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Reflexiones Pedagógicas

# Latino/as in the hard sciences: Increasing Latina/o participation in science, technology, engineering and math (STEM) related fields

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## Science, Technology, Engineering and Mathematics (STEM) in Urban Schools

In the fifth grade, our promotion required a massive science project. Our teacher had us pretend to be National Geographic scientists researching the habitats and biomes of an animal. Mine was the platypus. As a 10-year-old attending a mostly Latino immigrant school in the Santa Ana Unified School District in 1992, I loved pretending to be like the late Steve Irwin and dissect the life of this creature. In a city where over 94 per cent of students are Latino children of Mexican or Central American born parents (Santa Ana Unified School District, 2011), this was only one of the intriguing ways that science, one branch of the STEM disciplines, was incorporated into our elementary education by our teachers.

At the intermediate and high school levels in Santa Ana schools, we took math and science, but STEM-related courses such as chemistry, human anatomy and physics were only mandatory for a minimum of 2 or 3 years. Standardized projects included hands-on tasks such as the dissection of animals, devising

a parachute that would safely land an egg when dropped from a high building, and an activity where students would have to plug in batteries into a circuit breaker and make a light bulb turn on. Yet today, teachers and administration in schools like Santa Ana are increasingly worried about their students simply passing the California Assessment High School Exit Exam (known as the CAHSEE), a basic skills test that measures tenth-grade-level reading and language skills and seventh-grade-level math skills (California Department of Education, 2008). Much of the focus has shifted to ensuring that Latino students, and all students for that matter, become proficient in English language speaking and comprehension skills. Their success, of course, is measured through high-stakes tests that measure basic mathematics skills, but do not measure proficiency in science, engineering or technology.<sup>1</sup> Important skills in these areas might not even make it into regular school day curriculum. As FairTest (2007, 1) notes,

1 These subjects are often tested through advanced placement (AP) exams, but these tests and courses are often limited in urban schools where many Latina/o students are concentrated.

The higher the stakes, the more schools focus instruction on the tests. As a result, what is not tested often is not taught. Whole subjects may be dropped; e.g., science, social studies, art or physical education may be eliminated if only language arts and math are tested. Important topics or skills that cannot be tested with paper-and-pencil tests – such as writing research papers or conducting laboratory experiments – are not taught.

STEM-related courses have taken a back seat in school districts like Santa Ana, limiting the occupational prospects of many students of color, especially 1.5 and second-generation US born Latino children. The schools seem to be teaching less on subjects focused on STEM and are expecting less of students in these areas due to high-stakes testing.

These issues are not exclusive to Santa Ana schools. These dilemmas are pervasive in poor urban communities in which race/ethnic and language minority children predominate. In this report, I address the current state of the STEM professions today, how Latinos are marginalized from these professions, and I give policy directives that school districts like Santa Ana – which serve Latino immigrant populations – can implement to spur Latina/o participation in these fields.

## The STEM Professions Today

The United States is undergoing dramatic demographic and economic change. Over the next two decades, 70 million baby boomers – most of whom are Caucasian – are expected to retire and exit the US workforce (Myers, 2008). Currently, only 5 per cent of the general US population works in STEM-related jobs such as nursing, dentistry and electricians. While US citizens occupy these



jobs in the United States, many are foreign-born and are recruited to work in the United States with H1B visa sponsorship from countries in Asia as highly skilled laborers (Myers, 2008; Feliciano, 2006). The US Department of Labor expects jobs in the STEM fields to grow 22 per cent between 2004 and 2014. This will require nearly 2 million new STEM professionals to enter the field in the United States by 2010 to replace retiring baby boomers alone. Today, Latinos are the largest racial/ethnic minority group in the United States, but they are severely underrepresented in the STEM fields even though the STEM professions and professionals are highly revered in Latin America.

