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Encouraging Science Education and Careers Among Latinos

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Abstract

Latino students perform poorly on tests that assess proficiency in science and mathematics. The lack of scientific knowledge considerably hinders the economic and social development of Latinos, placing them at a disadvantage in pursuing science and technology-related jobs. Since this group is growing at a fast pace, outgrowing all the other ethnic groups, the competiveness of the United States in these fields will be constrained by the scientific advancement of the Latino population. For this reason, science education policies that address the limitations of Latino students should be encouraged. The goals of this article are to explore the limiting factors to Latinos in science and to provide recommendations to help promote science and technology education and careers among Latinos.

Introduction

Historically, scientific and technological innovation has been responsible for a large share of the growth of the American economy, resulting in 75 percent of the growth of the U.S. economy since World War II (Grace Creek Media and The George W. Bush Institute, 2010). Today, the U.S. leadership in technological innovation is documented by its dominance of patents, trademarks, and licensing of computer software, in which it enjoys a longstanding surplus in trade with the rest of the world (National Science Board, Science and Engineering Indicators: 2010). Such economic growth and innovation production has been accomplished by having one of the best workforces educated in the fields of science, technology, engineering and mathematics (STEM).

Over the past 20 years, the U.S. students' performance on science and mathematics and the production of STEM-educated graduates have become a matter of concern raising doubts of its future as leaders in science and technology. Recent reports demonstrate that U.S. K–12 students' perform poorly in science and mathematics in comparison to other countries (PISA, 2008, TIMMS, 2005 and 2008) . As China, India and other countries close the gap or outperform the U.S. in science and technology education, it would only be a matter of time for the U.S. to lose its once secured advantage in innovation. This was eloquently affirmed by President Obama in a recent speech, "The countries that out-educate us today will out-compete us tomorrow."

Latinos underperform in tests that assess K–12 student's proficiency in science and mathematics (National Center for Education Statistics, 2011) and are underrepresented in the STEM-related workforce. Whereas these findings are the focal point of multiple reports, none should be a matter of surprise, since Latino students underperform in other areas of education, such as reading comprehension (National Center for Education Statistics, 2011) and are underrepresented in STEM-unrelated professions. The significance of these findings relies on how dependent the Unites States competitiveness is becoming to the success of Latinos and the relevance of these fields to the economy.

As the fastest growing ethnic group, the U.S. scientific and technological competitiveness will be largely influenced by the achievements of the Latino community. Latinos are the largest minority group accounting for 1 of 6 Americans (U.S. Census Bureau, 2011) and half of the school-age youth (U.S. Census Bureau, 2008), but only occupy 4.3 percent of the U.S. STEM workforce (National Science Foundation, 2007), significantly below their share of the population. Given Latinos continuous growth, the industry, academics and the government recognize the important role of Latinos in the protection of our nation's science and technology competitiveness.

Science and technology indicators demonstrate that the U.S. competitiveness is at stake. In 2000, the U.S. ranked 20 out of 24 countries in the percentage of 24 years olds who had earned a first degree in sciences and engineering. For the U.S. to maintain their scientific competitive edge, increasing the number of young college graduates in stem-related fields is fundamental. For this reason, *The Gathering Storm Report* recommends

increasing the percentage of 24 year old graduates holding a degree in science or engineering from 6 percent to at least 10 percent (COSEPUP & PGA, 2007). Considering that Latinos are the largest minority group and their current share of the population, for the U.S. to achieve this goal, the number of 24 year olds Latinos holding a science or engineering degree, would need to increase significantly, perhaps even quadruple.

The status of the United States K-12 student's performance in science and math proficiency: What has standardized testing revealed?

There are many ways to interpret international comparative data, but in general, the U.S. performance in mathematics and science education is widely viewed as inconsistent with the nation's role as a world leader in scientific innovation. For example, in the World Economic Forum's 2010–2011 Global Competitiveness Report, the U.S. ranked 1st in the world for innovation and 52nd for the quality of mathematics and science education (World Economic Forum, 2010). In addition, the average scores of U.S. students on international science and mathematics tests also tend to rank below those of top performing nations.

According to the Program for International Student Assessment (PISA, 2008) and Trends in International Mathematics and Science Study (TIMSS, 2005 and 2008), there are instances in which the U.S. students have improved their performance over time (e.g., 4th and 8th grade mathematics) as well as instances where they have not (e.g., 4th and 8th grade science). In some cases certain U.S. students are global top performers (e.g., Massachusetts 4th graders ranked 2nd on one science test) even while the nation as a whole ranks below international competitors (e.g. on the same test U.S. 4th graders overall placed 5th). This complexity makes it difficult to accurately characterize the U.S. global position in STEM education with a single factor or statistic, and suggest that some of the policies being implemented or already establish are being effective. However, the overall consensus is that the international competitiveness of U.S. students in k-12 science and mathematics is lagging.

