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Latinas and Problem Solving: What They Say and What They Do

Paula Guerra
Kennesaw State University

Woong Lim
Kennesaw State University

In this article, the authors present three adolescent Latinas' perceptions of ideal mathematical competencies, their perception of their individual "abilities" in mathematics, and their work on a mathematics problem-solving task. Results indicate that these Latinas recognize flexible mathematics as the ideal mathematical competency in problem solving but demonstrate rigid mathematics in the problem-solving task. Reasons for the discrepancy between the three Latinas' perceptions of ideal mathematical competencies and their own work on mathematical tasks are discussed. Implications related to opportunities for girls of color to pursue careers in STEM fields are discussed as it relates to flexible problem-solving skills in mathematics.

KEYWORDS: Latinas, mathematics education, problem solving, STEM

Children have different schooling experiences that can be shaped by race and gender and that influence their decisions regarding career choices. In particular, classroom mathematical experiences can help explain divergent aspects of mathematics among boys and girls as well as how children perceive their own mathematical "abilities."

Despite a growing interest in science, technology, engineering, and mathematics (STEM), women of color remain underrepresented in STEM fields. Although girls might enjoy studying mathematics and science at school, they are less likely to pursue careers in STEM than boys; this leads, in part, to the "leaky pipeline" in the fields, a disparity in representation of women in STEM today (De Welde, Laursen, & Thiry, 2007). For example, although women represent nearly half of those awarded bachelor's degrees in mathematics, they earn only 27% of doctoral degrees in mathematics (National Science Foundation [NSF], 2013). Similarly, women are underrepresented in physics (30%), computer science (23%), and engineering (13%; NSF, 2013).

PAULA GUERRA is an assistant professor of mathematics education in the Department of Elementary and Early Childhood Education at Kennesaw State University, 1000 Chastain Road, Kennesaw, GA 30144, USA; email: pguerral@kennesaw.edu. Her research interests include Social justice and mathematics education, ELL mathematics schooling, and the mathematics schooling of girls, in particular, girls of color.

WOONG LIM is an assistant professor in the Department of Secondary and Middle Grades Education at Kennesaw State University, 1000 Chastain Road, Kennesaw, GA, 30144, USA; email: wlim2@kennesaw.edu. His research interests include the interrelation between language and mathematics, gender studies in mathematics education, and inclusive classroom practice.

Two decades ago, Catsambis (1994) discussed the lack of research focusing on women's experiences in mathematics; she noted: "Women of color are the most underrepresented group in mathematics and science, but few researchers have specifically studied their educational experiences" (p. 201). More recently, Varley-Gutiérrez (2009) made similar claims about gaps in the literature, explaining that "little (if any) mathematics education research speaks specifically to girls of color or to a feminist of color perspective in relation to Mathematics," and that "there is an urgency to include the voices of women of color in re-envisioning Mathematics education [so that it can be] used as a tool to transform society to be more just" (p. 49). With the growing numbers of Latinas/os in U.S. schools, the case of Latinas and their underrepresentation in STEM merits careful attention. In particular, few studies exist on the complex intersection of Latinas and their mathematics learning demonstrated by problem solving.

Using qualitative case study methodology, we present three adolescent Latinas' perceptions of their mathematics schooling, of the mathematics that they produce and value, and of success in mathematics. In doing so, we examine the adolescent Latinas' perceptions of success in mathematics and mathematical competency compared to their demonstrated competencies on a specific mathematical task. Two research questions guided the study:

1. What are the Latinas' perceptions of different ways in which they do mathematics?
2. What kind of mathematics did, in fact, these Latinas demonstrate in problem solving, and how does it compare to their identification with mathematical ability?

Theoretical Framework

Latina/o Critical Theory (LatCrit) was used to elicit, explain, and understand the participants' comments and their interactions with each other and with the researchers. LatCrit holds that multiple forms of oppression can affect Latinas/os and that such racial experiences permeate our education with regard to the ways Latinas/os experience race, class, gender, and issues of language, immigration, ethnicity, culture, and identity (Huber, 2010). Solórzano and Yosso (2002) defined critical race methodologies in such a way that they could help shed light on issues that affect minoritized groups when used as a lens for research.

LatCrit is a theoretical approach that foregrounds race and racism in all aspects of the research process. However, it also challenges the separate discourses on race, gender, and class by showing how these three elements intersect to affect the experiences of students of color. Racism, for example, is a category of analysis, but its intersection with other forms of subordination, such as sexism or class discrimination, serves as a lens for analysis (Solórzano & Delgado, 2001; Solórzano & Yosso, 2002). Likewise, LatCrit positions Latinas at the multiple intersections of gender, class, and race.

