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LEARNING MATH WITH MY FATHER: A MEMOIR

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Abstract

If he is indeed wise he does not bid you enter the house of his wisdom, but rather leads you to the threshold of your own mind. –Kahlil Gibran

We all build our own houses of wisdom, each of us; we cannot build them for each other. Teachers cannot simply invite students into their "houses of wisdom," but can often find ways to help learners to enter and explore their own minds.

While Constructivism has had a positive impact on the teaching and learning of literacy mathematics instruction continues to rely heavily on rote memorization and drills.

As a young child, I learned to love math. My love of math stems from learning math with my father. He did not focus on rote memorization and drills. The primary emphasis was for a real purpose. My self-confidence was enforced when he started me out with problems that were less difficult and had many different solutions. These solutions were valued and respected, which allowed me to trust in my own problem solving abilities.

How can we hope to lead children to the thresholds of their own minds when we remain intent on forcing them into our 'houses of wisdom'? What alternative ways can we devise of interacting with children that respect their confidence and leave intact their

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Learning Math with My Father: A Memoir

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We all build our own houses of wisdom, each of us; we cannot build them for each other. Teachers cannot simply invite students into their "houses of wisdom," but can often find ways to help learners to enter and explore their own minds. The use of "construction" as a metaphor for learning underlies the Constructivist framework, widely used in education theory and practice influenced by Dewey, Piaget, Vygotsky and Bruner, and promotes student involvement in understanding *processes*. For example, the National Council of Teachers of English (NCTE) Standards include the following: "Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts" (from Standard 3) and "Students adjust their use of spoken, written, and visual language" (from Standard 4), suggesting that literacy involves a range of strategies and that language use is to be adjusted, i.e., is variable depending on mode, audience, and/or context.

While Constructivism has had a positive impact on the teaching and learning of literacy (Au, 1998; Dyson, 1993), mathematics instruction continues to rely heavily on rote memorization and drills. Literacy instruction has shifted over the past few decades

to a greater focus on *process* rather than only on *product*; while math instruction gives lip service to "how you got the answer," of primary concern is the product - getting the right answer "in the right way," i.e., by following the formula being taught. Draper (2002) points out that while the National Council of Teachers of Mathematics (NCTM) provides content standards, "…the authors of the Principles & Standards offer few suggestions on how teachers can help their students negotiate mathematics texts to create understanding." A growing literature seeks to clarify the causes of math anxiety, especially the connection between teachers whose math anxieties may spread to their young students (Ashcraft, 2002; Hembree, 1999; Kelly & Tomhave, 1985; Rayner, Pitsolantis & Osana, 2009).

Thinking of learning as the construction of a building is a useful ontological tool. It can also be useful to think of learning as a growing plant, with roots and stem and branches growing strong under nurturing conditions; at the same time, a plant is also constructing itself, complete with its own DNA blueprints. As learners, we can think of ourselves as having unseen roots linked to our understandings of concepts that are not visible or apparent to others, and often not even to ourselves. These root experiences, if allowed to be reflected upon and shared, can reveal a personal source of growth and understanding that can help us overcome obstacles that prevent us from learning new concepts successfully.

As a professor of math education for the past 25 years, I have helped many teachers overcome their own math anxieties, anxieties whose roots reach far down into childhood and early school experiences. I have witnessed, time and again, how the roots

of math trauma can be uncovered, and the trauma and anxieties overcome, by inviting adults to share their stories, to reflect on their own roots, and to begin to heal themselves.

What happens in childhood that causes so much anxiety over math, and the condition of "math phobia" in so many adults? Math phobia, such intense discomfort with math that one's ability to perform math calculations is severely inhibited, has been estimated to affect 85% of American adults, (which, of course, immediately brings to mind the idea that what we are doing is very wrong!), from all socioeconomic strata of our society. Math is taught through all the years of compulsory education, yet leaves most adults more fearful of math than confident in math practice. In school, girls are more often ridiculed for making math mistakes and are discouraged from pursuing math study (Jackson & Leffingwell, 1999). Indeed, women tend to admit to higher levels of math anxiety than men, despite the fact that their actual math performance shows no difference from men's (Hembree, 1990). How is it that I, a young, Spanish-speaking girl growing up in a poor barrio in southern California, developed such confidence in and love of math that I pursued the study of math into and beyond the PhD level, and became a math education professor?

Here is the story of my roots, and the roots of my lifelong love of math. I am the sixth of nine children. Although my father did not attain a high level of education, he was a man who knew what it took to get ahead in American society. Born in Mexico and moving to the United States at the age of 24, he understood that hard work could only take him so far. He supplemented his weekly income with his own weekend gardening service for a regular clientele. The work team consisted of my father, my six brothers, and myself. My two sisters chose to stay at home with our mother. One of our weekly

customers was a medical doctor, who became a family friend, delivering the last five of my parents' babies in home births. This family friend offered us math-tutoring services, which my father recognized as important for the future wage earners, my brothers. As I was a girl, my receiving math tutoring seemed less critical to my father, but I begged to participate, and was allowed to join in.

