Why Hispanics are Underrepresented in STEM & Effective Ways to Encourage Hispanic Presence in STEM

A Literature Review of Current Explanations

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Authored by: Scarlett Luis

Introduction

There has been an increased demand for a workforce in science, technology, engineering, and math (STEM) fields especially now that technological innovations have become increasingly important in solving global issues. Despite the increased demand and diversification of its population, the United States is experiencing a lack of diversity in STEM fields. Today, more than half of employees in STEM careers are white males (Platt 2013). According to a U.S. Census report in 2011, about 70.8% of STEM professions were held by non-Hispanic whites followed by 14.5% held by Asians. Hispanics held 6.5%, Blacks held 6.4%, those who classified as "Other" held 1.4%, and American Indians and Alaskan Natives held 0.4%. Diversity in STEM professions is important because it drives better ideas and teamwork. A study conducted by MIT and Carnegie Mellon found that individual intelligence was less important for successful projects than collective intelligence (Platt 2013). As a result, underrepresentation of minorities in STEM fields has become a pressing concern, particularly for the Hispanic population because their representation in STEM careers does not reflect the increase in the Hispanic share of workforce (Landivar 2013).

In 2011, Hispanics accounted for 15% of the U.S. workforce but held 7% of STEM occupations (Landivar 2013). The available literature on Hispanics in STEM offers explanations for their underrepresentation in STEM fields, mostly based on qualitative research. Understanding the forces that foster Hispanic underrepresentation in STEM fields is important because the explanations ultimately influence the types of programs and policies that are implemented in order to encourage Hispanic presence in STEM fields.

This paper aims to investigate why there is an underrepresentation of Hispanics in STEM by reviewing the explanations offered in the available literature. Moreover, the analysis section will address whether the current findings help explain Hispanic underrepresentation in STEM by analyzing the explanations against qualitative and quantitative research as well as discussing the factors that drive Hispanic success stories in STEM fields. As a result, this literature review will help fill in the gap in the current literature on how to better understand Hispanic underrepresentation in STEM by highlighting current explanations that have led to the implementation of effective methods of encouraging Hispanic presence in STEM and proposing future areas of research that will further clarify our and ultimately lead to better methods of encouraging Hispanic presence in STEM.

Background

Several explanations have been suggested to account for the underrepresentation of Hispanics in STEM fields. The following is an overview of overlapping explanations in the available literature which attributes Hispanic underrepresentation to the following: lack of mentorship and parental involvement, socioeconomic challenges, lower levels of educational readiness, cultural barriers, and/or perceived ethnic discrimination. Moreover, many success stories of Hispanics in STEM fields have been documented to help understand what factors better inform how to improve Hispanics presence in STEM fields.

Lack of Mentors & Parental Involvement

Many scholars argue that the presence of mentors for Hispanic students affect their likelihood of pursuing a STEM related career. According to a survey of Hispanic leaders

conducted by Public Agenda, the lack of mentors or role models is a major inhibitor (Litow 2008). Moreover, in "A Silent Crisis: The Underrepresentation of Latinos in STEM Careers", Litow describes how the lack of parental involvement hinders their assumed role as advocates for their children. In a qualitative research conducted by The Tomas Rivera Policy Institute, successful Hispanic STEM professionals were interviewed and asked to share their source of inspiration and motivation to pursue a STEM career. An engineer expressed how as a child he was inspired by watching the astronauts on the moon and how this inspiration further grew after hearing about the first selected Latino astronaut. The rest of the interviewees acknowledged teachers and mentors as key motivators who guided them in making career choices (Tomas Rivera Policy Institute 2008).

In addition, one respondent expressed how a lack of consistent professional mentorship throughout one's career is problematic. According to them, they did not have enough people to talk to who could advise them about available career options. Another qualitative research conducted by Moller et al. found that teachers who evoked excitement in their subject matter were influential in students' decisions to pursue a career path in STEM. There is much emphasis on mentorship as a key factor in encouraging Hispanic presence in STEM fields because without access to role models, awareness of college programs, and specific guidance, students are unlikely prepared for college and have the necessary information to go about choosing a career in STEM or in another field altogether (Schneider 2012).

Socioeconomic Challenges & Background Education

The current literature emphasizes the role of socioeconomic challenges as a major reason why Hispanics are underrepresented in STEM fields. In most successful high schools, students receive help from parents, tutors, and special services such as independent college counselors (Schneider et al. 2012). According to the Center for Urban Education, Hispanic students are more likely than peers to come from low-income families; they face extra challenges in time, money, and choice of school. By following the logic of both sources, accessing such resources can be problematic for low-income families. The report also urges schools to recognize that many Hispanic undergraduates support themselves financially and are therefore more likely to put in longer hours at work than peers.