LatCrit offers a liberatory or transformative solution to racial, gender, and class subordination and focuses on the racialized, gendered, and classed experience of students of color. Furthermore, it positions these experiences as sources of strength. Finally, it uses the interdisciplinary knowledge base of ethnic studies, women's studies, sociology, history, humanities, and legal studies to better understand the experiences of students of color (Solórzano & Yosso, 2002). Using a LatCrit lens to study the experiences of Latinas in school mathematics specifically enabled the researchers to critically examine the notion that the functions and ideological purpose of schooling are colorblind, objective, merit-based, neutral, and offer equal opportunities (Solórzano & Delgado, 2001; Solórzano & Yosso, 2002). When a study includes girls of color as participants to examine racialized experiences of individuals in the learning of traditionally White- and male-dominated subjects at school (e.g., mathematics), there needs to be a clear effort to examine how their gender, race, and/or social class influenced their perceptions about various aspects of school mathematics.

Literature Review

Stereotyping in Mathematics

Stereotyping in mathematics—related to gender and ethnicity specifically—is common inside and outside of schools. Gender stereotyping leads some girls to hide their interest in mathematics, fearing that this interest could challenge their femininity (Mendick, 2005a, 2005b; Walkerdine, 1989). Kiefer and Sekaquaptewa (2007) examined gender identification and stereotyping among women enrolled in college calculus courses. They reported that women with low gender identification and low gender stereotyping performed best on examinations, and women with high gender identification and stereotyping were not inclined to pursue careers in mathematics. They also suggested that those who were not expressive but were suspected as accepting that women have lower mathematical competence than men were not likely to choose a career in mathematics.

Teachers' beliefs about girls' success in mathematics may also influence female students' relationships with mathematics. For example, Walkerdine (1989) pointed out how teachers talked about girls' mathematics success being a result of their hard work or "effort." In contrast, in the same classrooms, teachers believed that boys who were not achieving at the same rate as the girls were still had potential and were not trying hard enough. In fact, researchers have pointed to the inadequacy in how girls are taught and socialized into mathematics rather than to innate differences between men and women (Battey, Kafai, Nixon, & Kao, 2007; Boaler, 2002; Carr, Jessup, & Fuller, 1999; Clewell & Campbell, 2002; Fennema, Carpenter, Jacobs, Franke, & Levi, 1998). However, gender stereotyping is a complex issue and includes more than whether women participate in mathematical activities or careers (Hyde, Fennema, Ryan, Frost, & Hopp, 1990). For instance, Mendick (2005b) equated doing mathematics with "doing masculinity" (p. 235).

Ethnic stereotyping in mathematics is also prevalent in schools. Regarding the participation of Latinas/os in mathematics courses, their achievement in mathematics, and participation in STEM careers, researchers have found that Latinas/os are overrepresented in low-ability classes (Catsambis, 1994) and underrepresented in high-ability mathematics courses and STEM careers (Zarate & Gallimore, 2005). According to Gutiérrez (1999, 2002), even though the scores for Latinas/os in mathematics have improved, the improvement has been mostly in basic skills. This underachievement "has serious life consequences for earning potential and for participation in an increasingly technological society" (Gutiérrez, 2002, p. 1048). Gutiérrez (1999) also stated that not only are Latinas/os' and African Americans' scores below those of White students, but they also tend to score significantly lower in advanced placement (AP) courses and college entrance examinations. Using data from the National Educational Longitudinal Study of 1988, Catsambis (1994) concluded that by eighth grade, fewer adolescent girls than boys decide to pursue a career in mathematics or science, with female African Americans and Latinas being the least likely to do so.

Latinas and Mathematics

Women of color are underrepresented across all science and engineering fields. Statistics for Latinas are particularly troubling: the percentage of Latinas in undergraduate engineering programs was 2%, while the percentage of Latinas in graduate engineering programs was less than 1% (NSF, 2013). However, these statistics are not surprising when you look at K–12 experiences. McWhirter, Valdez, and Caban (2013) reported in their study that 41 high school Latinas experienced barriers such as lack of financial and language resources, negative peer influences, and discrimination from teachers and peers. Related to mathematics specifically, Catsambis (1994) found that Latinas tend to have less confidence in their abilities to do mathematics, report higher levels of mathematics anxiety, and appear to have less interest in mathematics. For instance, many Latinas believed that mathematics courses would not be useful for them. Catsambis also found that Latinas were afraid to ask questions in mathematics classrooms and were less likely to express enjoyment in studying mathematics when compared to male students.

Zarate and Gallimore (2005) studied factors that impact college enrollment for Latinas/os and reported that teachers and school counselors play important roles in Latinas' educational shaping. Additionally, Jilk (2006) found that first-generation immigrant Latina students' mathematical successes were related to the identities they constructed in schools and at home. Furthermore, she criticized the views that English learners cannot learn difficult mathematics and that parents and the cultures of the immigrants might cause the students' academic struggles. With first-generation Latinas who were "low performing" students, Pyne and Means (2013) conducted a case study and found that hidden social and institutional discourses created stress, struggles, and doubts with regard to success in society. As a response to those societal influences, Weisgram and Bigler (2007) claimed that girls might benefit from learning about feminism and gender equality in order to disavow the notion of women's low achievement in mathematics and science.