Further analysis of the TIMSS data results on science and mathematics shows a relationship between poverty status and students proficiency. Analysis of the students' proficiency data utilizing, as a poverty measure, the percentage of the students at the school eligible to receive free or reduced-price lunch through the National School Lunch Program (NSLP) demonstrate that schools with higher percentage of students eligible to the NLSP have significantly lower and below average TIMSS scores in science and mathematics than schools with low percentage of students eligible to the program. In mathematics and science, the average scores of 4th graders in the highest poverty schools (at least 75 percent of students eligible to the NSLP) in 2007 (479 in mathematics and 477 in science) was lower than the TIMSS scale average (500). In contrast, the average scores of 4th graders in the lowest poverty schools (less than 10 percent of students to the NLSP) in 2007 (583 in mathematics and 90 in science) was higher than the average TIMSS score and the national average. Since Latinos constitute 24.2% of the U.S. population living in poverty (U.S. Census, 2008), these data suggest that poverty influences Latino students' proficiency in math and science.

Latinos perform poorly in national tests that assess science and mathematics proficiency. Results from the National Assessments of Education Progress (National Center for Education Statistics, 2011), a federal test, demonstrated that 47 percent of Hispanics in 4th grade perform below basic level in science, while only 13 percent of White students perform at this level. The discrepancies in the students' proficiency in science and mathematics between Latinos and whites suggest the need of a comprehensive approach to address the educational needs of Latinos and the U.S. science and mathematics competitiveness.

Current Areas of Debate Affecting STEM Education

The U.S. is not producing the quantity and quality of STEM workers needed to continue its dominance in global competitiveness. About 50 percent of the individuals holding a doctoral degree in science and engineering in the U.S. are not citizens or permanent residents. In other words, half of the U.S. workforce in charge of leading the nation efforts in innovation, technology and science are immigrants. As STEM fields become fundamental to the economic growth and competitiveness of the U.S., it is imperative to develop a long-term plan of action to provide the STEM-related workforce needed. While it may seem that the STEM education advocacy movement began recently, in the last two decades, multiple laws, guidelines and recommendations have been developed. It is not the goal of this article to mention and/or analyze all these different policies; however, to facilitate an understanding of some of the areas of need and improvement potential, a brief review is provided.

The first area of debate is the implementation of the right education policy. Most academics and policy makers agree that development of a sustainable STEM-educated population and workforce begins with quality K–12 science education. However, to what extent and which science education policies should be implemented is a matter of debate. A recent policy publication analyzed what has been the most prevalent policy on K–12 science education, the "Some STEM for All" approach (Robert Atkinson and Merrilea Mayo, 2010). The "STEM for All" approach proposes better science education for everybody and suggests that by filling the pipeline at the beginning of the process, more will be received at the end. This approach has been criticized because of its cost, and is considered ineffective due to leakage effects and other variables that are often ignored. In addition to this, as demonstrated by the performance of African Americans and Latinos in the National Assessments of Education Progress tests, the "STEM for All" approach has failed to recognize and correct the science

and mathematics gaps among minorities. These facts expose the ineffectiveness of the current policies and suggest the need of a comprehensive/holistic approach to promote science education and school completion.

The second area of debate is the role of the federal and state government in the creation and implementation of science education policy. Primarily, education is regulated by the state giving the federal government a lesser role. Since there is no centralized control of education, the adoption and creation of national educational guidelines is challenging. As a result, it is very difficult to compare and track students' performance across states. To address this problem, different states have started to adopt the same guidelines while the Federal government has initiated competitive programs such as, Race to the Top.

The third area of debate is the allocation of funds. Most public schools are funded by the states through their local tax bases (property taxes). School districts in wealthy areas generally enjoy more funding for supplies, teacher's salaries, and equipment, and thus can offer higher quality education. In the nation as a whole, the U.S. spends approximately $900 less per year on each student in the school districts with the poorest students than in the school districts with the fewest poor students (Education Trust, 2005). This funding gap is a great contradiction, and as a result, kids that have less to begin with at home also receive less in school. Since studies have demonstrated an association between poverty and educational performance, more attention should be given to schools in which a higher number of underprivileged students are enrolled.

As schools in poor areas try to resolve their deficiencies on a limited budget, the lack of sufficient funds becomes a challenge in the classroom. These schools experience problems hiring teachers since the better qualified teachers are attracted to higher salaries offered by schools in wealthier areas. As a result, the education provided by underprivileged schools at best, is less than favorable. In addition to this, schools in poor areas have less funding for resources such as computers, projectors and other systems that have been shown to be very effective tools in enhancing learning. Due to the unleveled playing fields, the students' performance across schools of wealthy and poor areas cannot be compared. To alleviate this problem, the state and federal government should *comprehensively* allocate more resources to schools serving areas of high poverty. If this is ignored, the U.S. educational system would perpetuate the social problems and inequalities that have been established for decades instead of solving them.

The fourth area of debate is the capacity of higher education programs to develop the STEM workforce needed and attract students with the right set of skills and abilities. Several contradictions have been observed that have identified weaknesses in the STEM education pipeline. A large number of high school graduates with the competence and skills necessary for pursuing STEM-related college education decide to enroll in other programs. Furthermore, studies have shown that a significant amount of students graduating from college with a STEM-related degree choose not to pursue a career in STEM. Only by identifying the reasons why students are not opting to continue their education in these fields and choosing non-STEM-related careers, we will be able to develop measures to attract students with the set of skills and abilities necessary for careers in STEM.

