g., language policy, immigrant families), yet I do not necessarily see my work as “fitting” the political category. It is clear to me that issues of power and privilege permeate my attention to valorization of knowledge and participation in the mathematics classroom, but I feel like I leave these issues somewhat implicit. In her response, Laurie's section on “making the political explicit”, drawing on one of the examples from funds of knowledge that I present in this paper, was particularly inspiring for me. This is just one example of the back and forth exchange of ideas that Laurie and I engaged in as we each wrote our pieces.

In what follows I first provide some background to indicate my positionality with respect to the idea of “equity in mathematics education.” Then, I provide a brief historical account of my experience with PME-NA, given that the theme of the conference is “Looking back, looking ahead: celebrating 40 years.” This is my personal (and I admit, incomplete) attempt at tracing equity across PME-NA since the first conference I attended. The rest of the paper looks at some aspects of my research around in-school and out-of-school mathematics.

Some Background

I was drawn to issues related to equity through my work with preservice elementary teachers. I have always had an interest in how children and adults make sense of mathematics, how they think about mathematics. To this end, I like to use tasks that may lead to cognitive conflict. In listening to preservice teachers talking about mathematics, I noticed that some of them brought their everyday experiences to the discussion. I also noticed that oftentimes, those who sought to make sense of the mathematics (by connecting it to their life experiences) had had less “successful” trajectories with school mathematics than their peers who basically played by the rules and did not seem to be concerned about whether mathematics made sense outside (or even inside) the classroom. What are we doing in our teaching (K-16+) that leads to this lack of

connection between in-school and out-of-school? This lack of connection is what drives much of my work. Shortly after I moved to the University of Arizona in 1990, I was fortunate to join the Funds of Knowledge for Teaching project (González, Moll, & Amanti, 2005), which was a perfect fit for me. The project took me into working-class communities and schools attended largely by students of Mexican origin, many of whom spoke Spanish as their home language, yet another fit for me as that is my home language too. I was able to work with teachers dedicated to developing learning experiences that built on students' and their families' funds of knowledge; teachers who invited family members to come to the classroom to share their expertise. I saw children engaged in discussions, participating in rich classroom activities. This is where my definition of equity developed. For me equity is about the opportunity to participate in mathematical experiences that are both rich from a "mathematics for the sake of mathematics" point of view ("reform / standards-based") and at the same time reflect the socio-cultural experiences of the participants (culturally responsive / sustaining). It is about participants maintaining their cultural identity while also engaging as doers of mathematics. Over the years, I think that what has most influenced my approach is my work and friendship with immigrant families. Learning from them and seeing their enjoyment and sense of humor in mathematical discussions (whether it is a group of mothers or a group of seventh graders) constitute uplifting experiences and are constant reminders of why I do this work. To me, this is particularly important currently, given the stressful and depressing reality that many immigrant families are experiencing.

Looking Back at PME-NA

I attended my first PME-NA when I was a graduate student in 1989. In looking at those proceedings, these were the topics: Affective and cultural factors in mathematics learning (2 papers, 1 on cognitive and affective aspects with 2 prospective elementary teachers; the other reports on a study done in Ciskei (South Africa, though an independent state at the time of the study); that paper mentions "socio cultural" and "lack of continuity between the cultural world of the family and that of school" (p. 13). The author was from a university in South Africa; Algebra/Algebraic Thinking (4 papers); Calculus (3 papers); Computer environments in mathematics learning (3 papers); number concepts (5 papers); geometry, measurement, and spatial visualization (6 papers); multiplicative structures (8 papers); representations, metacognition, and problem solving (6 papers); teacher beliefs (4) (my paper, "prospective elementary teachers' conceptions about the teaching and learning of mathematics in the context of working with ratios", was in that section); teacher education and teacher development (8 papers). There were two plenary lectures (and responses) (one on mathematical processes, the other one around understanding of numbers (the authors have a section on the research on out-of-school mathematics, in terms of how "non-schooled" children and adults understand numbers). There were five Symposia: realistic mathematics education; sex differences in mathematics ability; clinical investigations in mathematics teaching; assessment and function graphing tools; probability.

The next PME-NA I attended was in 1993. In that one, there were several strands including one on equity, which had a panel and discussion sessions. The panel has one Australian researcher (Gilah Leder), one US researcher (Walter Secada), and one respondent from Brazil (Ubiratan D'Ambrosio). There was one paper in the section on language and mathematics (by Judit Moschkovich). And there was a section on social and cultural factors affecting learning (5 papers), where one of my first papers on funds of knowledge was located ("Household Visits and Teachers' Study Groups: Integrating Mathematics to a Socio-Cultural Approach to Instruction").