Problem Solving and Invented Algorithms

Problem solving is one of the essential functions of STEM. There is a growing body of literature indicating that problem solving in mathematics offers students opportunities to experience how their mathematical knowledge creates solutions to problems and also helps students to develop a deeper understanding of mathematical thinking and reasoning (Lubienski, 2000; Millard, Oaks, & Sanders, 2002).

Adeleke (2007) claimed that problem solving dwells on the use of conceptual and procedural knowledge, and other researchers found that it takes balanced strategies of using both types of knowledge to achieve success in problem solving (Hiebert, 1986; National Research Council [NRC], 2001; Sfard, 1991). Conceptual approaches in problem solving, for instance, enable students to employ an integrated understanding of mathematical ideas. Procedural approaches to problem solving allow students to execute related procedures to solve problems (NRC, 2001; Rittle-Johnson, Siegler, & Alibali, 2001). However, Hiebert and Lefevre (1986) argued that the two approaches are hard to separate, as they actually support each other. Rittle-Johnson and Siegler (1998) found that articulating how procedures and concepts interact is critical to understanding various methods in problem solving. In describing ways in which one conducts problem solving, Adeleke (2007) explained that those with high conceptual understanding apply a host of related, but possibly unknown, procedures to problem solving, and others may apply skills in a routine and rigid manner with fluency; overall, learners tend to use one primarily over another.

Fennema and colleagues (1998) found that girls solved mathematics items primarily using taught algorithms, while boys used invented algorithms. This difference is troubling when given that success in mathematics, particularly in the STEM-related fields, has been connected to a student's ability to produce invented mathematical solutions (Adams & Hamm, 2011; Carr et al., 1999; Fennema et al., 1998). Adding to this, Carr and colleagues (1999) found that girls too often do not reflect on their solutions nor ask the *how*s and *why*s when solving mathematical problems. Failing to consistently ask these higher-order questions can translate into limiting the opportunity for girls to remain engaged in what the National Council of Teachers of Mathematics (NCTM) considers to be "doing" mathematics. For Stein, Smith, Henningsen, and Silver (2000), doing mathematics consists of engaging in complex and non-algorithmic thinking, as well as exploring and understanding mathematical concepts, processes, and relationships. Thus, it seems critically important to look carefully at female students' experiences in mathematics, particularly those women from underrepresented groups.

Methods

Setting

This study was part of a larger research project investigating Latinas' schooling experiences related to mathematics. The research took place in an elementary school in the southwest United States. The student population of the district is 53.6% Latina/o, 23.6% White, 11.5% African American, 7.7% Native American, and 3.4% Asian/Pacific Islander. The class to which the participants belonged did not reflect the demographics of the school, with only five Latinas/os in a class of 25 students. According to the state, the school was not meeting adequate yearly progress.

Participants

The participants were three eighth-grade Latinas—Viviana, Rocío, and Teresa (all pseudonyms)—who were enrolled in the school's honors track program. Honor student Latinas were chosen for this project as representative of traditional notions of success in mathematics, with recognition that these notions must be critically examined. For example, good grades in mathematics classes may not mean that Latinas are learning the kind of mathematics that society and participants value. Alternatively, these grades could mean that Latinas perform well in the current assessment system of their mathematics classrooms.

Viviana showed a strong personality during interviews. She frequently stated that she did not like mathematics. Rocío was a quiet girl who took time when she spoke. Rocío stated that she wanted to be an architect in the future. Teresa demonstrated a modest disposition and stated that being an honors student was challenging. During the time of the study, the three girls were taking geometry and had taken algebra the previous year. Viviana, Rocío, and Teresa were all first-generation Latinas, and their family members emigrated from Mexico. They spoke fluent English like native speakers and declined to speak Spanish with the interviewer, who spoke Spanish as the first language. The participants chose to speak Spanish only when the interview involved meeting with their parents.

Design

The participants met with the interviewer nine times from September 2010 to March 2011. There were four focus group interviews, four follow-up individual interviews, and one individual working session with a mathematics task. Group interview questions prompted participants to share their experiences learning mathematics in classroom and home settings and also to share their unique experiences they had at school because they were Latinas. During the individual follow-up interviews, participants had an opportunity to talk more about the topics discussed in the group interviews. During the mathematical task working sessions, participants engaged in a problem solving activity and to explain their reasoning. Additionally, the interviewer asked the participants to solve one equation that could have been a key component to finding solutions to the problem solving activity.

In addition to interviews and working sessions with Viviana, Rocío, and Teresa, the researchers conducted one interview session with the girls' families. For the family interview, Viviana, Rocío, and Teresa provided questions of interest they wanted to ask their parents regarding their mathematics schooling and the influence of parents and family. Finally, the researchers had informal conversations with the participants' teacher.

