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Math Identities in Formation: Latin@ Students Tell Their Math Stories

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Math Identities in Formation: Latin@ Students Tell Their Math Stories

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Dedication

To Antonio, Itzel, Leo, Ernesto, Samantha, Jorge, Salvador, Alexa, Rosa, Sonia, Jose, Jenny, Luisa, Marisol, Josefina, and all the other students have taught me so much already.

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Abstract

Math Identities in Formation: Latin@ Students Tell Their Math Stories

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Bilingual fourth graders' math stories were collected to explore their math identities. Students expressed identities of powerfulness and powerlessness and identified the key resources they need in order to feel like successful mathematicians. These resources included collaboration, manipulatives, their native language, and the support of family. Implications and suggestions for educators are discussed.

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Chapter 1: Introduction

Antonio is the mental math king of my classroom—he sees numbers in ways that no one else in the room does (including me). When I want to see a strategy that surprises me or that shows a sophisticated understanding of how numbers work, I can count on Antonio. Antonio is quiet, and when he is thinking about numbers, his face scrunches up behind the thick frames of his glasses until he raises a triumphant finger in the air, exclaims, "I got it!" and rushes over to wherever I am to show off his victory. In a narrative he wrote at the end of fourth grade, he said that math puts him in a good mood, because "I know I can always get the answer—it might take me a long time, but I can do it."

Antonio has been my student for over two years. The year that he became my student was the year that he had to repeat third grade. He had been in an all-English speaking classroom and had fallen behind. Worse, he identified with this sense of failing. Every time I passed out a math problem, he would avoid working on it, sometimes slowly underlining every word, sometimes doodling. If I approached him and asked him questions about what he was thinking in relation to the problem he would stay quiet. If I kept asking, or encouraging, he would burst into tears. How did that child, who had such a sense of despair when it came to math learning, become my triumphant finger waver?

Seeing this shift in how Antonio viewed himself as a mathematician prompted me to wonder about the math identities of the other students in my classroom. My math teaching is centered on students and their mathematical thinking. I routinely pose problems and encourage my students to make sense of these problems in whatever way

works for them. My practice is based on showing my students that I value their thinking and want to understand their ideas. Because of this, I believed that they would have a lot to say about math and who they were as mathematicians. I decided to find out more about my students' math stories. What would their stories reveal about their math identities? How do they enact these identities during problem solving?

Stories are an important way of making sense of who we are. Delgado (1989) reminds us that hearing the stories of others can "allow us to see how the world looks behind someone else's spectacles. They challenge us to wipe off our own lenses and ask, 'Could I have been overlooking something all along?' (p. 2440)" It was this challenge—to find something I may have overlooked, to understand something about individual students that I had not yet made sense of—that drove this research.

Conceptual Framework

Construction of a math identity

Math identities help us, as educators, understand how students see themselves in relation to math. Understanding students' math identities provides a richer perspective on how and why our students engage with math in different ways. Martin (1997) defined math identity as being constituted by an individual's "beliefs about their ability to perform in mathematical contexts, their beliefs about the instrumental importance of math knowledge, and their resulting motivations and strategies to learn or do math" (p. 24). In other words, students have deeply held beliefs about themselves and about math that impact their approach to the subject.

When students are in math classrooms they are learning more than just content, they are learning how to participate in that context, what is expected of them, and how to manage those expectations. As Boaler, Wilian and Zevenbergen (2000) put it, "They learn how to be a math student. They develop a sense of who they are as learners in that context," (p. 3).

Student's identities are not only about how they see themselves, they are also identities which they are performing. They enact this sense of who they are as math learners, which can shape the way that they are evaluated by educators and other students in terms of their ability, motivation, and so on. Understanding our students' math identities allows us to reflect on our practice, but also to critique those practices which produce negative identities or identities of failure. Hersh and John-Steiner (2010) argue that people are not born hating math, but rather, learn to hate it through their experiences in school (p. 305). Hating math may be a way of expressing a negative math identity, and in that sense, addressing identity becomes crucial if we hope to impact the underrepresentation of minorities in the field of higher math (p. 312). If this is the case, then careful consideration of the identities that students form in different contexts can help us to identify spaces in need of improvements. Hating math or having a negative math identity should not be seen as solely the product of a person's sense of him or herself, but rather the product of experiences in math classes.

The identities that students create are malleable based on the teacher and classroom environment (Boaler, Wiliam, & Zevenbergen, 2000). They are in constantly stages of (re)formation based on the mathematical contexts in which they participate.

This is key for educators—the pedagogy children are exposed to serve to create identities that students carry with them.

A Larger Context: Being Latin@ in School

Reflecting on teaching practices that can produce negative math identities also entail understanding the external forces that impact classrooms. Antonio's experiences in math class were also the result of a persistent tendency by schools to position Latin@ students for negative math identities.

Antonio tended to be seen through the lens of what people believed he could not do (Solórzano & Yosso, 2001; Valencia, 1997). When Antonio started 3rd grade, he was not provided with any Spanish services. His language was seen as a problem to be fixed, rather than a resource that could help him learn math. As a result, what he was seen as being capable of ignored his totality, instead focusing on narrow areas of ability. These schooling practices subtracted skills from Antonio, a violent and painful process common to the Latin@ schooling experience (Valenzuela, 1999).

Antonio was ascribed an identity of failure and his language was used to mark him as deficient. He is one of many of my students who have experienced the marginalization of their language (and, subsequently, their selves) in math classrooms, constituting a racialized experience of schooling and of math. Students' language, culture, and subsequently, their selves are marked as out of place in math classrooms. Del Rosario Zavala (2014) found that the math identities that children are forming are inseparable from the impact of deficit views of Latin@ students and their linguistic identities (p. 78). Deficit views ensure that students are limited in the resources they can

access, and in their ability to belong fully in math classes. The impact of deficit views is the labeling of students who are able to display the limited characteristics associated with success as intelligent and students who are not as needing intervention.

But students are not one or the other—successful or failures, smart or dumb, good at math or bad at math. Their experiences in different environments will leave room for them to rewrite identities, to swing between persistence and hesitancy or to find new responses based on what it means for them to be learners in differing contexts. Antonio, and the way in which his math identity and practices have so sharply changed, suggest that this rewriting of identities is a powerful possibility in challenging narrow, deficit based views of Latin@ students.

Language and Math

While math is often characterized as a "universal language" leading to its usage as a vehicle for English as a Second Language instruction, (Gomez and Gomez, 2014), this tendency is counter to literature that argues in support of the important role that language and culture plays for bilingual Latin@ students learning math . Gutiérrez (2002) argues that the marginalization of bilingual Latin@ students' language leads to an identity that is marginalized within the context of math. This outsider identity, one of not belonging, ensures that students do not see themselves as capable participants in math communities.

Language plays a fundamental role in the construction of an identity as a successful mathematician, and must be considered as fundamental to the process of learning math. Research has shown the extent to which students are more comfortable solving problems, using advanced strategies to solve problems, and addressing questions

requiring their reflection on math if they can do so in their native language (Domínguez, 2011; Clarkson, 2006). In other words, bilingualism can serve as a resource for students as they engage in mathematical tasks or reflect on mathematical experiences (Domínguez, 2011; Turner, Dominguez, Maldonado, & Empson, 2011).