Another recurring explanation for the underrepresentation of Hispanics in STEM is observed lower levels of academic performance and readiness by Hispanic students in STEM subjects. According to U.S. Census Bureau report in 2011, Hispanic workers are less likely to have a science or engineering background that would facilitate STEM employment. Furthermore, based on the responses from a series of interviews with Hispanic students, The Tomas Rivera Policy Institute concluded that Hispanic students experience a general difficulty in adjusting to college life because it is difficult for students to adjust to a larger non-minority environment and a more demanding academic institution. In an interview with a student from UT Austin, they explained how it was difficult to adjust to college after moving from a small high school, mostly attended by minorities and into a college where now they were a minority and every student is as smart or smarter (Tomas Rivera Policy Institute 2008).

Parent's lack of educational background is another explanation provided in much of the literature today. Scholars claim that parent's lack of knowledge of how to navigate the education system offers another explanation as to why there is an underrepresentation of Hispanics in STEM fields (Litow 2008, The Tomas Rivera Policy Institute 2008, Schneider et al. 2012, Moller et al. 2014).

Cultural Barriers

Explaining Hispanic underrepresentation as a product of cultural barriers is found in much of the current literature. For example, in "A Silent Crisis: The Underrepresentation of Latinos in STEM Careers", Litow describes how immigrant parents have cultural attitudes carried over from home countries and how this may hinder them in assuming the role of advocate for their children. Additionally, in the report by the Tomas Rivera Policy Institute, they claim that parents may have gendered-based expectations and stereotypes. One respondent said, "… sometimes we have situations, for example, where females are not allowed to leave home to go to universities."

In "Moving Latino/a Students into STEM Majors in College: The Role of Teachers and Professional Communities in Secondary Schools", the authors argue that teachers play an instrumental role in guiding Hispanic students to pursue STEM careers. The authors claim that Latino[a] students often lack the informal networks, human capital, and knowledge to pursue STEM independent of teacher guidance. The article then continues to explain lack of Hispanic representation as a culturally determined behavior, as noted in the following statement, "Latino[a] cultures, while diverse, generally place more faith in teachers as experts in

education; and consequently, Latino[a] parents are less likely than other parents to question or challenge teacher's educational decisions and perspectives" (Moller et al. 2014). In the end of the article, the authors conclude that teacher's should be more culturally aware about their Latino[a] students in order to know how to interact with them and encourage them to pursue STEM majors.

Perceived Racial/Ethnic Discrimination

There is vast research discussing the influence of perceived racial and ethnic discrimination among Hispanic students and how this explains their underrepresentation in STEM fields. Perceived racial or ethnic discrimination may deter Hispanic students from pursuing STEM majors and thus entering STEM careers. Furthermore, Hispanics who do choose to pursue a STEM major face the challenges of stereotype threat which ultimately affects their academic performance and likelihood of successfully completing a degree in a STEM field (Rice et al. 2013). According to Rodolfo Mendoza-Denton, psychology professor and researcher at UC Berkeley, minority students in STEM fields experience high internal and external discrimination. He describes how in the domain of STEM in particular, there are stereotypes about inherent abilities and how minorities tend to be associated with the wrong end of such stereotypes.

One interviewer in the study by Tomas Rivera Policy Institute mentioned how instances of obvious and subtle discrimination in applying to school and jobs are challenges prevalent in STEM fields. The interviewer said, "It's just typical stereotype challenges… it's the constant having to work very hard to achieve the respect of your peers and where you see other people don't have to work as hard [but] receive as much respect as you do or maybe even more, I think

those were certainly challenges to me…" This student account is supported by research that suggests that campus climate in which Latinos are exposed to have a direct effect on both learning and social outcomes (Cole 2008). Hurtado, Carter & Spuler found that Hispanic students who experience a hostile campus climate have greater difficulty forming a sense of community in their college and have a complicated time adjusting academically and socially (as cited in Cole 2008).

Future Outlook

There currently exists a lot of qualitative research on the subject. Future research should focus on collecting empirical data that tests whether or not the current explanations do help explain Hispanic underrepresentation in STEM fields. There is little empirical research that studies the success stories of Hispanics in STEM fields as a result, another approach that may be more conducive to understanding how to improve the presence of Hispanics in STEM would be to develop this research in this area. This assessment will allow us to determine what methods currently work and how to improve these methods to amplify their effects.

Method

This literature review summarizes the available literature that explains Hispanic underrepresentation in STEM fields. The analysis of this review revisits each explanation and draws from current empirical research to assess whether current explanations help understand Hispanic presence in STEM fields.