Data Collection

During data collection, the researchers built a collaborative relationship with the participants (Erickson, 1986) in order to gain access. For example, they made efforts to establish trust and ultimately gain access to the experiences that participants shared and their views of mathematics, maintaining it throughout the process of data collection. Table 1 shows the timetable for the data collection and the different central topics for the meetings.

The focus groups were designed to encourage the participants to open up to the interviewer in an environment where the girls could support each other and help recall their experiences with mathematics, which included school and home experiences. Through these meetings, the researchers identified the community that the girls belonged to, how they saw this community, and what kind of participation they had had in it. By being in a group with others who shared similar lived experiences, the participants were able to discuss topics of common knowledge understood by each of them but not necessarily by others outside their community.

The researchers used individual interviews to further investigate the participants' statements from the focus group interviews by giving them opportunities to explain what they meant and why they made specific statements. The individual conversations allowed the participants to share details that they may have wanted to keep private. These interviews were semi-structured but with enough freedom to have an open conversation in a safe environment, pursuing emerging themes. The mathematics working session aimed to compare what the participants talked about while referring to mathematics, including the ways they do mathematics.

Table 1
Data Collection Timetable

Month	Topic of Focus Group Meeting – Date	Individual Interview Date
September	Mathematics autobiography – 9/16	9/30
October	What is necessary to succeed in mathematics – 10/7	10/1
November	Why do others not succeed in mathematics – 11/19	11/4
December	Non-applicable (N/A)	12/2
February	Our parents and mathematics – 2/4 (Participants prepared an interview with their parents)	N/A
March	No focus group meeting; individual mathematics working session during final interview	3/23

All of the group meetings were video- and audio-recorded, and all individual interviews were audio-recorded. Each video- and audio-tape was transcribed for analysis. The researchers also took notes during the working session and collected the work that the students produced.

Another source of data was the informal conversations the researchers had with the teacher at the school in the mathematics classroom after classes were over for the day. The researchers took notes on the teacher's comments. Additionally, when the teacher heard something the girls said in the group interviews—the teacher sometimes came to the room to get materials or make plans for the next day's class—she was allowed to make a comment. The teacher was a White woman in her 20s. She portrayed a calm, positive demeanor and demonstrated passion for her students. The three Latinas expressed respect toward the teacher and stated that they liked her very much.

Data Analysis

Following Erickson's (1986) methodology, data was reviewed multiple times in search of critical events (considering their frequency of appearance in the data, as well as the effect and emphasis the girls placed upon them) that defined (a) what each girl thought about her school mathematics experiences, (b) the different "kinds" of mathematics, and (c) the mathematics she valued and actually demonstrated.

The data were examined critically to determine counter-arguments that could serve to disprove the relevance of assertions made from the analysis of the data. When evidence was found that some assertions could be explained through verbalizations the girls made, the assertions were accepted with the supporting evidence. Some assertions were discarded when contradictory evidence was found. According to Erickson (1986), this process provides evidence for the assertions that were generated in an inductive way. Assertions supported by multiple sources of data were accepted as the strongest claims. To determine the strongest claims, the researchers compared all the pieces of evidence, weighing and comparing pro- and against-evidence. This process of finding the strongest claims was made in two instances: one for all data and another for each girl's individual data. The researchers often referenced the recordings to ensure that conclusions based on the transcriptions matched the interviews—an advantage that Erickson noted for the use of video.

Limitations

One limitation of this study is the impossibility of generalization. This study aims not to create a general case for all successful adolescent Latinas in mathematics classrooms in the United States but rather to bring light to the issue. This study can inform researchers' design studies with larger populations using this study as baseline data.

Another limitation regarding the design and the tools of data collection is the lack of classroom observations. Classroom observations could have been useful to tie the participants' accounts to the classroom environment and the behaviors demonstrated in the teaching and learning of mathematics in the classroom. Classroom observations would have provided the researchers with firsthand information about the mathematics favored in the classroom, instead of relying on descriptions based on the participants' and teacher's perspectives.

Findings

Rigid Mathematics vs. Flexible Mathematics

The Latina participants stated that smart people do mathematics quickly. All three girls, however, presented varying degrees of agreement with regard to competency in problem solving. While talking about those who demonstrate a high level of mathematics, Teresa said, "[smart students] don't want…like…work out the problems and the steps" (II1, Oct. 1).[1] She linked the idea of problem solving with fluency in executing the host of steps she needed to work out:

> I have a lot of friends, like, guys that are in my class, they just open…. They don't even need the teacher to explain. They just open the textbook, and they just start looking at examples really quick, and they are like *boom*. They really quickly got the idea. (II1, Oct. 1)

Teresa, who described Rocío and Viviana as smart, needed more steps to "see" the mathematics:

> I know [Rocío] will get the answer really quick, or [Viviana] will do like short steps, and I need to see like all the problems to understand it…. [People] should not be ashamed at trying to do memory things, because most things are in your mind. (FG2, Oct. 7)