Allowing students to access all of their linguistic resources provides positive mathematical experiences and expands educators' views of bilingual students as mathematicians. Depending on the availability of bilingualism as a resource in the math classroom, students' math identities could show differences in feelings of belonging. If belonging matters to learning, then this possibility becomes a matter of equity and opportunity.

The Importance of Math Stories

> The stories students tell about who they are as mathematical people have roots in multiple contexts...and contain notions of deeply seeded attitudes students have towards themselves and how learning math works in general (Del Rosario Zavala, 2012, p. 61).

There is a documented relationship between students' math identities and their sense of belonging (or not) in math (Del Rosario Zavala, 2012; Boaler, Wiliam, & Zevenbergen, 2000). Because students are learning what it means for them to do math, their understandings of themselves as mathematicians will influence their feelings of belonging in math, and vice versa. However, much of the research on math identities has been conducted on older students. The way that these identities look in younger students and the extent to which math identities are in formation in earlier schooling years has not yet been addressed in research. Students' math identities-in-formation shape what they

see, what they aspire to, as well as how they are seen and how their potential is measured (Delgado, 1989, p. 2416).

Because each child's history is unique, children in the same class will form different stories about themselves in math. These stories are expressions of their math identities and can reveal how their interpretations of math experiences have shaped identities. It is my belief that listening to students' voices can "open windows into reality" by revealing what they have understood about math and themselves (Delgado, 2414).

In discussing the impact of testing on students' identities as learners in England, Reay and Wiliam (1999) pointed to the "silences in relation to children's perspectives," which they interpreted as a sign that the concerns, attitudes and subjectivities of children were not of significant concern to educators and policymakers (p. 344). They found that teachers' pedagogy was having significant impacts on how students described themselves, but that these stories were not being sought out to understand how changes to curriculum affected students. Of course, whether children's voices are not sought out because they are not considered important or because their interpretations are not seen as relevant, children are "simultaneously active in the assessment process and profoundly affected by it," (p. 345).

Despite the fact that this research was done in England in 1999, and showed the profound effect of pedagogy in shaping student beliefs about themselves, there still is little research that actually considers or seeks out student's stories. Because student voices are consistently marginalized, their math stories can serve as a powerful exposure

of what they have experienced in math classrooms. Without hearing these stories, we can only speculate about what students make of their experiences in our classroom. Their voices and the way they describe their math identities in formation constitute a truth around who they are and who they see themselves becoming within the context of math. Any attempt to understand students' math identities without hearing their stories would constitute an imposition of a label on them, rather than an examination of how they see themselves.

Particularly considering the contexts Latin@ students like Antonio are facing in schools, their stories have the potential to show how their experiences of schooling practices are impacting the math identities they are able to form. Latin@ students are subjected to subtractive processes and viewed through narrow lenses of achievement, which constitutes a racialized schooling experience (del Rosario Zavala, 2012, p. 56; Martin, 2006). In addition, because race for Latinos is often marked by language, language itself is racialized in school contexts. Students' stories can serve the purpose of describing these experiences and they are an avenue through which we can understand what these subtractive and marginalizing processes actually look and feel like for children.

Research Question

Realizing that my students were forming and had formed math identities in my classroom and had had significant experiences that could impact the formation of their math identities before coming to my classroom, I knew I had to seek out my students' stories. Hearing these experiences would allow me to hear their identities described in

their own voices. Furthermore, I wanted to understand how the student behaviors and practices I was seeing connected to how students saw themselves as mathematicians.

My research sets out to answer the following questions:

1) What are my students' math identities?

2) How do they enact these identities while solving problems?

3) What stories do they tell of their experiences in math? In particular, what classroom practices do they reference, and were they framed positively or negatively?

Chapter 2: Methodology

This research was conducted with my students. Participants consisted of 18 of my students who were labeled English Language Learners when they started in US schools[1] and had been in my classroom for two school years (with the exception of two students who joined us in fourth grade, Jose and Samantha). All 18 are Latin@ and of Mexican descent. All began school speaking Spanish, and some also came to school speaking English. The group is composed of 7 boys and 11 girls. Prior to being in my classroom, these students were in very traditional math classes in which all instruction was in English[2]. None had had math classes with Spanish speaking teachers.

This group of students were involved in a pilot of a new two-way dual language program that began when they were in first grade. Prior to this pilot, the school had operated an early-exit transitional bilingual program in which students were taught entirely in English beginning in the second grade. The shift to a new dual language program, in which much more Spanish instruction was expected, marked a significant change in the school's policy. Despite this major change, there was no change in teaching staff.

In this particular program, math had been designated the "English-medium" subject area (Gomez, Freeman & Freeman, 2005), with the expectation that there would also be grade-level appropriate Spanish instruction outside of math. Unfortunately, this

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[1] While this research will only look at the data from 18 students, all 20 students participated in all activities.

[2] When I refer to traditional math classrooms I am referring to classrooms in which instruction is teacher-directed, strategies for solving problems are provided by the teacher and extensive use of workbooks and practice sheets are used to enforce student implementation of teacher modeled skills. This is the style of math teaching common at my elementary school.

was not the case. Students' classes were English dominant and skewed towards meeting the needs of native-English speakers first.

When my students began 3rd grade, they were introduced to my style of math teaching. I would describe this teaching style as being based on the valuing of student thinking. In our classroom we co-construct mathematical knowledge by building on what students notice and understand about math. This teaching style is influenced by Cognitively Guided Instruction, which emphasizes the importance of understanding student thinking and using student thinking to drive math learning (Carpenter, Fennema, Franke, Levi, & Empson, 2015). Our math lessons are structured around problem solving, where students are invited to use their own thinking and ideas to guide the methods they use to solve problems. These ideas are then discussed and analyzed and used to structure math learning. Students are expected to participate, share ideas, and take risks based on their understanding of math ideas. Mistakes are seen as opportunities for understanding and I often find myself learning math from my students.

Additionally, I am a bilingual teacher and bilingualism is used as a resource for understanding math in our classroom. The first day my students were in my classroom, they were given a problem written in both English and Spanish and were encouraged to share thinking in whichever language they felt more able to express their ideas. This marked a significant pedagogical shift for students[3].

[3] During this time, six students were being pulled for special education services and were receiving traditional math instruction from special education teachers. I believe that because identities are formed based on the mathematical contexts students are in, this other math class impactes the identities the students formed.

Data Collection

I chose to begin by collecting my students' math stories (Drake, 2006). A math story elicits the experiences that an individual finds particularly formative in their mathematical life, and accesses the feelings and beliefs that are attached to those experiences. By collecting narratives, I hoped to find more reflection than what I might have received from a traditional interview.

Initial attempts to collect student memories of prior math experiences showed me that students were struggling to remember their prior experiences. I began by modifying a Math Stories Measure used on pre-service teachers by Drake (2006). I found that students had trouble recalling experiences and their answers were limited. They were uncomfortable answering questions in detail.