Employment opportunities in STEM are expected to increase at three times the rate of other fields in the next decade. To keep up with the increasing demands of a service and knowledge-based economy and a competitive marketplace, it is imperative to recruit and train more STEM professionals especially those of Latino origin. Latinos are expected to comprise a substantial percentage of the US population in the near future. For instance, in 2006 Latinos numbered 44.3 million people, accounting for almost 15 per cent of the total US population (NACME, 2008), but only a mere 2 per cent of those 44 million Latinos living in the United States worked in STEM-related fields (McGee, 2008). By 2042, Latinos are expected to grow to 30 per cent of the US population (US Census, 2008) and already, Latino children comprise more than half of the school-aged population in California alone (Gutierrez, 2004). What explains this scarcity and why is it important to focus on Latino recruitment and retention in STEM-related industries in the United States?

### **Latinos, Education and STEM-related Fields**

The obstacles that Latino origin students face in the US educational system are well documented (Chapa and De la Rosa, 2006; Gandara, 2006; Taningco *et al*, 2008); they face numerous barriers to entering STEM fields. Myriads of explanations are offered to address this issue, but most tend to fall under three general schools of thought: school curriculum, structural and cultural factors. Studies indicate that Latino students continue to drop out of high school at an alarming rate, graduate in small numbers, and are rarely exposed to curriculum that would spark interest in STEM professions (Chapa and De La Rosa, 2006; Taningco *et al*, 2008). Those Latino students who do go graduate from high school and go on to 2- and 4-year institutions are at times ill-prepared for college curriculum and the challenge of STEM-related courses (Tornatzky *et al*, 2006; Taningco, 2008.)

Educational obstacles to entering STEM careers begin early for Latino origin students. School curriculum is generally designed for white middle-class students and is not culturally relevant for Latinos (González *et al*, 2005). Clearly, students must master basics in English and math; however, the near

exclusive focus on these skills displaces important math and science concepts and skills that need to be learned early. Our current educational accountability structure focuses resources on getting students to meet minimum performance benchmarks, to the detriment of preparing them for college.

This is especially relevant in the engineering field. It is estimated that 1.75 million engineers will be needed by “the end of 2010,” but if current trends continue, few new engineers will be of Latino origin. According to the National Action Council for Minorities in Engineering (NACME, 2008), engineering degrees accounted for 5.5 per cent of bachelor’s degrees awarded to Latinos in 1995, but only 4.2 per cent of degrees awarded in 2005. The same report found that while Latinos were more likely than non-Hispanic whites to earn degrees in the social sciences and management, they were less likely than their white peers to have earned degrees in the natural and physical sciences. And in 2001, Latino students attending US educational institutions earned 7.2 per cent of all bachelor’s degrees and 4.7 per cent of all master’s degrees in math and science, a much smaller number compared to their white and Asian counterparts. Moreover, doctorates for Latinos in the STEM fields numbered only in the hundreds (Chapa and De La Rosa, 2006).

### **Why So Few?: Structural and Cultural Explanations**

Research has identified many important factors that contribute to having so few Latinos in STEM fields; most generally fall under structural and cultural explanations. Financial constraints, blatant or subtle racial/ethnic discrimination in school or the workplace, lack of consistent mentorship, difficulty in adjusting to collegiate school culture and gendered practices in Latino families are just a few (Gasbarra and Johnson, 2008; Taningco, 2008).

After high school commencement, one of the most pressing issues Latinos students face is funding their collegiate studies. Several Latino students often feel the pressure to earn income immediately (or during) high school to help the financial situations of their families. Entering a STEM field is not a cheap endeavor, with many students having to take out massive loans and receive minimal financial aid. Financial aid programs such as the Federal Pell Grant and Perkins Loans are no longer available or as bountiful as they were in the past (Advisory Committee on Student Financial Assistance, 2001). Many Latinos relied on financial aid opportunities such as these to attend prestigious colleges and universities. Other sources such as the G.I. Bill still provide financial aid, but only to those in the military and at lesser rates than in the past. In light of financial aid programs dwindling, other sources of financial aid must be sought for Latino students, especially sources linked to STEM fields.