Rocío said she was successful in mathematics and used problem-solving skills to describe mathematical competence. Rocío explained that she, "like boys," preferred hard mathematics problems that "take more [than basic] information" to result in successful solutions. Rocío said she did not do her mathematics "step by step" like in textbooks, as if "one follows a prescribed recipe" (II2, Oct. 1). She added that, after solving problems in her head, the actual time-consuming task was writing the steps down as the teacher required:

> I can do mental math fast… I do it in my head. I use less steps than [Teresa and Viviana]…. But then I need to figure out the steps for the teacher…. We need to show our work and write it out…it takes time. (FG2, Oct. 7)

Rocío also explained why she did not choose easy problems to solve by drawing a parallel between her and boys' mathematics:

> I think [boys] think like higher… level or something sometimes. They think about the problem, for instance, like as it gets harder, they think more about it. Like the easiest problems they don't really care…. I don't really care either. (FG2, Oct. 7)

She also said: "I do [mathematics] like boys…. They just leave the easier problems behind; they don't really care. They think the harder problems, the more information they are gonna get out of it" (II2, Oct. 1).

According to Rocío, the mathematics she could do was the kind that would prepare her for a career in architecture: "Well, my dad, he's always been there, telling me specially to do my math homework because he thinks it's really im-

[1] Individual interviews are noted as II, followed by the number and the date. Focus groups are noted as FG. Example: the first focus group, which took place on September 16: FG1, Sept. 16.

portant, specially for architecture and engineering, and that's what I wanna be" (FG1, Sept. 16). Later she added: "This year we are doing geometry. So I think I still have a lot to go through to become an architect" (II1, Oct. 1). Rocío spoke about her career goal in the context of her ethnicity: "There are a lot of Latino poets and writers famous, but not architects or engineers. I want to show [people] Latinos can do it" (II2, Oct. 1).

All the girls agreed that mathematics "just comes naturally" and explained that some people are simply better at it "naturally":

Interviewer:	Why do they [boys] do it [mathematics] so quickly? (*short pause*) Any ideas?
Rocío:	I don't know.
Teresa:	Just comes.
Interviewer:	What?
All of three:	It just comes.
Rocío:	Comes naturally, I guess.
Interviewer:	What about for girls? Does it just come naturally as quickly too?
Rocío:	Well, to me it does but… I learn differently so…. (FG2, Oct. 7)

Unlike Rocío, Teresa stated that word problems were sometimes difficult for her:

Teresa:	I have some problems with those. I read them, but then I try to go back again, try to understand what they are asking, but I don't know how to like…. I don't know how to put the equations together like….
Interviewer:	Why would that be?
Teresa:	I don't know. Maybe 'cause I don't try to think higher, but I should. And… I don't know. That's hard. (FG2, Oct. 7)

Teresa identified the cause of her struggle as a lack of effort and cited "setting up the problem" and "writing the equations" as the best approach to solve problems in classrooms.

Often the girls relied on memorized routines to solve mathematical problems:

Viviana:	When we are young, we do stuff the long way, but now there are like…formulas and sure-ways, shortcuts…
Teresa:	And if we memorized something from the past, it's easy to…when we are using formulas; it's just easier to…. I don't know… put all together. (FG2, Oct. 7)

Teresa was not satisfied with her performance. She discussed not being sure about whether she should change her style of doing mathematics to emulate the ways boys do mathematics:

> I have a lot of friends that go to another school…guys…. They don't need a lot of questions. They just read it and they know…. They know what to do. I ask a lot of questions. I was embarrassed at first, but if I don't ask, then I don't know what to do. I don't know…. Maybe I should change…. I don't know." (II2, Oct. 1)

Rocío stated—and Teresa agreed—that Viviana did not need as many steps to solve a mathematics problem like other girls (e.g., Teresa) but still needed more than Rocío. The teacher agreed by saying, "Yes, they are smart and very hard working. Viviana needs a little help, and Teresa needs a little more. Rocío is ahead of the bunch…. It is pure effort. Pure effort" (Conversation with teacher on Nov. 19).

Even though Teresa struggled with application problems, Viviana and Rocío claimed these were fun and made them connect mathematics to the real world:

Viviana:	I don't like math.
Interviewer:	Really? Why is that? You are so successful at it.
Viviana:	I don't like it.
Rocío:	Sometimes [it] is boring.
Interviewer:	Really?
Rocío:	Sometimes [it] is good, like when we connect with science or something, so we *see* how it is.
Viviana:	Yeah, like with problems.
Rocío:	Yeah, problems.
Viviana:	Everything is connected with math. It is not boring when it is connected. (FG1, Sept. 16)

Viviana described mathematics in the textbook as being one type of mathematics where memorizing rules and following steps were synonymous with success in schools. While talking about those steps, Viviana was proud that she took fewer steps than Teresa did.

In the last meeting with a mathematical task, the participants completed a mathematics problem and solved an equation. In the next section, the problem-solving experience is described.