I began to rethink my ideas and decided to select only three of the major questions from the Math Stories measure (a positive experience, a negative experience and an imagined future with math). Before having them write these stories I invited the students to participate in an exercise of guided remembering. I had them think about each grade they had been in, beginning with their current grade, 4^{th} and moving backwards to Kindergarten. As we visited each grade level, students were instructed to write notes of what they remembered from each year. This constituted the first math story sample and is more macro in scope, with only some detail.

After the guided remembering, students wrote personal narratives describing both a positive and a negative memory involving math. They wrote each memory on separate

days during 30 minutes of class time. These narratives were collected as two more samples to add to each student's collective math story. The math story of each individual student was intended as a document of their developing math identity and the experiences that they identified as being salient in their experience of math.

After writing their memories, I asked them to imagine themselves in a middle school math class. Who was there, what were they doing, how did they feel about math and about themselves? These imagined futures gave me an idea of how they imagined their identities would play out in future math classes, once their current context changed.

Once the narratives had been collected and read over for salient experiences or major themes for each individual student, students engaged in one-on-one problem solving with me. These problem-solving sessions also served as an opportunity to engage them in conversations around the themes or memories in their math stories and to observe the way they would react to math problems. The problems given were ones which could challenge students, but which they should have felt comfortable solving. If the student became upset, I would stop videotaping and take notes to document their elaborated stories. Student reactions to mathematical problems were intended to show what their identities looked like in practice.

Data Analysis

Students' math stories were analyzed for major themes twice. The first time occurred prior to the videotaping and was intended to facilitate conversation and give context for how students might react to the problem solving activities. In the first reading, I was looking for general experiences in order to see what stood out as being important to

students. I hoped to think of questions to ask them, or to predict certain reactions or behaviors during the problem solving.

After video was collected, I analyzed their stories for a second time in order to locate common themes and emergent patterns. Themes were analyzed in order to see how they matched up with student reactions to the problem solving and to the conversations had with students around math. This analysis allowed for the patterns to emerge from the data itself, rather than the imposition of my own assumptions on to my students. I was not looking for specific themes, rather I wanted the students' voices to provide the directions for the analysis of findings.

Chapter 3: Findings

My students' stories revealed their beliefs about math, as well as factors that they believed impacted these beliefs and shaped who they were as mathematicians. Students told of memorable experiences, of changes in classroom practices, of frustrations and successes. In doing so, they told me a lot about themselves and what they value in math class and believe is valued in math class.

The beliefs about math that I found in student narratives aligned consistently with how students responded to solving math problems. Because I had set out to find my students' math identities and to understand how those identities are enacted, these connections showed me that I had gotten close to an understanding of the math identities my students had developed.

I also found, however, that certain themes emerged as particularly important in shaping students' beliefs about math because of their role in shaping student experiences. The availability of resources, the role of language, and support from family all came up throughout various narratives and interviews in ways that show that they play a role in how students have experienced math.

I begin my review of the findings by emphasizing the connection between beliefs about math and specific responses to engaging in problem solving. I will explain how students expressed these beliefs in their narratives, as well as how they enacted these beliefs while solving problems. Then I will move on to exploring the themes that have shaped student experiences of math—the availability of resources, the role of language and support from family.

The themes that emerged showed that students tended to view math as a site of powerlessness—it is either easy or hard, something you are either good at or not; or they viewed math as a site of powerfulness, requiring their effort, thoughtfulness, and practice. In addition, students pointed to the importance of having access to resources and to familial support networks.

Powerlessness in Math

Some students expressed ideas about math, and themselves as mathematicians that showed that they felt math was either easy or it was hard and that one is either good at math, or not. These students seemed to view their ability to understand math as something they could not change themselves. They did not see themselves as the agents who could alter or control their math experiences. In other words, if something seemed easy, they liked math and felt good because they felt they successful. If a concept was hard, they no longer liked math, felt successful or believed that they, as an individual, were capable of altering the situation of struggle. This shows an attitude in which the goal is not understanding, but rather being able to do things in the "right way" quickly. For these students, struggles required the intervention of an expert, and were not something they could address on their own.

Because of how these students viewed math, they also tended to be very concerned with correctness and teacher praise. This idea was expressed in narratives where positive memories of math were getting the answer right, receiving gold stars or good grades and making the teacher happy. For these students, adults' subjective measures of success are important, because they are how you know you have done

something correctly. This goes hand in hand with their certainty that teacher intervention that shows them how to solve a problem is necessary in order to solve something that they find difficult.

This concern with praise and insecurity showed up in negative memories as nervousness. In their narratives, the students expressed that they felt a lot of nervousness about both thinking through how to do something new and explaining their thinking. One student, Itzel, is particularly uncomfortable when she is trying something new. In her narrative she said that she is always scared to admit when she does not understand something, and that she feels angry with herself for not understanding. If anything, this shows the extent to which this belief about math is dangerous—when students are unsuccessful they see it as a reflection of themselves and their ability. What's worse, they look to the evaluation of an adult in order to see themselves as successful. For these students, success or failure are very emotional events that they use to construct identities of success or identities of failure.

When engaged in problem solving this identity showed itself readily. These students tended to be more unsure, more likely to guess, or have more hesitancy or negative behaviors when solving problems, even if they were more generally successful in math. When problem solving, Itzel was quick to change the decimal 0.1 to the fraction 1/10, because she knew what to do with 1/10. When asked to transfer that process to the decimal, she asked to be shown how, rather than trusting her own thinking.

Alexa and Jorge show how this identity looks in writing and in practice. These two students have different experiences. Jorge is generally a successful student, while

Alexa is labeled as having a learning disability in math. Despite the differences in how they have been labeled by teachers and schools, both of them show problematic beliefs about math and about themselves as mathematicians. They also show how these identities can be enacted in ways that significantly limit their understanding of math or future participation in higher levels of math.

Alexa

Alexa is a slight girl, with enormous eyes and a bright, gigantic smile. She is quiet in class, carefully observing everything that is going on. In her positive memory, Alexa[4] describes not knowing why "6 ÷ 36 = 6" was wrong. It is only after being given a multiplication table by her special education teacher that she finally understood that "36 × 6 = 6." She added that the teacher was happy with her for fixing her mistake. Unfortunately, her memory shows that she does not, in fact, understand what she was being shown and that the only outcome of the experience was her pleasing her teacher by getting an answer correct. It also points to her reliance on adult intervention that gives her a strategy to get an answer, rather than developing understanding.

In fact, most of Alexa's memories are focused on her teacher's personalities and appearances. Her description of 3rd grade says "me sentí feliz porque en matemáticas Ms. Adams me puso una A porque saque bien la multiplicación y me sentí inteligente y tuve una maestra tan buena y bonita. (*I felt happy because in math Ms. Adams gave me an A because I got the multiplication right and I felt smart and I had such a nice and pretty teacher*)." For Alexa, grades are placed on your work by a teacher and that determines

4 Alexa is pulled out for math support by the special education team for 2.5 hours a week.

how you can interpret your own intelligence. Each grade level memory includes a description of prizes and rewards, as well as physical descriptions of her different teachers. Her imagined future is predicated on math being very hard, her not understanding, but her having a nice teacher.