These sessions ranged over a period of years, and included basic math to algebra concepts. We all become successful in mathematics because it demystified difficult concepts and created a love and a challenge that opened a gateway of options as we grew. I believe that these sessions transformed our lives by offering us a light of worlds possible through this new knowledge.

Although my father was not as informed in math concepts as we were becoming, I learned a lot from observing his use of mathematics. His tools were not those we had been taught to use, but the results were just as effective as ours. For example, he used simple addition to measure the amount of time it would take all of us to complete different kinds of jobs. Once when I was still very young, I remember one of my older brothers using algebra to get the same results as my father did using repeated addition. I created drawings to represent the length and width of both front and back yards, then multiplied the length times the width to calculate the total area of the job.

My father checked his results with mine to see if his were correct. Next, my older brother would confirm our results with his algebra calculations. Most of the time they were pretty close. My father often relied on my drawings to confirm his calculations since he was able to understand my outcomes and sometimes he corrected my errors. Once I was way off in my calculations and my older brother number two accused me of being a

mensa (dummy, in Spanish), because I had made a multiplication error. My brother showed me his calculations using algebra to prove his results were the correct ones. This work was unknown to me therefore useless to help understand and resolve my errors. My father showed me how to correct my errors using his technique, repeated addition, to recheck my results. I tried both ways, using multiplication and addition and came up with the same answer as my brother.

As we gained more math understandings through these math-tutoring sessions, I never forgot how my father, who was more limited in math than my brothers, was able to help me learn from my mistakes more effectively. He helped make my understanding clearer and he never criticized me for not getting the correct answer. He allowed me to use my creative yet underdeveloped methods to figure out the area of our workspaces. I ended up being just as successful with math as my older brothers, whose math understanding was much more advanced than mine at the time, but this is only because of cognitive development due to age.

My father's reassurance prevented me from feeling like I was incapable of contributing to the math required to calculate the area of our gardening jobs. I felt like an equal contributor even though I did not possess the advanced math skills of my older brothers. It also afforded me the ability to teach my two younger brothers basic math skills when they began helping with the family business. I used my drawing examples to help them perform their calculations.

There are many methods to teach mathematics successfully, but unfortunately, many math courses do not enable students to learn by a variety of methods. As I continued gaining math knowledge I was increasingly struck by the teaching methods

employed by most of my math teachers at school. Their teaching techniques were more similar to those of my older brothers than to the practices of my father. From middle school to university math courses, I recall how many of my peers shared feelings of incompetence in math, due to in their continued failure to catch up. They talked about feeling like *mensos* (dummies), as they fell more and more behind. The majority of these instructors had their backs to the students as they scribbled math formulas and solutions on the blackboard, offering little or no explanation. It was accepted by everyone that you either have a math mind or you don't. Those who were convinced they lacked a math mind made sure to choose career paths that did not require higher math courses. Instructors were never challenged to explain their processes or to find a different way of explaining the process or helping students manipulate objects, make drawing or do whatever helped so that everyone could understand.

In graduate school, I was a member of several tutoring groups that helped those who needed to pass higher-level math courses. What was striking to me was the number of students who never asked their instructors to explain a process differently. A different explanation can often help strengthen a struggling student's understanding, instead of merely confirming their failure to complete higher math courses due to personal math deficiencies.

As a math educator, I have repeatedly seen confirmation of what I learned long ago from my father. There are many pathways to solving math problems, just as my father employed arithmetic, rather than algebra, to obtain an answer, and was entirely comfortable and confident of his solutions. I am certain that if instead of being allowed to think through and solve problems in a way that made sense to him, my father had been

repeatedly told that his way was ineffective or insufficient, he would have lost confidence in his own thinking and become less competent in solving math problems. I have observed many, many students, children and adults alike, struggling to understand math after years of being pushed to solve ever more complicated problems via formulas and processes they never quite grasped. Rarely do these struggling students continue studying higher math for a moment longer than is required of them.

My twenty-five years as a math educator have convinced me that year after year of feeling like *mensos*, prevents students from experiencing authentic learning. In the math courses that I teach to adults who want to work with children but have been traumatized by their math learning experiences, I require students to write about their roots, to explore why they have failed previous math courses. These short essays often bring up stories and feelings that the students themselves had avoided recognizing, feelings that had not previously been visible or apparent to the students themselves. As they share their feelings and experiences with me and with each other, students are often able to tap into a personal source of clarity and strength that leads to their increasing understanding of how past math traumas have prevented them from becoming successful in math courses. As a result of these self-reflections, my math students learn to cultivate transformational habits that can begin to change their experiences with math, which can lead to highly satisfying and successful outcomes in learning mathematics.