The Latinas' Performance in Problem Solving

Viviana, Rocío, and Teresa were given the following problem:

I have 1 2/3 cups of milk. My recipe calls for 2 1/2 cups. By how much do I need to reduce the other ingredients in the recipe so that I can use 1 2/3 cups instead of 2 1/2?

The participants solved the problem while the interviewer observed what they were writing. Application problems were not the focus of their mathematics class, according to the teacher. The teacher said: "Sadly, we don't have time for that. Problem solving takes time. It is great, but we need to cover so many things, we stick to the workbook." (Conversation with teacher on Mar. 23)

One step the three Latinas commonly took after finishing reading the problem was converting the fractions to decimals, demonstrating that they were fluent with calculation. Although the participants stated that they understood the problem, they struggled with identifying key mathematical ideas of the problem as well as expressing their thinking algebraically. They read the problem repeatedly. Viviana said: "We need this milk, but we have less…. We can't make the cake. Reduced…smaller cake?" (II5, March 23). They went over the numbers, writing them down, saying them out loud. It took them 5 to 6 minutes to start writing their work on the paper.

The participants stated that the percentage by which the other ingredients were reduced corresponded to the percentage by which the milk was reduced, but they could not translate the key concept to algebraic expressions or equations. When the interviewer changed the problem during the interview so the percentage was half of the original, the participants were able to solve the problem. However, they still could not solve the original problem.

Rocío struggled to find the percentage and said that the wording in the problem was confusing. She started by finding the difference between the amount of milk in the original recipe and the amount that she had available. She said she wanted to find the percentage of reduction. Rocío was persistent in using decimals instead of fractions. It took her longer to solve the problem because she was working with a repeating decimal (which made the computations difficult). Also, it was difficult for Rocío to guess a number multiplied by 2.5 to result in 1.667 (i.e., $2.5x = 1.667$). The interviewer suggested writing an equation for Rocío to solve: $(2\ 1/2)x = 1\ 2/3$. When the equation was proposed, Rocío solved this equation quickly but still struggled to understand how the equation may represent an algebraic path in the problem.

Similar to Rocío, Teresa quickly converted the fractions to decimals. She said that the applications to real-life situations in these types of problems were confusing. As it became clear that she had grown frustrated with the problem, the interviewer suggested a slightly different situation, where the original recipe used 2 cups and the cook had 1 cup only in the kitchen. Then, the interviewer asked about the relationship of these numbers (one being double the other) and how much of the whole "cake" we would bake if we had 1 cup when we needed 2, in an attempt to tie the mathematics with the real-world situation of the problem. Teresa decided to find the difference between the numbers, similar to what Rocío did. She said that the new recipe should be reduced by 50%.

The interviewer also asked Teresa if the original recipe called for 3 cups of sugar (moving into another ingredient where she would have to keep the same relationship), how much she would need for the reduced (to half) recipe. With this suggestion, Teresa became frustrated. After 13 minutes passed with failed attempts at the problem, the interviewer provided the same equation she had provided to Rocío. Teresa solved this equation without difficulty. She told the interviewer: "Word problems are harder because you have to set up the equation" (FG5, Mar. 24).

Viviana, similar to Rocío, found the difference between the amount she needed and the amount she had with decimals. Then she tried to convert this difference back to fractions but was not successful. The interviewer presented Viviana with the easier version of the problem provided to Teresa. Viviana said that she wanted to work with percentages because she thought that was what the problem aimed for: "Like…if it was half, like you [the interviewer] said, then it will be 50%. I need to know the percentage" (FG3, Nov. 19). Applying her thinking in the simpler version of the original problem, Viviana was able to figure out the solution to the original problem.

Summary

The participants described mathematical behaviors in problem solving in two categories. First, they talked about one type of mathematical behavior as rigid or "textbook-like," consisting of steps and rules to memorize and follow. They described the other type of mathematical behavior in problem solving as fast mathematics or flexible mathematics that is not bound by rules, as it just "happens naturally" immediately after reading a problem. The three Latinas indicated that they considered the fast and "naturally" occurring mathematics superior to the methods that are typically presented in the textbooks as a rigid set of procedures. In problem-solving sessions, however, the Latinas demonstrated performance in rigid mathematical behavior closer to the level of mathematics that they considered inferior. The girls struggled to translate their mathematical thinking into algebraic structures and demonstrated limited mathematical reasoning. Instead, the participants were fluent in solving explicit equations that could be solved through procedural routines. The girls solved the equation by adhering to a set of rules and procedures they had been taught. These ideas are explored further in the next section.