Educators, community organizers and business groups with experience tackling the problem have discovered that many Latino students are generally



not encouraged by teachers to pursue careers in STEM, and Latino students rarely have Latino mentors who are science or math teachers. Many Latino students are often tracked into remedial classes and vocational trade schools because they are perceived to be limited English proficient or only capable of working in these fields, further hindering them from STEM jobs and upward mobility. Latino students that attend 4-year institutions, in addition to experiencing a sort of “culture shock” in white mainstream institutions, must also manage their heavy course load.

Some factors, while not exclusive to Latinos, are also more likely to affect Latino families. Fear of deportation for undocumented Latino parents often disengages them from school. For many Latino immigrant parents, language barriers prevent them from accessing services prompting children to serve as translators for them. If students lack information about these services or do not understand them, parents who do not speak or understand English, cannot advocate for them effectively. In addition, the DREAM Act, a bill proposed to aid undocumented Latino students who have received the majority of their schooling in the United States to attend higher educational institutions, also attempts to restore the college aspirations of Latino students in US schools.

Gendered constraints require culturally sensitive attention among Latino families. Although Latinas are entering higher educational institutions at far greater rates than Latino men (López, 2003), they are scarcely represented in STEM. Similarly to Latino men, Latina women are generally not exposed to curricula related to STEM careers but Latinas may experience gendered obstacles as girls and women growing up in Latino families. While Latino families may or may not encourage their daughters to pursue a collegiate education, the general perception is that STEM careers are largely a male-dominated domain. Moreover, recent scholarship shows that college educated Latinas are “hyper-segregated” into occupations associated with professional versions of “carework” such as sex-segregated fields like teaching and social service jobs (Castanzarite and Trimble, 2008).

In general, most Latino students and their families are unaware of the rich diversity of jobs available in STEM fields. Parents may have vague notions about the existence of science or engineering jobs, but most have no idea about how they can help their children prepare and succeed in these fields. We need programs that help Latino parents and educational personnel understand the possibilities available for Latino children.

## Proposed Solutions

To increase the presence and participation of Latino students in STEM careers (and all underrepresented groups in STEM), the America Competes Act (ACA) was developed to increase financial aid to underrepresented students. Passed in

2007 by President George W. Bush under his “American Competitiveness Initiative,” the act was devised to maintain a well-developed and skilled workforce in STEM. In 2010 advocates were working to increase the funding by an additional 30 million dollars with support from the National Science Foundation (NSF); a portion of the funding would be allotted to Hispanic-serving institutions. The ACA contains provisions geared towards increasing the number of racial/ethnic minorities and women who enter science and technology professions. Specifically, the legislation directs the US Department of Energy to increase the number of women and minorities in science and technology fields at all education levels, from kindergarten to graduate school. It also establishes a new outreach program for underrepresented minorities in grades K-12 to promote careers in science and technology.

Moreover, soon after he assumed presidency, President Barack Obama signed into law the “American Recovery and Reinvestment Act.” Continuing the efforts of the ACA, this legislation will provide 2.5 billion dollars in additional federal funding for the National Science Foundation, including new funding for STEM education programs. It requires that 100 million dollars of that 2.5 billion dollars be used for the NSF’s Education and Human Resources Department, and it is presumed that the funds will go to support teacher training and research to improve math and science instruction in schools (Lips and McNeill, 2009).

The International Business Machines Corporation, through their generous philanthropy, has held a series of summits to address Latina/o participation in STEM and to propose solutions. These solutions span from changes to US school curriculum to modifying teacher education programs (Flores, 2008). High school and college curriculums pose a challenge for Latino students who might be poorly prepared in their classrooms early in their academic career. Many Latinas/os need programs such as summer school classes in order to make the transition to more advanced study. Universities should provide support structures to address the varying preparation levels of Latino students making the transition to higher educational institutions. These support structures should expose them to high academic standards, as well as the culture of collegiate life. Latina/o students can also be encouraged to focus on STEM fields by offering small financial rewards to those who complete and pass Advanced Placement (AP) classes and pass the AP exam successfully in high school.