Reading Alexa's ideas about math showed me how much she based her ideas about herself on the successes others determined for her. Working with her on problem solving, I observed that she would quietly wait when asked questions, as if hoping eventually she would be told what to do or given a tool with which she could "sacar la respuesta (*find the answer*)" as she described doing with the multiplication table. It seems clear that her experiences with decontextualized tools and instruction to get answers without sense-making have left her unclear about math and about herself as a mathematician. So much so, in fact, that her math memories are memories of the personalities at the front of the room and not about math or herself.

Jorge

Jorge is my class clown. He has a winning smile and a quick wit. Charming and friendly, everyone loves Jorge. Jorge also typifies the idea that his math ability is fixed and teacher praise determines success in his imagined narrative of his math future in middle school.

> Salvador is gonna be next to me in middle school and I'm gonna like Algebra because I know algebra already because I learned it. I think I'm going to sit all the way back and me and Salvador are going to play with little kid toys and I'm gonna have good grades and I think the teacher is going to like me because I'm happy.

Jorge's math experiences have shown him that teachers like him because of his personality and that once he has learned something, it stays the way it has always been.

When problem solving with him, I found that he was only comfortable working on problems that were similar to work he had already done. In those situations he would reproduce strategies that had been successful for him in the past. Any attempt to push him to try something different was met with confusion. He believed that he had already figured out *the* way to do something, rather than seeing his strategy as *one* way to solve a problem. If he was presented with a problem that he was not comfortable with—one that he did not immediately know how to solve—he would guess repeatedly, without attempting to solve. He would quickly become frustrated when I asked him to explain his guesses or prodded him to think carefully.

Jorge's negative memory shows that he has a lot of nervousness when it comes to explaining his thinking and that he dislikes having to find ways to solve unfamiliar problems. He also restates ideas that demonstrate the extent to which he views math as static.

> No me gusta hacer problemas duros porque no sabes que hacer y unas veces no sabes multiplicaciones como 4×8 o 12×12 y tratas de encontrar manera pero no puedes y como explicarlo y diciéndole a la clase y te da mariposas en el estómago y esta duro porque unas veces se te atoran las palabras y eso me pasa a mí por eso no quiero decirle a la clase.
>
> *I don't like doing hard problems because you don't know what to do and sometimes you don't know multiplications like 4×8 or 12×12 and you try to find a way but you can't and like explaining it and telling the class and you get butterflies in your stomach and it's hard because sometimes the words get stuck in your throat and that happens to me and that's why I don't want to tell the class.*

For Jorge, not knowing a multiplication fact means not being able to solve the problem. You need to have it memorized in order to answer the question, otherwise there is no way of figuring it out. Moreover, having to talk about what you are thinking, especially when you lack confidence in your ideas causes nervousness and embarrassment—people will see you and determine that you are not able to do something. In the same way that not knowing the answer to a multiplication fact can stop you from solving a problem, being seen as not knowing how to solve a problem will label you with an unchanging mark of failure. Jorge expressed disliking math in 3rd grade because he did not know all of his multiplications. For him, that meant math had gotten hard and he no longer enjoyed it. He had enjoyed math in second grade because he felt it was easy, while in 3rd grade he got hard problems.

Interestingly, Jorge is a fairly successful student. Most adults foretell a bright future for him in school and he enjoys being in class. His math identity, however, may pose significant challenges for him as his classes become more challenging. If he cannot rely on himself, or trust in his ability to think through problems, he may limit himself from being more successful in math. He may come to see himself as not belonging in math, like many of the capable students profiled in Boaler, Wiliam and Zevenbergen's piece (2000).

Of the 18 students who participated in the study, 6 expressed similar ideas and sentiments to Alexa and Jorge in their narratives. Of those 6, 4 were pulled out of classroom instruction for special education services. One student who also receives special education pull-out, showed similar nervousness and hesitancy while problem

solving, but her narratives did not express the same beliefs about math or about herself. This student, Marisol, will be discussed in detail in the section on language. Another, Itzel, seems to have developed strategies to help her math identity through her use of familial support networks

Powerfulness in Math

As it turns out, Alexa and Jorge represent a smaller group of the students who participated in this study. While reading the narratives my students had written about their math experiences I came across several stories (written as responses to both the positive and the negative memory prompts) that followed a similar pattern. This pattern began with something in math being difficult to understand or figure out how to do, but through hard work and self-motivated determination success eventually came in the form of understanding. Their stories show that these students view themselves as agents who control their own fate—the hero in their story is not a smiling teacher or a gold star, it is them. If believing you control your own destiny ties into a productive form of hope, then this points to these student's belief in their own possibilities. (Duncan Andrade 2009).

These students had very different reactions in the face of difficulty. In many stories they would tell themselves "no te rindes (*don't give up*)," and pushed themselves to think through the problem. For them, the success came when they understood, not when they got a good grade or were told they were right. They wanted to feel that they knew what to do and that their hard work had led to something valuable.

It is important to note that these narratives were very much about achieving success in math. However, these students measured success on their own—they knew

they got the answer right or they finally understood how something in math worked. Not only were they the ones to determine whether or not they were successful, they were also the ones to push themselves to try and to find the way on their own.

For these students, their success is a matter of their effort and is always associated with understanding. Rosa, for example, says "I think I'm going to be good and bad in math. Mostly bad, but I'll have fun. Because I like math, but I get distracted." Rosa enjoys math and feels positive about her participation in math class, but sees potential for trouble based on her own efforts and actions.

Another major theme that emerged in these narratives was the idea that math is not static—something that is difficult can be understood and something that you learned can become difficult again. Often they remember learning something in one grade and then it being difficult in later grades. For example, they may remember learning how to multiply in third grade and then struggling with larger numbers in fourth grade. For these students, math is fluid, ever changing and providing opportunities for learning and growth. Jose, for example, wrote an imagined future filled with excitement saying he liked thinking about his math future because he knows he will always keep learning more and more. In contrast to Jorge who knows Algebra will be easy because he "already learned it," Jose sees the possibility for more unknowns in future math study.

Two students who display these attitudes both in their narratives and in their behaviors when engaging in problem solving are Ernesto, a stubborn boy with an almost magical way of thinking about numbers and Sonia, an artistic girl who believes in her own strength.

Ernesto

Ernesto has a fierce personality, and sees himself as a tough kid who can handle anything. For example, he wrote about not knowing how to solve a division problem, but continuing to read and reread the problem until an idea came to him. In this, his negative memory, he says:

> Yo nunca había hecho un problema del día tan difícil de división. Empezé a leerla y cada vez más se me hacía difícil. Luego lo fui entendiendo un poco mejor hasta que logré hacerlo
> *I had never had such a difficult problem of the day of division. I started to read and reread the problem and every time it just got harder. Then I started understanding it a bit better until I managed to do it*

Interestingly, both his negative and positive memories show his persistence in trying to understand a problem, as well as trying to explain his thinking to others in a way that they could comprehend.

When we worked together on problem solving, I chose problems intended to challenge him. On one problem, in which he had to subtract 0.1 from 7 inches, he refused to give up. Despite not knowing how to start and feeling frustrated, he would not allow me to try a different problem. In fact, he had me leave him to solve the problem on his own and called me over when he was certain he had been successful.