Discussion

Different Notions of Doing Mathematics

The three Latinas recognized varying degrees of school mathematics. Their descriptions of mathematical competencies of problem solving were primarily two-fold: flexible and rigid. In flexible mathematics, the student will quickly grasp the key elements of a problem-solving task, devise creative strategies, and produce solutions. We believe flexible mathematics aligns with the kind of mathematical behaviors of the learner who effectively uses her or his conceptual knowledge base and is willing to take risks to produce a solution to a problem-solving situation (Adeleke, 2007; Hiebert, 1986). The three girls used adjectives such as smart, fast, "just happening in one's head," or high-level mathematics to describe flexible mathematics. In rigid or algorithmic mathematics, the student would recall memorized rules, use prescribed procedures, and apply taught strategies. The participants also described rigid mathematics as low-level or mathematics "like in textbooks."

Flexible mathematics could be in opposition to algorithmic mathematics and useful to devise strategies in unknown problem-solving situations. Rigid mathematics could be useful to execute efficient calculations in a clear application of formulas or common strategies of problem solving. This comparison parallels the differences in using an invented algorithm versus taught strategies (Fennema et al., 1998). Rocío, Viviana, and Teresa knew that some students, mostly boys, could perform and relate to flexible mathematics more positively than toward rigid mathematics. For the most part, mathematics educators agree that neither boys nor girls have some special "innate" ability toward mathematics (Campbell, 1995, 1997; Fennema, 1996). The participants in this study, however, showed less confidence in their mathematical abilities, which support conclusions drawn in prior research (e.g., Catsambis, 1994).

The findings of this study add that some Latina students associate flexible mathematics with boys' mathematical ability and rigid mathematics with girls' mathematical ability. For example, the girls showed excitement describing how fast one can work out a solution in problem solving. Rocío associated herself with flexible mathematics by saying that she learned differently than other girls who rely on procedures and taught strategies. Rocío described her way of doing mathematics as "different" from that of most girls and more similar to what boys do.

The mathematics these Latinas considered "higher" did not reflect the nature of mathematical learning at school. Rocío explained that the longest part of mathematics work was translating what was in her head into procedures so that the teacher could see her work. Teresa talked about higher mathematics as something students at a different school do. These statements reveal a glimpse of the school mathematics the three Latinas experienced in which problem solving was not emphasized and mathematics curricula and pedagogy were different from school to school. The teacher confirmed this difference when she said there was no time for problem solving (or, at least not in this teacher's classroom).

The occurrence of bias in mathematics classrooms was evident in the study. Rocío's teacher, with whom the interviewer talked informally before and after all the interviews and focus groups, agreed with the idea of Rocío being the one doing mathematics faster and in "fewer steps." She added that it was "pure effort working for her." According to the teacher, putting forth effort was a characteristic common among the three girls: "All of them, they work really hard for the class, and they are very responsible. They are doing very well in this class." (Conversation with the teacher, Nov. 19). This comment confirms what much of the existing literature says: teachers more times than not believe girls' success in mathematics is due to their efforts alone, not their intelligence or skill (Damarin, 1995; Forbes, 2002; Walkerdine, 1989). The teacher also agreed that Teresa had to put in more work toward her success than the others. However, Teresa's conception about mathematical competency was centered on rote learning and memorization. When asked about the skills to be good at mathematics, she said: "[People] should not be ashamed at trying to do memory things because most things are in your mind" (FG2, Oct. 7).

This path of memorizing as the way to learn mathematics neither aligns with what the NCTM (2000) defines as doing mathematics nor matches the statements the Latinas provided during the study when they explained their success and what they were able to do. NCTM recommends problem solving, yet the girls' schooling experiences did not provide learning opportunities to experience the NCTM recommendations. Nevertheless, while navigating the rigid mathematics available to them at school, the girls were awarded the possibility of being in the honors track, which could be part of the conflicting schooling to which the Latinas adhere, but it may fail to build the necessary skills (i.e., problem solving) to be successful in the STEM fields. We note the teacher stated Teresa was the least successful of the three girls, but she could, ironically, be the one who methodically adheres to the rigid mathematics that are common to school mathematics, as she explained:

> Because a lot of people I know, they just know the answer, or they just do it in their head and can just write an answer real quick. But I actually go through all the steps and make like a long list so I can actually understand it. [Motioned to Rocío and added] 'Cause I know she [Rocío] will get the answer really quick, or she [Viviana] will do like short steps, and I need to see like all the problems to understand it. (FG2, Oct. 7)

Teresa's schooling also shaped her perception about higher mathematics. While Teresa was cautious about her mathematics, she clearly still valued the same mathematics Rocío did: fast, in your head, and not prescribed by books or even teachers. These girls valued highly being fast and doing work in their heads. To explain why girls sometimes do not achieve at the same level boys do, Viviana said: "I can do mental math fast" (II2, Oct. 1). What Viviana shared about mathematics and how she achieved success fit with the other two narratives. Her evaluation of mathematics was similar to Rocío's, and, like Rocío, she related to this better way of solving mathematical problems when she showed some disdain for the textbook's way of doing mathematics by following steps—sometimes many steps. In sum, these girls indicated that they learned rigid mathematics at school but see the boys as capable of doing flexible mathematics and believe the current school curriculum offers few opportunities to experience the balance between the two kinds of mathematics.