There were 14 discussion groups; one of them was on “cultural support for mathematics understanding” (related to relationship between culture, language and numerical systems).

The strand on social and cultural factors (renamed later on as “sociocultural issues”) remained till 2007. Then in 2009 through 2011, there was a strand called “equity and diversity” (I am not including 2008 because that was a joint PME / PME-NA meeting). The strands we currently have (with no specific strand for equity or similar terms) were implemented in 2012. One possible argument for not having a strand on equity is that equity should permeate the work we do (Aguirre et al., 2017). Having a separate strand seems to imply that some researchers do equity work and others do not, or that equity is being addressed in one part of the conference and we do not need to worry about it elsewhere. This is something that calls for further reflection.

Finally, I took a more in-depth look at the most recent PME-NA proceedings (2017) to see how equity was featured. There was one plenary talk that focused on equity. There was also a response to another plenary (not-equity focused) that looked at that talk with an equity lens. Finally, one of the papers in the technology panel also addressed equity. Three of the 13 working groups had something to do with equity, with one of them being explicitly about equity, one on critical perspectives on disability, and the third one on special education. Two of the other working groups mention equity a few times in the write-up. I then went through all the strands and searched for the keyword equity. In some cases, where the term equity did not appear, I used my judgment to classify some of the papers as pertaining to equity based on other terms (e.g., culturally relevant; social justice). This is not a scientific analysis and I am aware that I may have missed some papers that are about equity. At the same time, there were some papers that had the keyword equity, but it was not obvious to me why that keyword was there. Here is what I found out: there were 75 research reports (RR) presented; 8 of them had something to do with equity. I counted 134 brief research reports (BRR), with 26 of them mentioning equity. Finally, I counted 141 posters, with 22 mentioning equity.

While over the years I have attended quite a few PME-NA conferences, I have also skipped several of them here and there. For a while, I felt that PME (rather than PME-NA) was more my community. At PME, I always seemed to find several presentations, working groups, discussion groups that related to my research interests in equity, while that was less the case with PME-NA. And yet, even in that more international arena, I should note that there was dissatisfaction with the attention to equity, in particular to social and political issues. In 1996, at PME in Valencia, I recall a fascinating AGM (Annual General Meeting) that discussed dropping the “P” from PME to reflect the fact that many research papers had moved away from the Psychology focus. Shortly after that, in 1998 Mathematics Education and Society (MES) was created in great part as a counter-space to PME (Gates & Jorgensen (Zevenbergen), 2015). In 2000, Lerman’s influential chapter for the field, “the social turn in mathematics education research” was published (Lerman, 2000). In 2004, the book edited by Valero and Zevenbergen (Jorgensen) on the socio-political dimensions in mathematics education research was published (Valero & Zevenbergen, 2004). Of course there are several other researchers who have written on these issues since then. But for me those are two pivotal pieces. For my own work, Lerman’s chapter is particularly relevant as it refers to the influence of Vygostky’s work, which is central to the program of research around Funds of Knowledge (González et al., 2005); that chapter also discusses situated cognition and mentions ethnomathematics, all of which are at the center of my long term interest in studying the affordances and tensions around out-of-school and in-school mathematics. In what follows, I turn my attention to this topic.

Navigating Out-of-school and In-school Mathematics

In the 2006 PME-NA plenary (Civil, 2006), I trace my trajectory from mostly a cognitive preparation to a sociocultural approach in my work, where concerns for equity became central. I am bringing this up here because the cognitive aspect is still very present in my work, but at the same time, I cannot interpret data (a video, students' work) without wondering about sociocultural elements (who is involved? What are their stories?). I argued then and I still argue now that we need these two perspectives (and most likely others too) to make sense of the teaching and learning of mathematics. In fact, what I wrote then is still very present in my thinking now:

Sometimes I wonder if I have moved away from my initial cognitive-based interest in research in mathematics education to address issues that focus largely on the social and cultural context, with mathematics playing a very peripheral role. As I look over my writing from the last few years, I notice that I often raise the question "where is the mathematics?" Mathematics plays a central role in my work and recently, in our current project, I find myself pushing for the mathematics in our activities and research discussions. (p. 30)

Thus, in this paper I am continuing this thread by focusing on three key elements in my work: funds of knowledge; valorization of knowledge; and participation. As I wrote in 2006, "A concern for those who are being left out of the mathematical journey seems to guide my work" (Civil, 2006, p. 30). This concern has not changed.