This was very much in keeping with Ernesto's stubborn nature. At the same time, his persistence is more than just stubbornness. It is Ernesto's beliefs about math and about himself as a mathematician that allow him to continue to try to solve a difficult

problem. For Ernesto, math is something you don't know until you figure it out. In his view, he has to push himself to make sure he figures it out himself.

In addition to motivating himself and figuring it out for himself, Ernesto evaluates his own success. He called me back to our problem solving session when he was sure he had been successful. All his struggle to success narratives end with self-determined success "supe que tenía la respuesta correcta *(I knew that I had the right answer)*" or with convincing other students of his success. At no point does he bring up teacher determined correctness or grades, rather his view of the teacher is as a poser of problems.

Sonia

Sonia enjoys that math offers her the opportunity to learn several ways of solving a problem. For her, this is encouraging and offers choices she can look to when a problem is difficult. For Sonia, math is constantly changing—some days algebra may seem easy, other days it will be difficult. She anticipates these changes and finds strategies to help her.

Her negative memory shows the extent to which she sees math as fluid and understands the need for persistence over time.

> Algo que me ha hecho sentir cosas negativas es cuando nos ponen trabajos difíciles que no entiendo. Cuando aprendí primero mis multiplicaciones fueron difíciles para mí porque no sabía como multiplicar. Solo me sabía la tabla del 1 y el 0 pero cuando fui más para el medio del año sabía más porque estábamos practicando. Pero lo que me sigue molestando es que no me acuerdo mucho sobre mis divisiones. Trato de acordarme pero no puedo. Pero lo voy a conseguir porque voy a tratar porque no me doy por vencida.
>
> *Something that has made me feel negative things is when they give us difficult tasks that I don't understand. When I first learned my multiplications they were hard for me because I didn't know how to multiply. I only knew my 1 and my 0 tables but by the middle of the year I knew more because I had been practicing.*

> *But what keeps bothering me is that I can't remember much about my divisions. I try to remember but I can't. But I will get it because I will try because I never give up.*

What she demonstrates here is an understanding that things that are difficult get better over time, like her multiplications. While she feels negatively when she does not understand, she has an awareness that not understanding is temporary. When she refers to "my divisions" she is talking about a strategy she showed the class. She worries about not remembering it well, but again knows this is temporary and that she will eventually get it because of her persistence. Sonia's explanations of her math work regularly include the phrase "I didn't give up," implying that part of how she sees herself as a mathematician is as someone who is always persistent.

This attitude held up during our time problem solving. She was comfortable and regularly began by drawing out what she saw happening in the problem, allowing her drawings to help connect quickly to numerical concepts. She was confident in expressing her ideas and attaching numbers to her strategies of partitioning. When she drew a situation in which 3/4 of a package of clay was given to eight people, she quickly wrote a number sentence showing that 3/4 eight times was equal to 24/4, or 6, and could explain the connection between her drawings and the numbers when questioned.

When Sonia imagines her future in math she sees:

> 2 niños que molestan. Se ríen de mi porque soy inteligente pero los ignore porque no entienden nada…tratan de hacer me bullying pero no pueden porque les pregunto preguntas de matemáticas.
> *2 boys bother me. They laugh at me because I am smart but I ignore them because they don't understand anything…they try to bully me but they can't because I ask them math questions.*

For Sonia, math is a potential tool for defense and empowerment. Sonia imagines that her persistence in math will lead to her success in her math classes. That may bring jealousy from others, but she will be confident and capable of standing up for herself.

While she has a level of comfort and confidence in math, math does not come easily to Sonia. She uses her persistence as a place from which to gain confidence. Sonia knows that even when something is difficult for her—she cites struggling with division—that she will eventually master it. She tells her positive memory story, in part, about having to struggle with divisions and then being able to teach her mother and older brother how to divide in a way they could all understand.

Other Students: Confidence Through Persistence

For Ernesto and Sonia, as well as the other 11 students who told stories of keeping at it when math was difficult, their persistence worked to build confidence. Jose, who had recently arrived from Mexico, talked of having to understand how to work with the customary system, but being able to understand it because of his efforts.

When we sat down to problem-solve together I asked him how he was feeling. "Emocionado (*excited*)," he replied. When I asked why, he said, "si estamos resolviendo problemas significa que voy a aprender algo (*If we're solving problems that means I am going to learn something*)." Not surprisingly, he was very thoughtful and motivated while solving problems, even when I tried out difficult combinations of numbers.

Antonio, the student whose remarkable change sparked this study says that he will be successful in future math classes because he knows "I can solve all the problems. It just might take me longer than the other kids." He knows that his mathematical ability is

dependent on his effort and does not allow himself to be discouraged by working at a different pace or thinking in different ways. He writes, "sometimes I confuse multiplication and division, but then I use it to help me." This flexibility—making use of mistakes—comes from a confidence in himself as a mathematician. When we worked on problems, he was quick to access materials, think through strategies, use mental math to solve problems and readily explained his ideas.

Both Jose and Antonio show that persistence has allowed them to develop confidence in themselves as mathematicians. They also are examples of students who embrace the uncertainty in problem solving and in math as opportunities to learn or think things through.

Powerful Students Made Powerless

Students who have developed positive math identities show resilience and thoughtfulness when problem solving. Their beliefs about themselves as mathematicians show that they may be willing to push themselves to higher levels of math. So it is important to note that several of them referred to negative feelings about many of the features of traditional math classrooms. These problematic practices could stymie the paths of these students.

For example, Luisita wrote about how "antes detestaba matemáticas (*I used to detest math*)" because of worksheets filled with problems to fill out, but not to think about. Sonia, also mentioned that in second grade she felt she needed a lot of help because "solo teniamos libros de problemas para resolver (*we only had these books of problems to solve*)."

For Antonio, timed testing was a major complaint. “Time isn’t fair,” he said. Considering that for him time came up as a necessity for thinking about and solving problems, having a page full of problems to do in a short period of time causes him to feel destined to fail. At the same time, he is not able to be thoughtful or persistent when the goal is to complete a task as fast as possible.

Finally, standardized testing was a big complaint from several students. They reported that the STAAR[5] test, which requires students to answer over 50 questions (including field questions) in four hours was tedious and stressful. Salvador noted that he liked the problems in class and everything we learned, but that he hated taking tests. Sonia imagined a positive future where she knew a lot of math, but the teacher was nice and never gave us “los exámenes (*the tests*).” Jose’s negative memory was also around testing—he felt like not knowing the vocabulary used in the test caused him to be held back a grade. For many students who view themselves as successful in the math classroom, standardized testing, which has been shown to be culturally biased, often challenges their positive identities (Valencia, 2012).

That these students identified specific practices that they felt undermined their positive identities points to areas for reform in all classrooms. If students who have positive identities about math and about themselves as mathematicians can cite areas that created negative feelings towards math, then the use of these practices needs to be challenged.

Resources to Build Positive Math Identities

[5] State of Texas Assessment of Academic Readiness is Texas’s high stakes standardized test. The Mathematics version is administered to all students from 3rd to 8th grade.