Factors Affecting Latino Students' Educational Attainment

Multiple factors can affect educational success. Students' educational achievements are not only influenced by what happens in the classroom but also by school-independent factors such as, poverty, family, child health and culture. Teachers are among the most influential academic achievement factors. Exposure to effective teachers has been shown to help overcome learning obstacles and close achievement gaps (Babu and Mendro, 2003). It is for this reason that the the President's Council of Advisors on Science and Technology (PCAST) plan for improvements in K–12 Science, Technology, Engineering, and Mathematics (STEM) Education is primarily focused in the development of better teachers in the fields of STEM. While this is a good strategy, many of the factors that detrimentally affect the educational achievement of Latinos are not school-related. To effectively promote science education and careers among Latinos a coherent strategy that will take in to account these factors is required.

In order to have a better understanding of the obstacles experienced by minorities, including Latinos, in the pursuit of science education and careers, the Bayer Corporation provided a survey to minority chemists and chemical engineers (Bayer Corporation, 2010). In the survey, larger socioeconomic issues were identified as the most influential factors to underrepresentation in STEM fields. Seventy-five percent of the chemist and chemical engineers indentified the lack of quality science and math education programs as the top contributor to underrepresentation in STEM. This was followed by stereotypes that say that STEM is not for girls and minorities (66%) and financial issues related to the cost of education (53%). Latinos more than any other minority group, identified financial issues relating to the cost of education as the top significant barrier faced in pursuing pre-college STEM studies. Among the additional significant barriers mentioned were the lack of mentors and role models.

The results obtained by this survey demonstrate that minorities, including Latinos, recognize that socioeconomic issues as the main contributors of underrepresentation in STEM fields. Measures to alleviate socioeconomic issues must be taken into consideration when proposing policies to address Latinos underrepresentation in science careers.

Encouraging Science Education and Careers among Latinos: Recommendations

Distinct policy changes can be implemented to promote science education among Latinos. Given the significance of increasing the STEM-related workforce for U.S. scientific competitiveness, policies that increase the number of STEM-related graduates in the short term should be of highest priority. The short term approach would be to facilitate college attainment of students already and soon to be enrolled in STEM-related programs. For this reason, the first policy recommendation is focused in further supporting community colleges and Hispanic-Serving Institutions (HSI).

First policy recommendation: to strengthen, promote and facilitate community college STEM- related programs and transfers to Hispanic-Serving Institutions. Community colleges play an important role in the education of Latinos. Roughly, 50 percent of Latinos that are enrolled in post-secondary education attend a community college (National Center of Education Statistics, 2008). These institutions are effective given that they recognize the needs of the community to which they serve. Often, community colleges have programs designed to alleviate some of the socioeconomic issues affecting minorities, provide more support and flexible hours of study. Further strengthening these programs and facilitating STEM-related educational paths, fellowships and scholarships would have the greatest impact in increasing the number of Latinos in STEM-related fields. In addition to improvements at the community college level, the transfer from community colleges to 4 year HSI needs to be improved. Hispanic Service Institutions compose 10 percent of the colleges in the U.S. and enroll more than half of the Latino students and graduate many in STEM-related fields every year. With additional support, HSI can expand their effectiveness in recruiting, retaining, and graduating an increased number of students in STEM-related careers.

Second policy recommendation: to significantly improve K-12 science and mathematics education in underprivileged schools. While new policies and strategies to improve K–12 science education will not have an immediate effect, these are the strategies that will have a greater impact in the strengthening of the STEM-education pipeline. To accomplish this, the Federal government should require more equitable school budgeting practices and encourage teacher preparedness in science and mathematics. Once these STEM-oriented teachers are trained, the states should establish programs to help recruit and retain these teachers in underprivileged schools. Recruitment and retention of qualified teachers in underprivileged schools is difficult, but can be encouraged by establishing teacher induction programs. Teacher induction programs cut turnover rates in half (Smith, 2004) and increase teachers' effectiveness (Hanushek, 2005; Villar, 2007). This is crucial since new teachers are disproportionately concentrated in underprivileged schools. An example of a successful induction program is The Connecticut's Beginning Educator Support and Training (BEST). This an excellent program and its success was shown on state achievement tests (Wilson, 2006).

The third recommendation: to develop a pre-college curriculum that promotes and sustains college readiness. The development of comprehensive curricula between K–12 and college stakeholders and industry is of high importance to increase the success of Latinos pursuing degrees in STEM-related fields. Latinos often have to work to maintain their families and/or themselves. It would be an additional detriment for these students to have to catch up with college work due to poorly designed high school curriculums. By preparing Latinos with the knowledge necessary to perform in college, education attainment will increase. Additionally, corporations could offer internships. While monetary donations are helpful, the establishments of partnerships between the industry and educational systems can provide career and skills guidance that the students may not be able to acquire otherwise.

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