Funds of Knowledge

Since the terms "funds of knowledge" is now so widely used in mathematics education research, I thought that providing some history may be useful. Anthropologists Vélez-Ibañez and Greenberg (1992) are credited to have introduced this term, as they write, "strategic and cultural resources, which we have termed *funds of knowledge*, that households contain" (p. 313). Through their collaboration with educational researchers (in particular, Luis Moll and Norma González), the project Funds of Knowledge for Teaching (FKT) was developed in Tucson in the 80s (see González, et al., 2005, for a detailed account of this project). When we bring these ideas to mathematics education, what we are saying is that all communities and families have mathematical funds of knowledge. Children come to school with mathematical funds of knowledge. Yet, as we well know, whether these funds of knowledge are recognized and used as resources for learning varies greatly. How did Alberto (Civil 2016; Civil & Andrade, 2002), a recent immigrant, see himself as a mathematical learner in his fifth-grade class, as he kept largely to himself and was not encountering success? A concerned teacher did not leave it at this and sought to learn more about Alberto and his family, through a funds of knowledge household visit. In that visit she learned about Alberto's unwillingness to leave Mexico and move to the US with his family. He left behind places, people, and activities he enjoyed, including actively helping out with his family's bakery business. He had his set of customers and was in charge of all monetary and goods transactions, yet at school he was struggling with "basic" arithmetic? Alberto's case reminds me of the studies on street mathematics (e.g., Nunes, Schliemann, & Carraher, 1993), which were very influential in my work. If we do not see the relevance in what we are being asked to do, if we do not have an affective connection, is it surprising that we may not do as well?

What about the several children (mostly in grades 5-8) who told me in interviews that they were learning things in mathematics that they had already learned in prior years in Mexico, yet I saw no evidence of them being given more challenging tasks, and in fact sometimes they seemed to be placed at a lower level because they did not know English well yet? This school knowledge

(e.g., different algorithms) and learning habits (e.g., use of a notebook for each subject to record their work; bringing their own school tools instead of the school providing them) that they bring from other contexts are part of their funds of knowledge, but schools do not necessarily know of these. The lack of communication between families and school and the differing understandings of each other's roles and expectations are two of the most common findings in my work with immigrant parents.

An example of funds of knowledge in a parents' workshop. Elsewhere (Civil, 2002; 2007) I have discussed examples of applications from funds of knowledge to the mathematics classroom. Here I want to share a brief example (Menéndez & Civil, 2009) of how an activity on comparing fractions became more meaningful when a father participant suggested a connection to wrenches. While I do not know if in this case their children were familiar with how wrenches work (in terms of the different sizes), based on my experience of many years working with families, I would not be surprised if indeed several students at that school had a familiarity with wrenches. Comparing fractions is a typical school activity that can be challenging for children (and for adults, as we have seen in the Math For Parents courses that we have run for several years). In this scenario, the facilitator had asked the participants (most of them mothers and fathers of students at that middle school) to compare $\frac{3}{4}$ and $\frac{6}{8}$. One of the men (Isidoro) successfully drew some pictures to show that they were equal. Another man (Marcos) then mentioned something about wrenches and how they have different measures. The facilitator encouraged both men to bring the wrenches to the next meeting. Isidoro brought "a few wrenches" (people laughed when he said that he had only brought a few of them, as he had about 15 wrenches on display) (see Figure 1). Isidoro very confidently explained what the standard measures are for the wrenches and the facilitator recorded those on chart paper, as Isidoro was mentioning them: $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$, $\frac{11}{16}$, $\frac{7}{8}$, $\frac{13}{16}$, $\frac{15}{16}$, 1) (the facilitator noticed that $\frac{7}{8}$ and $\frac{13}{16}$ were switched but did not mention anything at that point); Isidoro commented that there were other wrenches but that these were the most commonly used. Marcos noticed that the $\frac{3}{4}$ was missing and Isidoro told the facilitator to put it between the $\frac{11}{16}$ and the $\frac{7}{8}$. Isidoro did not look at the wrenches to see the size, he seemed to have those visualized and knew their ordering (despite the error in the list). The facilitator then said, "I'm not completely convinced that these (the fractions on the chart paper) go like this, in this order. It's just that I have to believe it because I don't know (participants laugh). Or is there a way to find out?"