Collaboration

Many of my students cited the resources that they felt made for a more effective math class for them. Regardless as to whether they viewed math as something they had the power to understand on their own or not, many pointed to the importance of collaboration as a resource for learning. Jenny wrote about how a positive future class would include all students working "together like a community," in which members were all "respectful, empathetic and smart, having lots of ideas and strategies to share." For her, the experience of working together in math class has meant that more learning has occurred. Furthermore, the establishment of collective math knowledge allows everyone to access the thinking that students use and create positive relationships.

Ernesto's positive memory was about a time he was able to help another student whom he perceived as being very smart and having classmates with whom he could debate the answers. He recalled having shown me his answer at the same time as another student, Josefina, and my having them discuss their different answers to see who was right. He talked about trying to help her see his ideas and how the participation of another student, Eric, helped convince Josefina that Ernesto was right. "Me hizo un poco feliz, porque yo nunca habia ayudado a Josefina (*It made me kind of happy because I had never helped Josefina before).*" For Ernesto, Josefina was a smart and successful student, and the experience of helping her made him feel very proud. The opportunity to collaborate with Josefina meant that he felt responsible for her understanding and also felt successful on different levels.

Leo, who felt math was very difficult for him, had positive memories around working with others. He discussed how he felt good when peers would explain and he could understand. "Estoy hacienda lo mejor que puedo cuando pido ayuda. Cuando hago el trabajo me siento nervioso, pero cuando estoy trabajando con alguien me siento mejor porque me están ayudando y explicando (*I am doing the best I can when I ask for help. When I do the work I feel nervous, but when I work with someone else I feel better because they are helping me and explaining).*" For Leo, collaboration is key to lessening his nervousness and helping to build confidence. The support of a classmate helps him feel like he is more likely to learn. Interestingly, despite having a relatively negative math identity, he did not feel the need to rely on teachers. Instead, he looked to his peers as sources of knowledge and support.

Hearing the importance of collaborating was very heartening because I can remember how reluctant students were to speak when they came to my 3rd grade class. Many of them were unaccustomed to speaking in math class (because of language alienation and also because student discussions were not a learning strategy that was employed in previous classrooms) and resisted speaking or listening to each other. Seeing that they had adopted much more positive attitudes towards collaboration and listening to each other as sources of knowledge showed that this practice was effective in the eyes of my students.

Manipulatives

Sonia's 3rd grade memory states, "me acuerdo que me dejaban usar materiales *(I remember when they let me use materials)"* in math class. For her this is a salient

memory because, after a workbook she needed help with, she was able to make sense of math using manipulatives. Sonia mentions that she likes the ability to use multiple strategies, including manipulatives, even when she has the answer. Samantha was another student who made repeated references to enjoying being able to use cubes to see the problem. That these are still not standard practice is a concern, but it is clear that students appreciate the opportunity to use manipulatives.

Manipulatives are interesting to see in student narratives, in part because the use of manipulatives was something my kids learned to do in 3rd grade. It was only when they were struggling with problems that had been posed that they looked to concrete representations in order to think through possible solutions. While manipulatives are often made available, it is when students see their usefulness that they truly become resources for learning and understanding.

Manipulatives also contributed to the classroom's collaborative environment. Students would see how others used manipulatives and intuit numerical concepts or mimic strategies. They played a fundamental role in getting students to see each other as resources for learning.

Language

All students in the study are bilingual to some extent—expressing themselves and reading the world in English and Spanish. Prior to 3rd grade (and in some cases 4th grade) this bilingualism was an absent resource in students' math classes. In fact, their ability to use their bilingualism was inhibited. This is because the school district had adopted a dual-language program that required that math be taught only in English. As a result,

math classes were taught by mono-lingual teachers who could not communicate in or understand Spanish. If students wanted to ask questions, share ideas or seek clarification, they could only do so in English.

For some students language was a primary reason for their being held back a grade. Out of the 18 students in my class labeled English Language Learners, six had been forced to repeat a grade. In other words one-third of the class had been labeled as failures due in large part to their being Spanish speakers. Another three[6] had been placed, meaning that they could have been sent back to second grade after the first six weeks of third grade. Antonio repeated 3rd grade in large part because he was seen as not having enough English to be a fourth grader (despite qualifying for bilingual education services). Ernesto was sent back to second grade for the same reason. While he was my student I nominated him for the gifted and talented program. He ended up being identified as gifted in all subject areas. Jose had arrived from Mexico when my students were in third grade and joined our school's fourth grade class. His teacher had him repeat fourth grade because she wanted him to join our bilingual program. She did not feel he would be successful in fifth grade, where everything was done in English, and where the instructor was not a bilingual teacher. Teachers had, at other points, also tried to hold back Jorge, Rosa, and Sonia.

Three students, Leo, Alicia, and Marisol were held back and also placed in special education in part because of their linguistic skills. Because of this, while they were in my

[6] Jorge, Sonia and Rosa

math class they were also pulled out and given traditional math instruction in English only. Of the three students, Marisol's story stands out.

Marisol Marisol is a very bright girl, who wavers between disengagement and excitement in math. Her narratives told the struggle to success story beautifully. Her positive memory was of working so hard in her Kindergarten math class that "mi cabeza se me calentó tanto que se me quemaba (my head heated up so much it felt like it was burning)." She wrote of working at home with her family and of her persistence in learning. Her story seemed to describe a positive math identity.

When I sat down to problem solve with her, however, I saw the same behaviors that had come to typify her as a math student. We read the problems and she would stare at me. I'd ask her questions and she would, very reluctantly, take one step towards solving the problem. She'd then look at me again, clearly checking with me to see if she was correct and could continue. I knew that she knew what she was doing, so her hesitancy concerned me. By the time we had completed two problems, I knew I had to talk to her about this. She seemed very uncomfortable, so I stopped the camera and took field notes. My notes read:

> Stopped camera and asked her why she was so uncomfortable when she could do everything in the problems. Her eyes are welling up with tears. I said, "Does anyone make you think you can't do everything?" She is crying and says "My brother. He says I'm retarded *porque reprobé* (because I failed) second grade and that was the easiest grade." I asked her "What language did they do second grade in?" and she replied "English *y yo*…I couldn't do it."

Marisol was at a different school in second grade, one in which all students are pushed to English as early as possible. I knew that she had been retained and identified in order for

the school to remove her. Because her former school does not have a bilingual special education teacher, they can send any bilingual students they identify as requiring special education services to our school. In this sense, they can remove any students who they do not feel are making language gains at their required pace. It is clear that Marisol was labeled and marginalized as a result of her linguistic identity and that this has caused her to enact this label in math, even when she is a successful math learner and thinker.

Sonia I had wondered if any students would raise the issue of the language shift between second and third grade. For Sonia, this was a very salient experience that seemed to mark a positive shift in her math experiences. Her guided remembering shows that what she remembered from 2nd grade was needing help every day in math class to do the workbooks they had. Her main memory from third grade stated, "Me fascino que habían puesto el problema del día en español en vez de puro inglés. (I loved that they had put the problem of the day in Spanish instead of just pure English)." For her positive memory she wrote about third and fourth grade.