The Mathematics Produced

The mathematics the three girls demonstrated here suggests that they could not engage higher-level flexible mathematics. The mathematics the participants demonstrated appeared to be the rigid mathematics they described as lower-level mathematics. This outcome is not unexpected, considering problem solving was not a regular part of the mathematical learning opportunities available at their school (or, at least not available to these three Latinas).

Both Rocío and Viviana chose to use additive thinking instead of multiplicative thinking in the working session. Even though finding the difference could have helped them solve the problem, the fact that the participants did not use the difference to calculate the percentage of reduction from the original recipe suggest their solution path considered little about the relationships of the quantities involved in the problems. The participants appeared to struggle with justifying procedures or strategies, but they were proficient with lower levels of cognitive demand tasks (Stein et al., 2000) such as calculations. As Carr, Jessup, and Fuller (1997) reported, the girls were not comfortable asking the *hows* and *whys* or explaining their thinking and reasoning.

We noted that the participants talked about their success in mathematics, especially with problem solving and how good they were at it. Problem solving contributes to cognitive development, and the benefits of using problem solving motivate students' learning of mathematics (Turner, Celedon-Pattichis, & Marshall, 2008). However, in this case, the participants could not perform well in the problem-solving task presented. Discrepancies existed between the Latinas' expectations and their demonstrated skill sets. We posit some reasons to make sense of the discrepancy. These girls could simply be narrating the image of successful and higher mathematics that they perceive from society. The partcipants may echo what they hear from society about the ideal skills necessary to be successful in careers in STEM fields. Alternatively, and more implicitly, the girls could be expressing their desire to grow from the biased notion of women's low achievement in mathematics in which flexible mathematics can be a valuable tool for success (Weisgram & Bigler, 2007).

It is important to reiterate here that neither the mathematics curriculum nor the teacher's pedagogy appeared to nurture the specific skills and knowledge necessary for problem solving. The teacher stated that problem solving was not the main focus of their mathematics courses, claiming that too much material from the textbook had to be "covered," and they had to stick to it by drilling. This focus may echo the status quo of mathematics instructions for girls in many parts of the country; as Boaler (2002) argued, the learning environment created by teachers and schools does not always support girls' needs. It is essential to ask whether Latinas, and girls in general, have access to learning opportunities to develop such skills and knowledge that support their perception of good mathematics and continued interest in STEM fields.

Researchers have found that teachers, parents, and peers influence Latinas' perceptions of academic achievement and motivation to purse STEM professions (Frome & Eccles, 1998; McWhirter, et al., 2013; Robnett & Leaper, 2013). Teachers who interact more with boys, question boys' thinking and strategies for problem solving, and who ask girls only lower thinking skill questions (e.g., a numeric answer or a rule that they were meant to memorize), are not helping girls learn mathematics that they can use later in their careers. These actions may lead girls to learn more structured and less inventive mathematics. Thus, it is not surprising that girls choose to give memorized answers and use taught algorithms and traditional strategies at a higher rate than boys (Fennema et al., 1998). It could also explain why girls, at times, appear to struggle with problem solving and vocalizing flexible mathematics strategies in classrooms.

Concluding Remarks

One finding this study depicted is that these three Latinas wanted to be able to perform the higher-level flexible mathematics but fail to do so in the specific problem-solving task presented. It also revealed that the mathematics instruction in which these girls were provided (i.e., lower-level rigid mathematics) did little to enhance flexible problem-solving skills. Why the three girls thought, felt, and performed that way, and why their opportunities to learn flexible mathematics were limited, are questions that should guide the work that needs to be done if the under-representation in STEM is to be changed.

Latinas, as illustrated here, may do well in school mathematics in which problem solving is avoided and rigid mathematics is the only way to sustain their success. We ask, then: How do Latinas respond when flexible mathematics becomes the key skill not only in the mathematics curriculum but also in the pedagogical practices? When they struggle with flexible mathematics, does this lead them to stop pursuing careers in STEM fields? Could this explain part of the reason why Latinas are underrepresented in the STEM fields? And from a LatCrit perspective, how does the intersectionality of race, gender, language, immigration status, and so on, confound the mathematics learning opportunities provided to Latinas? Research needs to continue to investigate the connections between Latinas' access to opportunities to learn problem solving through the use of flexible mathematics and the underrepresentation of Latinas in STEM fields. Future studies could examine a larger group of Latinas and consider providing Latinas access to multiple mathematical tasks including in-depth problem solving in order to examine Latinas' mathematics achievement and career choices.

In the end, it is important to preempt girls, in general, and girls of color, in particular, from gendered and racialized learning experiences and opportunities that hinder them from choosing a career in STEM fields (Weisgram & Bigler, 2007). Equally important would be providing learning opportunities for girls of color with an aim toward increasing the knowledge and skills that are relevant in STEM fields, such as flexible problem-solving skills, which could be significant in addressing the underrepresentation of women of color in STEM fields.

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