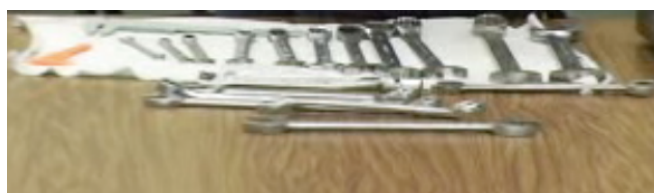


Figure 1. Isidoro's wrenches

The facilitator then encouraged the group to come up with a visual way to help him see how to compare $\frac{1}{4}$ and $\frac{3}{8}$ and $\frac{7}{8}$ and $\frac{13}{16}$. The participants had grid paper and used this to come up with a visual approach to compare the fractions and resolve the issue with the ordering of $\frac{7}{8}$ and $\frac{13}{16}$. At this point the activity is a typical school task with the participants representing the different fractions on graph paper and comparing them. But the familiarity with the wrenches provided a context for this activity. The participants remained engaged, and while there were clear gender aspects with the men appearing as experts, some of the women asked questions, probed, and made comments, indicating they were engaged in the task too. There are probably

several other mathematical explorations that could use these participants' knowledge of wrenches as contexts. For example, Isidoro and Marcos referred to their knowledge of the metric wrenches. Familiarity with the metric system is one aspect that has come up in other contexts (e.g., recipes). I have noticed students bringing in a knowledge of the metric system either from home or from having lived in Mexico and yet teachers teaching it as if it was new material for everybody.

It could be argued that the wrenches' example is a superficial or contrived context to promote a deep understanding of the mathematics behind comparison of fractions. This is a tension that I have expressed before in my work on funds of knowledge and mathematics (Civil, 2007; González, Andrade, Moll, & Civil, 2001). In Civil (2007) I refer to this tension as preserving the purity of the funds of knowledge at the expense, maybe, of the mathematics. This tension is related to what we decide counts as mathematics.

Valorization of Knowledge

I argue that questions around which mathematics for whom and for what purpose are at the center of any equity debate. I am encouraged by the current discussions around school detracking and, at the college level, around the efforts to create more avenues for students' access to mathematics beyond the standard college algebra (in a traditional sense), precalculus, and calculus path. But I am also aware of the potential obstacles to those initiatives, obstacles mostly based on what we count as a "good" mathematics education and who can "really" do it. I work in a mathematics department and this discourse permeates how we talk about the content of the courses, what needs to absolutely be in these courses to be a mathematics course, and who takes which courses.

For me, this is a personal issue because in my own teaching and research I find myself going back and forth between the need to engage students in activities that are culturally relevant (e.g., funds of knowledge based) and the need to engage students in rich mathematical learning experiences. I do not mean to imply that this is an "either – or" situation. Obviously, both can happen. But I do not find that easy to accomplish. Researchers engaged in social justice mathematics teaching report a similar tension between the mathematical and the social justice goals (Atweh & Ala'i, 2012; Bartell, 2013; Rubel, 2017).

My recent conversations with teachers and colleagues around after school projects with middle school students and mathematical modeling of culturally relevant contexts with teachers bring up these questions for me: is the context taking over the mathematics? Is the mathematics superficial or contrived? In a chapter on modeling and culturally relevant pedagogy, we write, "Teachers may encounter some tension between incorporating authentic cultural knowledge into the modeling process while staying true to the goals and modes of analysis of the discipline of mathematics" (Anhalt, Staats, Cortez, & Civil, 2018, p. 326). Elsewhere (e.g., Civil, 2002; 2016), I comment on the difficulty in seeing mathematics in culturally-based activity when our only lens may be that of "academic / formal" mathematics. In these cases we may not be able to appreciate the mathematics in the activity or we may risk trivializing both the mathematics and the activity.

Throughout my current work and teaching, I often bring up the famous question, "where is the math?" Yes, I do ask this question in part probably due to my own view of what counts as mathematics, but in part too because of the many classrooms I have visited where students are not being challenged in mathematics and are subjected to what I would consider quite dry and uninteresting tasks. Most likely, tasks that are related to their funds of knowledge would be more engaging, but they need to also be mathematically engaging. I also raise this question because I

have seen these same students engaging in mathematical discussions of tasks that are largely what I would describe as rich tasks, but not necessarily culturally relevant. In the next section I discuss the concept of participation and in particular the importance of developing classroom environments that let students use their cultural ways of being (which includes the use of their home language(s)) as they do mathematics. So, while the tasks themselves may not have been culturally relevant, developing trusting relationships and letting the students use their cultural resources (language, humor, interaction style) seem to support their engagement with mathematics (Civil & Hunter, 2015).

Participation

The idea of participation has been central to my work for many years. For example, in Civil and Planas (2004) we look at “the effects of social and organizational structures on students’ participation in the mathematics classroom” (p. 8) in two different contexts, Tucson and Barcelona. In other pieces, I have looked at the effect of language policies on the participation of emergent bilinguals (English Learners (ELs)) in the mathematics classroom (e.g., Civil, 2011) and of immigrant parents in their children’s schooling (Acosta-Irrique, Civil, Díez-Palomar, Marshall, & Quintos-Alonso, 2011). In Civil (2012, 2014), I look at participation and issues around what language gets privileged? Whose experiences are represented in the tasks? Whose knowledge and approaches get valued. Finally, in Civil and Hunter (2015) we look at immigrant students’ participation in argumentation in the mathematics classroom through lenses of culture and language in two different geographic contexts, New Zealand and the US.