> Me gusto las matemáticas en español porque antes en puro ingles no le entendía mucho. Me gusto también que hicieron matemáticas en español y enseñan otras maneras de hacer le matemáticas. Se me hizo más fácil sacar una respuesta y me gustó porque me la explico mejor.
>
> I liked having math in Spanish because before when it was pure English I couldn't understand it much. I also liked having math in Spanish and showing different ways of doing math. It made it easier for me to get an answer and I liked it because I could explain it to myself better.

What Sonia is telling us is that for her, Spanish was part of having more strategies to solve problems and engage in math. She is showing us the extent to which language is

mathematical resource that allows students to feel more confident and access greater understanding of the content.

The Role of Family in Math

One interesting finding that I had not expected to see was the extent to which math identities were also written in the home. In other words, student's math stories showed that their experiences in the home have much to do with how they view math and themselves as thinkers and doers of math.

Itzel, who is a very successful student, tends to be very nervous in class and focuses on grades and correctness. For her, math is static and one is either right or wrong. Her narratives, however, largely took place at home. She shows how family can cause struggles with math in the form of distractions but also how their support is crucial to being a good student.

While most students mention learning skills like how to multiply and divide at school, Itzel cites her space of learning as the home. Perhaps because of her nervousness about correctness, the home provides her with a safe space in which grades and subjective evaluations of skill are not present. She writes:

> Una memoria que me hizo muy feliz era cuando aprendí a multiplicar. Yo estaba en mi casa, me recuerdo que eran las 6:30 pm y mi hermana me estaba dando una clase. Cuando me dio un examen vino una pregunta de multiplicación. Todavía me recuerdo de que se trataba…cuando se lo entregue a mi hermana dijo "Mira Itzel, tu hiciste multiplicaciones."
>
> *One memory that made me very happy was when I learned to multiply. I was in my house, I remember it was 6:30 pm and my sister was giving me a lesson. When she gave me a test there was a multiplication question. I can still remember what it was about…when I gave my sister the test she said, "Look Itzel, you did multiplication."*

Even though grades are very important to Itzel, the opportunity to practice schooling settings in the home with her sister allows Itzel space to feel successful and to take risks. It is good to know that she has these spaces to create a more positive math identity, but it also leads to questions as to how to recreate this environment in the classroom.

Like Itzel, Salvador and Luisita also find support and spaces for learning in the home. Salvador told a negative memory story of not knowing what to do to solve a problem of the day and feeling very angry. That day when he got home he practiced. "When my mom got home, I told her the problem of the day was hard so she said that doesn't mean you're dumb and she said better luck next day. And the next day I did get my answer quick." When Salvador is frustrated with himself for not understanding a problem, his mom is there to encourage him. In problem solving settings, Salvador always seeks the fastest way to an answer—he is very fond of mental strategies. In fact he did all our problems in his head, correcting himself quickly.

Luisita, likewise, uses family to support her when math is difficult. She begins her positive memory by stating, "el día más feliz de mi vida fue con mi familia (the happiest day in her life was with my family)." She tells a story of having to do math work at home that is very difficult for her.

> Mi papá, mi mamá, mis hermanos me ayudaron…era difícil pero lo resolví con mi familia. Desde ese momento me sentí con un alivio y tomé las matemáticas. Desde ese día me gustaba cuando me daban tareas de matemáticas.
>
> *My dad, my mom, my brothers and sisters helped me…it was hard but I solved it with my family. From that moment, I felt a relief and I took the math. From that day I liked when I had math homework.*

For Luisita, the ability to rely on her family's collective support implied that any difficult task was possible because of her family's support. Interestingly, even at school while problem solving, Luisita always carried an attitude of being capable of solving any problem. She always looked forward to problem solving and expressing her ideas about numbers. What her story shows is that the support from her family allowed her to persist and continue to enjoy math.

Chapter 4: Discussion and Conclusion

I decided to have my students tell their math stories as a way of helping me to understand their math identities. I wanted to listen to their descriptions of their experiences. Student voices are routinely marginalized in both research and professional circles and students' descriptions of their experiences in math class are not used to understand the work they do and behaviors they display in math class. In the era of standardized testing, it can seem as if the only data accepted on students is scores on standardized tests, which have been shown to fail when it comes to measuring the skills of English language learners (Valenzuela, 2005; Menken 2008). This, of course, leads to narrow views of bilingual students as deficient math learners (Gutiérrez, 2008, 360-361). As an educator I believe it is crucial that we understand students from a more humanizing perspective, and in that sense I feel that my research might provide a more holistic view of my students, one that they deserved.

I encourage all math teachers to gather their student's math stories. These stories can reveal which experiences students see as key in defining who they are in relation to math. For Marisol, it was her brother's teasing of her when she was retained. For Sonia, it was gaining access to problems written in Spanish. For Luisita, it was finally having an end to workbooks.

Math stories can help educators learn how their students view math and what they believe about math as a practice. Whether they see math as static, fluid, or something completely different, these views shape the way they approach math class. In fact, they also clearly shape how they see themselves in relation to math. Leo only believes he can

be successful if a friend shows him how to solve a problem, while Antonio believes anything is possible, given enough time. Collecting and reflecting on students' math stories can contextualize what we see them do in class and helps us to really consider who our students are and the forces that shape these identities.

Dismantling Destructive Practices

Antonio's early schooling experiences did not allow him access to all his resources, and did not frame him as a successful student. The emphasis on what he could not (yet) do did not allow for additive practices that would have built on what he could do. He was either smart or not, based on his success taking standardized math tests in English. I was encouraged to submit him for special education testing multiple times, despite the marked academic progress he made from year to year. Even in research contexts, the focus of studies on Latin@ students is typically on narrow notions of achievement rather than on broader math literacies, academic identities, or their interpretation of their experiences and how those produce success and failure, persistence and hesitancy, and so on, (Gutiérrez, 2008, 360).

What students' math stories showed, however, was a much fuller picture of who they saw themselves to be in math, and what they believed about math. Understanding these identities and beliefs is key to educating students in a way that orients them towards success in math. Their stories tell us who they are in math, what they believe about math, and what they see themselves as capable of doing in math. They also show the experiences in math classes that shape those beliefs, pointing towards reforms that would help improve the success of Latin@ students.

Math stories provide us with evidence that can help to challenge forces that have excluded students or fostered negative identities. Students' voices, so often ignored or simply unheard, reveal how institutional practices can harm or heal students. Those institutional practices (such as standardized testing or monolingual environments) that hurt and marginalize students need to be challenged. Using students' own words and stories to challenge these practices would be a powerful action. As Delgado (1989) tell us, "stories can shatter complacency and challenge the status quo, (p.2414)."

Language: Inclusion and Exclusion

When my class first began students were not accustomed to speaking up in math class, and it was only over time that they began voicing their ideas. Like Antonio, they were reluctant to discuss their ideas or share their thinking. I attribute much of their silence to having experienced traditional classes in which their language was not used as a resource. It is obvious that access to their language was important for my students. In fact, we can see their bilingual approaches to math reflected in the writing of their math stories. Most students wrote either in Spanish, or in both languages, reflecting that language is very much a part of their math identities. What this suggests is that any limitation on students' linguistic identities necessarily limits the extent to which they can develop or express positive math identities. If they feel part of themselves is not welcome in math class, how can they develop an identity of belonging in math?