In literacy research, it is argued that children who have positive and consistent experiences with reading and writing often learn to read and write in spite of the literacy instruction they receive in school, not *because* of it (Heath, 1983; Gee, 2004). It is widely accepted today, by parents and teachers alike, that children benefit from being

read to frequently at home. By the same token, it should be apparent that children who experience math and numeracy as a delightful, frequent family activity are most likely to learn math easily and successfully. Unfortunately, few parents or teachers experienced math and numeracy learning as positive and rewarding; instead some researchers have estimated that as many as 85% of adults who received math instruction at school are math-phobic. How then are these math-phobic adults to create home and school math experiences that can delight and inspire children?

While my father did not have the luxury of pursuing the study of higher math, he was a confident and competent user of arithmetic and other basic mathematical concepts and tools. By contrast, far too many people I have met and observed have been pushed to work with math in ways that did not make sense to them, to the point where they lost all confidence and competence, and were left without even the most basic abilities to solve arithmetic problems or perform other basic computations. Perhaps it is time to consider that school math instruction, locked as it is into pushing abstraction and formula use, may have the effect of decreasing children's math understanding rather than increasing it. Of what benefit can it possibly be for children to receive instruction that leaves them bewildered and feeling they're *mensos*?

How can we hope to lead children to the thresholds of their own minds when we remain intent on forcing them into our 'houses of wisdom'? What alternative ways can we devise of interacting with children (and with traumatized, math-phobic adults) that respect their confidence and leave intact their levels of understanding, that lead them to the thresholds of their own minds excited about entering, rather than eager to turn and run at the first opportunity?

Learning math with my father did not focus on rote memorization and drills. The primary emphasis was for a real purpose. My self-confidence was enforced when he started me out with problems that were less difficult and had many different solutions. He checked my work, which sometimes included drawings, against his solutions. If they contained errors, I self-checked my own work and was usually able to use a different approach to find a solution. These solutions were valued and respected, which allowed me to trust in my own problem solving abilities.

What should be done differently in school? The National Council of Teachers of Mathematics (NCTM), with members from all over the US and Canada, listed these (1989, 1995b) suggestions for teachers seeking to prevent math anxiety include:

- Accommodating for different learning styles
- Creating a variety of testing environments
- Designing positive experiences in math classes
- Refraining from tying self-esteem to success with math this is a silly statement, really. What if someone is really good at it?
- Emphasizing that everyone makes mistakes in mathematics
- Making math relevant
- Letting students have some input into their own evaluations
- Allowing for different social approaches to learning mathematics
- Emphasizing the importance of original, quality thinking rather than rote manipulation of formulas

These suggestions demonstrate that there is a movement to prevent math anxiety among students, but the structure of schools continues to contribute to the problem.

Although a strong background in mathematics is critical for classroom teachers, many have inadequate understandings of mathematics with unresolved math phobias. Teachers are key players in the success of their students. They can create classroom cultures that assist students in overcoming early negative influences. Building an inclusive classroom culture allows all students to feel safe when trying out new mathematical strategies. Such experiences are capable of counter-acting cultural and historical inadequacies by providing many opportunities for students to be successful at their own level but the essence of schooling is that you must be successful at someone else's level. How do we change this? How do we remedy this in the formal classroom? Is this possible?

Like my father, teachers can recognize when students have little confidence, and help them to build self-confidence. By allowing students to play with and experiment with problem-solving strategies until they are thoroughly comfortable and truly ready to move on, by not introducing more complex strategies until students begin to see a need for them, teachers can prevent students from becoming frustrated and permanently discouraged. Positive experience in math learning is critical for mathematics understanding; to maintain positive experiences, we must stop running students through the curriculum as if only the curriculum matters, and start paying more attention to students and their needs and interests. Students can become convinced they are capable learners who experience success with mathematics, or they can become convinced otherwise.

My father may not have had the most sophisticated math formulas and concepts at his disposal, but neither was he math phobic; he used math skills and enjoyed solving authentic math problems as part of his daily life. A love of math was deeply rooted in my

father, and he passed his enjoyment of math on to my brothers and to me. Every time I help students explore the houses of knowledge they've built, help them tap into the intellectual and emotional roots of their understanding, I feel again my father's legacy, this deep understanding that learning is first and foremost a human activity, something that people do, not something that a curriculum does. It's time that all educators come to understand that the learner is more important than the lesson.

Dr. Yolanda De La Cruz is a Professor of Math Education at Arizona State University. Her research focuses on the mathematics achievement among English language learners, on the role of language in theories of academic achievement differences among language minority students, and education policy related to English Language Learners in U.S. schools. Examples of her work appear in Teaching Children Mathematics Changing the faces of mathematics: Perspectives on Latinos, Hispanic Journal of Behavioral Sciences, and in edited collections. In 1997, she was selected as a grant recipient of the National Science Foundation and the McDonnell Foundation. De La Cruz has given numerous invited talks in the U.S. and abroad, including a plenary address at last year's meeting of the California Mathematics Council, and has served as a visiting research scholar at Northwestern University in Evanston, IL, the Cape Peninsula University of Technology in South Africa, and at the Universidad de la Habana, Cuba.

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