In this section I present yet another example from the same classroom discussed in Civil, (2011, 2012), and Civil and Hunter (2015) to illustrate how having an atmosphere where students can basically be themselves, can lead to rich mathematical discussions and students’ participation. The setting is a small seventh grade class composed of only 8 students, most of whom were recent immigrants from Mexico (within the previous two years) and all classified as ELs. Elsewhere I have discussed the restrictive language policy in Arizona (Civil, 2011; Civil & Menéndez, 2011) that places ELs in basically segregated classrooms for most of the school day. This was the case for these students. I worked with the teacher (an EL herself) and the students for close to a year. We videotaped 30 class sessions from February through May. It is important to note that three of the students’ mothers regularly attended the mathematics sessions for parents (and their children) we had at the school (Civil & Menéndez, 2011). The teacher also attended those sessions. Thus, we had developed rapport not only with the students but with some of the parents too. I have been arguing for quite some time for the importance of developing stronger and trusting relationships between home and school, particularly in the communities where my work is located, where families may be less familiar with the school system or worse, where sadly, they have reasons to feel insecure and less trusty of organizations.

By the time formal data collection began (videotaping) the students were starting to become used to the idea of discussing their work and having to justify their thinking to others. We let the argumentation develop naturally, that is we did not use any norms or roles. We basically relied on tasks that would create situations that promote argumentation. For example, in interpreting a distance / time graph of a bike trip, students engaged in spirited discussions arguing about which part of the graph showed the most progress made by the bike rider (Civil, 2012). When showing the video clips to varied audiences, while some do appreciate the level of engagement and mathematical argumentation that is taking place, others are somewhat surprised by the loudness and “chaotic” looking and sounding discussions. Yet, this “chaos” and “loudness” allowed for a student like Octavio to find his mathematical voice. Octavio was somewhat quiet and did not

seem very interested in engaging with mathematics. But it turns out that he liked to argue and that gave him an entry into the mathematics. As we encouraged students to talk about mathematics, we discovered a new (to us) Octavio. As he said in an interview towards the end of the year:

Marta: What is it that you like most about math class, well if there is something that you like, of course?

Octavio: To argue

Marta: And why do you like to argue?

Octavio: Because I feel, I feel like a good student when I think that the answer is right.

Marta: What other things do you like about the class?

Octavio: To chat and do work with my group.

Marta: Did you work in groups last year in math class?

Octavio: No, we worked individually.

(All the transcripts in this paper come from exchanges that took place in Spanish. For reasons of space I have only included the English translation. I know that this is unfortunate as we miss the idiomatic turns and the richness of the speakers' home language.)

The example below shows different features of how students (and us) engaged with mathematics, such as use of humor and teasing and use of their home language (Spanish). It was a relaxed atmosphere. Students had been working in small groups on a problem on planning a class party with three options (going to a pizza place and movie theater; going to a water park; or to a skate ring, (Preston & Garner, 2003)). They were given some information on the cost of the three options and the students were to decide which option may be best and why. Carlos and Larissa are at the board to explain how they used equations to find how the cost of the water park ($W = 100 + 5P$) and the cost of the skate ring compare ($S = 200 + 2P$). So what they are going to solve is: $100 + 5P = 200 + 2P$. They have just subtracted $2P$ from both sides and have: $100 + 3P = 200$.

1. **Carlos:** There it is. Here we take minus one hundred.
2. **Octavio:** But why?
3. **Marta:** Octavio is asking why
4. **Carlos:** Why did we take minus hundred? [smiling]
5. **Octavio:** Yes.
6. **Marta:** Yes, he is the one asking it. I wasn't asking it, he's the one who asked it
7. **Carlos:** Because that's what we have to take away. Because here we subtracted minus one hundred, and here, we also subtracted minus one hundred.
8. **Marta:** No, it's a very valid question.
9. **Octavio:** Ah, yes, okay, it's fine, it's fine.
10. **Carlos:** Then here you get one hundred and here you get three P.
11. **Octavio:** Three P? [with a tone of surprise]
12. **Simón:** Why?
13. **Octavio:** Why?
14. **Lucas:** Why?
15. **Carlos:** Because I subtract one hundred.
16. **Larissa:** Because we subtracted one hundred.
17. **Carlos:** And you get three P.
18. **Ms. Adams:** But what was the reason for subtracting one hundred?