Based on the experiences of being labeled as failures and having to repeat grades or be threatened with the possibility of repeating a grade, my students did not believe that they were successful or smart at math. These negative labels and low expectations of

students, ascribed to them simply because of their linguistic and cultural identities, have power in shaping how they see themselves. Dismantling these systems are key to any attempts to create positive math identities, or positive identities in general.

In my math class, I had instituted a bilingual math program in which students could make use of their full set of linguistic resources while learning math. Students could solve problems in their own ways, discuss their ideas, question concepts and access problems in both languages. I worked to create a collaborative environment, where students could support and learn from each other. I wanted them to trust in and express their thinking and ideas. My hope was to create agency in the math class, and help them unlearn the belief that knowledge only existed in the teacher.

Rewriting Math Identities

Since reviewing and pondering my student's math stories, I keep thinking about Alexa, Jorge and the other students who have developed math identities that limit their own agency and mathematical power. Despite similar experiences to Antonio, they did not reformulate their identities in similar ways. Because they remained my students in the year following this research, I took the opportunity to begin to question these identities and choose strategic moments to point out when they were able to do something on their own and when they found success in an area that they had struggled in.

I also questioned how providing grades or feedback could feed some of their nervousness and insecurity. How can math educators assess in ways that promote the construction of positive identities? It is interesting that those students with negative math identities were also very aware of the moments of praise that they received. In particular

because this praise did not seem to have positive effects or lead to their feeling more capable or having deeper understandings.

Students must be provided the opportunities to formulate positive math identities through positive experiences that allow them to determine their own success. Alexa and Jorge required acknowledgment of success from teachers, and viewed success in terms of grades or teacher designated correctness. On the other hand, students who had formulated more positive math identities determined their own success when they reached an understanding of a mathematical concept. It is worthwhile to consider what sorts of practices could foster this self-motivation and self-congratulation. Ideally, our classrooms will provide students with the opportunity to become agents in their own learning as opposed to passive recipients (or not) of learning (Turner, Dominguez, Maldonado, & Empson, 2011).

Family and Classroom Support Networks: Sites of Shared Learning

I think that there is a deep connection between student's identification of classroom collaboration and family support as being key parts of their math stories. Cammarota (2008) found in his ethnography of Latin@ youth, that respect and reciprocity are fundamental to Latin@ family relationships (p. 130). Schools, which tend to place the focus on individual success or failure, often fail to provide respectful and reciprocal spaces of learning. This is not only culturally irrelevant, but in contexts where language and culture are already excluded, serves to further alienate and marginalize Latin@ youth.

The fact that many students cited family support networks and the sharing of learning among family members (even students teaching parents skills learned at school) as well as the importance of in class collaboration, helps to prove this notion that respect and reciprocity are fundamental to creating positive learning spaces for Latin@ students. Jenny even used the words "respectful" and "empathetic" to describe an ideal community of learners.

Cammarota (2008) tells us that "a school environment that countervails respect and reciprocity between teachers and students removes any foundation on which Latin@ youth might form positive educational relationships (p.130)." What this tells us is that teachers also have to be members of the community of learners, gaining knowledge from students and sharing opportunities to learn. Teachers must respect the ideas and identities that students bring with them, and situate themselves in positions where they make clear how much they stand to gain from knowing and valuing their students.

At the same time, we can recreate aspects of familial support networks in the classroom. Itzel shows us that classroom spaces should remove some of the evaluative aspects that create nervousness, instead encouraging students to take risks, trust their thinking and push themselves mathematically. Salvador points to the importance of relationships and encouragement. Luisita's story shows us that creating a community of support that allows students to believe that everyone is capable of solving any mathematical task.

By creating respectful and reciprocal classroom relationships, in which collective support is a resource for encouraging thinking and persistence, students may feel more

comfortable in the classroom. Comfort could help alleviate the nervousness some students cite, while also countering past experiences of marginalization.

Chapter 5: Conclusion

This research began with my questions around the changes that I observed in Antonio. The positive shift in his attitude and the improvement in his math work got me thinking about how all students see themselves in relation to math. I wondered if there was something that I had overlooked, as Delgado (1989) put it. What I found was that there was so much that I had not yet seen, even in a student-centered classroom where student voices were valued. I was listening to their ideas, but I had not yet truly listened to their stories. Delgado describes the revelatory power of story as akin to wiping the lenses of your glasses and suddenly seeing clearly. He is right, listening to students' stories helped me to see who they really were in math class. Seeing them allowed me to address them as individuals and improve our classroom relationships. Students are constantly (re)writing who they are based on their experiences, but by listening to these stories, we teachers have the opportunity to help them write a positive self and to challenge those practices that we know have been destructive.

Appendix A: Amended Math Stories Measure

1) **Guided Remembering:** Beginning with this year, 4th grade, think back on each year of school and what you remember about your math classes. Write short notes of what you most remember from each year, going back until your earliest year in school.

2) **Positive Memory**: Think about a favorite moment you had with math. What made it such a nice memory? Who was there? What were you doing? How did you feel? What were you thinking?

3) **Negative Memory:** Think about a least favorite moment that you had with math. What made it such a bad memory? Who was there? What were you doing? How did you feel? What were you thinking?

4) **Possible Future:** Imagine you are in your middle school math class. Who is there? What are you doing? How do you feel about your math class? What are you thinking when you are there?

Appendix B: Sample Problems Used in One on One Problem Solving

1. Mrs. Wurtzel está preparando un proyecto de arte. Ella necesita darles (2 1/3) paquetes de plastilina a cada grupo. ¿Si hay (3) grupos, cuántos paquetes de plastilina necesita para la clase entera?

   Mrs. Wurtzel is preparing an art project. She needs to give each group (2 1/3, 3 2/8) packages of clay. If there are (3, 4) groups, how many packages of clay will she need for the whole class?

2. ¿Si tienes (4, 10, 2.5) libras de M & Ms, y quieres regalarles (0.25, 1/2, 0.1) libra a cada uno de tus amigos, a cuántos amigos pueden tener M & Ms?

   If you have (4, 10, 2.5) pounds of M & Ms and you want to give (0.25, 1/2, 0.1) pound to each of your friends, how many friends can you give M & Ms to?

3. Una clase de cuarto grado necesita (2.5, 5, 6) hojas cada día en orden de alimentar a sus (2, 3, 9) orugas. ¿Cuántas hojas necesitarían para (10, 12, 15) orugas?

   A fourth grade class needs (2.5, 5, 6) leaves each day to feed their (2, 3, 9) caterpillars. How many leaves would they need for (10, 12, 15) caterpillars?

4. Lupita tiene (4, 5 ¼, 8) pulgadas de cinta. ¿Si ella usa (1/2, 3/4, 1/9) pulgadas, cuántas pulgadas de cinta le quedarán?

Lupita has (4, 5 ¼, 8) inches of ribbon. If she uses (1/2, 3/4, 1/9) inches, how many inches of ribbon will she have left?

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