In conjunction with coursework, a set curriculum with internship opportunities should also be a part of the curriculum. To entice Latino students and enhance their learning experience, part of the educational experience can promote internationalization and global diversity. Sending minority students to their parents’ country of origin or overseas to developing countries in their freshman and sophomore years would offer them an unmatched experience in their field of choice early on in their academic career. Students also would be



inspired to bring back ideas to benefit the classroom and generate thoughtful discussion among peers and faculty.

Mainstream American education is in English, but the use of the Spanish language in educational institutions is a crucial and innovative learning strategy for Latino students in order to aid the learning process. In the new knowledge economy, it might be beneficial to train and teach students in their first language because people do their best work in their language of origin if it is cultivated properly. Promoting two languages – preserving a native language or learning a foreign one – is an incredible asset and advantage in the labor force. Scholars have pointed out that students learn best when taught in their native tongue if they are literate and can speak the language, which ultimately leads to picking up English faster (Hakuta, 1993), preparing them for a global economy. Fluent bilinguals also show signs of greater cognitive flexibility.

Policymakers should also consider financial incentives to draw more qualified people into math and science teaching. By qualified here, I do not necessarily mean only in terms of credentialing background. I also include training teachers in transmitting to students other possibilities available to them in STEM fields. Many teachers currently working at the middle and high school levels do not understand the broad spectrum of STEM-related industries and are therefore not able to give that message to parents and children. Math and science teachers need to be educated in these matters. Another proposed plan, although controversial, is differentiated pay, in which a higher pay scale is implemented for fully credentialed Latino teachers licensed to teach math and science courses. However, the terms of differentiated pay need not be static. For instance, a form of differentiated pay could focus on providing financial and housing packages for teachers who teach in neighborhoods where they are needed. On the financial aid plane, loan forgiveness geared specifically to credentialed math and science teachers can be implemented. Loan forgiveness is already in place in several other high-demand careers such as medicine.

## **Student Gendered Transitions: Reaching for the Moon and Stars**

On 28 August 2009, one of the first Mexican-origin astronauts shuttled off into space. Born to Mexican immigrant parents, José Hernández once worked in the fields with his father in Stockton, California. After decades of preparation and training, Hernández was selected as a NASA astronaut. Aboard with him on this voyage was third generation Mexican-American, Danny Olivas from El Paso, Texas. They were NASA's first two Spanish bilingual astronauts. Many see the accomplishments of these two men as opening up new possibilities for young Latinos aspiring to join this occupational niche. Hernández, a firm immigrant rights advocate, has even formed his "Reaching for the Stars" foundation in

Stockton, CA to inspire and offer scholarships to local Latino boys and girls to the field.

Although there is a plethora of research that states it is parental ignorance and gendered expectations for their children that influence whether or not their children pursue STEM-related careers, I would argue that it is not just about parental lack of knowledge or gendered cultural expectations for Latino boys and girls. This only became apparent to me after a conversation I had with my father when I had just started my doctoral program after deciding to pursue a doctoral degree instead of a career in elementary education. While discussing my career goals in our home in Santa Ana one day, I said to my father, “You always wanted me to become a teacher didn’t you?” A little bewildered, my father, a Mexican immigrant with less than a junior high education quickly quipped in Spanish, “*Yo no te dije que fueras maestra. Yo quería que te fueras a la luna. Yo quería que tu fueras hasta astronauta*” [I didn’t tell you to become a teacher. I wanted you to go to the moon. I wanted you to become an astronaut] and then slowly lifted his head up and beamed with pride. Thus, it is not entirely accurate to assume that Latino families only want their daughters to pursue a feminized profession or no profession at all. These gendered cultural expectations are more fluid and in flux in Latino families and Latinas, as well as Latinos, need to be encouraged to pursue these fields.

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