19. **Larissa:** We wanted (incomprehensible) to know for--
20. **Octavio:** Positive. Why negative?
21. **Carlos:** Be quiet. [Softly and smiling in the direction of Octavio]

In this brief exchange we hear Octavio probing four times (lines 2, 11, 13, 20). He is following the explanation and wants to make sure that he understands what they are doing. This is quite different from other cases where students are presenting at the board but the rest of the students are not really engaged. After that, Larissa and Carlos deciding how to solve for P because that is one thing they had not done prior to coming to the board to explain. They end up with $P = 33.333\dots$ There is also some joking around because the teacher and I ask them to erase what is in blue from the white board (from a previous exercise) so that they can have more room to show their work and Larissa points to the top of the board where part of the date is written in blue. This is sort of an inside joke because from when I started coming to their class I was asking them not to erase their work so that I could see how they were thinking, but it took a while for students to let go of their attachment to the eraser. And this time I was telling them to erase, so Larissa picks up on that.

Next, the teacher and I asked Larissa and Carlos about the meaning of having found P to be 33.333.

1. **Carlos:** That one P is equal to 33.33333.
2. **Marta:** Yes, but what does that mean?
3. **Carlos:** Because we divided it.
4. **Marta:** No, no, what does it mean in the problem?
5. **Ms. Adams:** What is P? What is P? People...
6. **Marta:** What does P represent?
7. **Larissa:** People.
8. **Carlos:** One person.
9. **Ms. Adams:** Okay—
10. **Carlos:** One person is going to pay 33...for the--
11. **Octavio:** Why 33 dollars if it's two dollars per person?
12. **Carlos:** It's cause, nosy [*mitotero*] [to Octavio, as implying stay out of it, in a joking way].
13. **Larissa:** It's cause it's wrong [slightly laughing]
14. **Marta:** It's a good thing that Octavio is, is, really on the ball, eh?
15. **Larissa:** Yes.
16. **Marta:** He's absolutely right
17. **Larissa:** This is the number of people that can go.
18. **Carlos:** That's why!
19. **Octavio:** Ah [incomprehensible; some laughter]
20. **Carlos:** That's what I was saying. [smiling]
21. **Larissa:** That's why, it's not the price! [smiling]

Larissa and Carlos are confused about what the P represents. As soon as Carlos says that it is the cost of one of the activities, Octavio jumps at that (line 11), since the cost of the activities are \$2 per person for the skating and \$5 per person for the water park. In line 12, Carlos uses a cultural term “mitotero” in a joking way to basically tell Octavio to stay out of it (“mitotero” in Sonora, Mexico (which is where many of the families in my context come from) means “gossipy” / “nosy”).

Finally, once they have agreed that P is the number of people, and they decide on $P=33$, the question of how much it is going to be comes up.

1. **Ms. Adams:** And how much would it cost?
2. **Larissa:** I mean we wanted to see, I mean we wanted, cause I mean we wanted to see--
3. **Carlos:** The exact point.
4. **Ernesto:** How much would it cost?
5. **Octavio:** So how much would 33 people cost? (pause- someone else says something) How much? Tell me, well!
6. **Carlos:** How mu—33 people?
7. **Marta:** Do it, do it, all of you --
8. **Carlos:** Ah well, here it is [looks at his notes again]
9. **Ms. Adams:** Let's see, that table--
10. **Marta:** You can all do it, eh?
11. **Carlos:** In the graph.
12. **Marta:** How much does it cost for 33 people?
13. **Carlos:** You can all do it. [repeating what Marta has said / teasing]
14. **Ms. Adams:** How much does it cost for 33 people to go?
15. **Marta:** All of you, yes, yes.

Once again, we see Octavio engaged and asking in a challenging tone to tell him how much it would cost for 33 people (line 5). I then turn it over to all of them and suggest that they all figure it out (line 7 and again line 10). In line 13, Carlos repeats my saying “you can all do it” in a teasing tone. Perhaps some could interpret his repeating what I said as mimicking me and not being respectful, but that is not how I took it at all because it was part of our interaction style. I had known Carlos since the year before; he and his two siblings came regularly to the mathematics workshops for parents with their mother. We had developed a rapport over the two years.

The concepts of “confianza” (trust) and family feeling are often mentioned in research with Latinx communities (González, et al., 2005; Rodríguez-Brown, 2010). The importance of building relationships among students and teachers and more broadly, among school personnel and families has been extensively documented in educational research with “diverse” students (e.g., Gay, 2000; Nieto, 2013). This importance has also been documented in the teaching of mathematics in non-dominant communities (e.g., Berlin & Berry, 2018; Guerra & Lim, 2017; Id-Deen, 2017; Kitchen, 2007; LópezLeiva, Celedón-Pattichis, Pattichis, & Morales, 2017; Martin, 2009; Musgrove & Willey, 2018). What I just presented is one more example of something we have known for a long time: relationships matter. If my view of equity is about the opportunity to participate, we need to develop an environment where students are going to want to participate. I saw this happening in that 7th grade class, and I also saw it in another school, first in a 4th/5th grade combination and then the year after (with the same teacher) in a 6th grade class. While the two settings were different, one aspect in common was a feeling of being a family and to a certain degree, the teachers acted almost as if being a family member. Allowing students to be themselves, to walk around the room and see what others were doing when working in groups, to tease each other (including me), all of this seemed to contribute to developing a safe and supportive environment where students were willing to take mathematical risks.

I have been wondering for quite some time whether what we are missing when working with minoritized students in school is to bring in their home ways of being and acting. While in the

work in the 7th grade class, I may have seen glimpses of that, I am certainly not claiming that we succeeded, it was just that, glimpses. In Civil (2016), I argue for the need to gain a better understanding of how people engage in out-of-school settings in practices that are potentially mathematically rich and see how these ways of engaging relate to how, for example, mathematicians engage in the practice of mathematics. Nasir, Rosebery, Warren, and Lee (2006) argue that as learners we navigate through a variety of repertoires of practice as we move through different settings (e.g., home, school, clubs, groups that we may belong to). In looking at “the intersections between everyday practices and important disciplinary knowledge” they claim that “educators can use the varied and productive resources youth develop in their out-of-school lives to help them understand content-related ideas” (p. 493). I wonder, is school helping or hindering connecting these two practices, everyday practices and disciplinary (e.g., mathematics) practices? When we develop learning activities that build on students’ funds of knowledge but also engage them in rich mathematics, is it school mathematics that we are working with? Is it disciplinary (mathematicians’) mathematics? Should it be something else? In discussing the possible connections between different forms of mathematics (e.g., everyday mathematics, school mathematics, mathematicians’ mathematics), Nemirovsky, Kelton, and Civil (2017) point out that schools can only bring in “real world” problems to a certain point since school has its own constraints and after all the students are not really engaged in that real world problem that often serves mostly as a scenario to address school mathematics.

I started this section discussing participation but the questions I just raised relate back to funds of knowledge and valorization of knowledge, thus bringing me back full circle. I want to close with some further thoughts on these ideas in part inspired by my current work as well as what I still see as challenges in the field when it comes to equity research.

Next Steps?

There are quite a few people now doing work in mathematics education building on the concept of funds of knowledge. This is certainly very different from the early 90s. Some of this work is informed by a variety of theoretical frameworks, which makes for a more robust account of the research efforts. In this sense, we are making progress, as researchers build on the concept and take it into different directions, contributing to the deepening of “the field’s knowledge base related to equity-based research” (Aguirre et al., 2017, p. 125). I think we can all agree that there seems to be more attention given to equity in mathematics education in recent years. Whether it is because some conference proposals ask for an explicit connection, or whether it is an expectation of funding agencies, or whether it is that there seem to be more researchers coming out of doctoral programs (and some NSF-funded Centers for Learning and Teaching) where equity is central to their preparation, I think that there are more people engaged in equity-related research activity than when I started my career. In Aguirre et al., we argue for the need to make equity part of research in mathematics education, no matter what our main topic of research may be. That is, we call for the need to make equity part of our research as an “intentional collective professional responsibility” (p. 128). In looking at the four political acts discussed by Aguirre et al., I see equity as central to my work (Political Act 1). As for Political Act 2, I have occasionally felt tokenized as the “equity expert” on projects but I would rather have that than the second approach described in that political act, which is having researchers who are not grounded in equity work provide superficial attention to equity issues. I believe that as researchers whose expertise is in equity, we have a responsibility to support others who want to do this work but may not feel knowledgeable. In looking at some of the recent PME-NA proceedings as well as listening to a variety of talks in diverse conferences, I wonder about how widely “equity

research” can be interpreted and whether we may be going in the direction that everything we do addresses equity somehow. Is that the case? Do we risk watering down equity?

Where is the mathematics and what counts as mathematics are discussed in Political Acts 3 and 4 (Aguirre et al., 2017) and are the center of my work, as I have addressed earlier in this paper. While I agree that to challenge equity work with the question of where is the mathematics can be problematic and creates a separation that is not (or should not) be there, the reality is that I have raised that question myself quite a few times, about my own work and about those of others, as I mentioned earlier in this paper. Is it mostly related to my views of what counts as mathematics? Are we doing enough in our writing and in our work to bring the centrality of equity to mathematics and the centrality of mathematics to equity?

In my current work, I continue to explore questions centered on equity as opportunity to participate and I wonder about the potential for K-16+ “formal” learning (as in a school / college class) of looking at how people learn in everyday life or in informal mathematics settings (see Nemirovsky et al., 2017 for more on the distinction between mathematics in school, in everyday life, and in informal settings). In particular, as I have discussed elsewhere (Civil, 2007; 2016) learning in everyday settings often takes place through participation in the practice, often by observing first and then engaging with the activity. Lipka, Sharp, Brenner, Yanez, and Sharp (2005) describe the case of a Yup’ik teacher, Nancy Sharp, using a Yup’ik approach to learning (apprenticeship; observing and participating in the practice) to work with her students in mathematics. Similarly in their work with teachers of Maori and Pāsifika students in New Zealand, Hunter and Anthony (2011) refer to how teachers draw on their “students’ concepts of collectivism to develop communal responsibility” (p. 6) and build on these strengths to engage students in mathematical discussions.

I am intrigued by the potential for mathematics teaching of building on students’ cultural ways of being and acting, as I illustrated briefly with the 7th grade example earlier and elsewhere (Civil, 2011; 2012; Civil & Hunter, 2015). Rogoff (2012; Rogoff et al., 2017) has been studying how children of Indigenous origin learn in communities in Guatemala and other places in the Americas, including some Mexican-origin children in the US, and contrasting these ways of learning to those of children from middle-class families, mostly of European origin. An example of this contrast is captured below:

The toddlers [in a Mayan community] observed keenly and engaged in multi-way interaction with the group. In contrast, middle-class European American mothers’ approach resembled Assembly-Line Instruction, with mock excitement and praise to engage the little one in mini language lessons. These toddlers were less broadly attentive and seldom engaged with the group as a whole. (Rogoff, 2012, p. 236)

Rogoff et al. (2017) discuss the concept of “sophisticated collaboration” that they have seen among Indigenous children, including children in the US of Indigenous Mexican origin. Sophisticated collaboration implies a form of working together that is fluid and coordinated. They noted that “rural Mexican children were more likely to cooperate in a game than were urban children in the United States, who competed with each other even at the expense of any of them winning” (p. 880). Children engaged in sophisticated collaboration think and work together. On the other hand, children from middle-class families tend to split a task and do less sharing, less thinking together, and take bossy roles. In a study of children engaged in computer programming, they note, “pairs from Indigenous-heritage U.S. Mexican backgrounds collaborated twice as much as did pairs from highly schooled European American backgrounds” (p. 880).

One of the key components of equity as opportunity to participate involves productive group work, in particular along the lines of Complex Instruction (Cohen & Lotan, 1997; Featherstone, et al., 2011). Do immigrant origin students from certain communities (e.g., in Mexico) bring strengths along the lines of sophisticated collaboration that we could be tapping onto? My work with families of Mexican origin points to interactions between parents and children in the mathematics workshops that range from direct instruction on the part of the parents to more collaborative, joint meaning construction (Civil, Díez-Palomar, Menéndez-Gómez, & Acosta-Irui, 2008; Menéndez, Civil, & Mariño, 2009). Certainly, more work needs to be done to gain a better understanding of the strengths that immigrant-origin students, such as the ones in the 7th grade class I describe, bring with them. Children from different backgrounds are likely to bring cultural ways of participation that may be different from the ones expected by the school. This is an asset, as the example of sophisticated collaboration shows. I think it is worth noting that students who belong to non-dominant groups often have rich experiences and skills such as knowing more than one language (important in a global world), knowing how to collaborate (important for teamwork, a trait that is valued in many professions), learning at home through participation in the activity rather than through direct teaching, contributing to the household functioning (e.g., helping out with the home economy; language brokers). What are the implications of this richness of skills, knowledge, and experience for teachers and researchers in mathematics education?

Why do I do this work? The words of Adrienne Rich (1986) say it much better than I could ever say it:

When those who have power to name and to socially construct reality, choose not to see you or hear you, whether you are dark-skinned, old, disabled, female, or speak with a different accent or dialect than theirs, when someone with the authority of a teacher, say, describes the world and you are not in it, there is a moment of psychic disequilibrium as if you looked into a mirror and saw nothing (p. 199)

As we reflect on the work we do with teachers, students, communities, I hope that we can provide accounts that counter these words. I would hope that the students and families with whom we work see themselves in the mathematics worlds that we share with them in our classrooms. I close with the words from a Pāsifika student, as a reminder that this is indeed possible: “When the maths is about us and our culture, it makes me feel normal, and my culture is normal” (Hunter & Hunter, in press, p. 16).

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