Analysis

The following analysis revisits the reasons why Hispanics are underrepresented according to the available literature. Successful case studies that address lack of mentorship & parental involvement, socioeconomic challenges, and background education show that these explanations do help understand Hispanic underrepresentation in STEM fields. Similarly, research on perceived racial and ethnic discrimination provides evidence of how this may influence Hispanic student's decision to avoid or discontinue their pursuits of a career in STEM. Culturally based explanations, however do not help understand Hispanic underrepresentation in STEM but rather help perpetuate stereotypes counterproductive to the goal of diversifying STEM fields.

Lack of Mentors & Parental Involvement, Socioeconomic Challenges, & Background Education

Organizations and programs have been created to provide mentors, tutors, and network opportunities to Hispanic students. For example, the Society of Hispanic Engineers (SHPE) offers a support system comprised of mentors and networks of engineering professionals that provide interviewing opportunities. The following is an interview response by a Hispanic STEM professional, "As I said, MESA played a big role and encouraged me to pursue engineering. In college, I was also involved in SHPE, and I got a lot of mentorship there to talk me though everything from putting together a resume and applying [and] interviewing for engineering internships and that's kind of how I got my first job…" (The Tomas Rivera Institute 2008).

Additionally, STEM magnet programs for public schools in heavily minority concentrated areas have proven to be conducive to successfully exposing students to STEM fields at an early age and thus preparing students to pursue a STEM major in college or career. For example, Miami Coral Park High School has a student population that closely mirrors the demographics of the community which has a significant proportion of newly arrived students to the U.S. who have little English proficiency, work long hours, and/or whose parents' work responsibilities and language barriers limit their involvement with the school (Hidalgo 2014). Spanish is the primary language spoken in most of the students' household. The school's students and students' parents fit all the characteristics described in the literature as being factors that play against the student's likelihood of pursuing a STEM career. However, Coral Park High School strives to reach out to the community through a night school program that offers adult education classes for students' parents. Moreover, the school has an engineering and robotics magnet program that has been recognized as one of the top magnet schools in the United States by Magnet Schools of America. Through this program the school has established a collaborative relationship with Florida International University School of Engineering and students in the program have the opportunity to attend college level courses at the FIU campus thus receiving college and high school credit. Students participating in robotics state and national competitions have experienced educational and leadership opportunities that prepare them for college.

Schneider's et al., "Boosting STEM Interest in High School", demonstrates how a program called College Ambition Program (CAP), led by Michigan University can influence the number of Hispanic students choosing STEM career paths. CAP recruits STEM majors at

Michigan State University to volunteer as tutors and mentors for high school students. Cap also offers free course counseling and advising for students and financial aid guidance for student's parents. An analysis using data from the Educational Longitudinal Study indicates that CAP students were more likely to take ACT multiple times to improve their scores and were more likely to complete FAFSA forms and seek other forms of aid, than other schools without CAP. Also, CAP students were found to have higher college attendance rates compare to other students in similar schools.

The successful impact that the engineering magnet program at Miami Coral Park High school and CAP has had in encouraging students to pursue STEM related majors and career paths provides insight to the kinds of programs that should be implemented if the U.S. wishes to successfully diversify STEM fields. CAP is effective because it provides the resources that address the challenges and concerns expressed not only by Hispanic students in interview based research but also by successful STEM professionals who experienced the same challenges in their career paths. The data collected by the longitudinal study provides evidence that these factors do influence a student's likelihood of pursuing a career path in STEM. As a result, similar programs should be implemented in schools in areas of large minority populations nationwide.

One common issue described in the literature as a reason for Hispanic underrepresentation in STEM fields is the lack of parent involvement in their child's schooling. A study by Contreras and Zwick found that parental education plays a role in a student's exposure to additional resources which has a positive effect on education achievements (as cited in Cole 2008). The night school program at Miami coral Park Senior High provides an example of an

effective program that strives to increase parent involvement. Programs like CAP may also be further improved by creating orientation classes for Hispanic parents who may not know how to navigate the U.S. educational system in order to improve parent involvement.

Other studies show a lack of diversity among faculty members in STEM disciplines (Lechuga 2012). This provides major deficit in potential access to mentors by Hispanic students in grade school and at colleges. Educational institutions should address the concern of diversifying faculty members in order to solve the issue of underrepresentation of Hispanics in STEM fields.

Cultural Barriers

The culturally based explanations found in the literature do not provide good insight as to how to effectively encourage Hispanic presence in STEM fields. In order to explain a behavior based on cultural attributes, scholars should consider the origins and forces influencing people's behavior before concluding it is innate to culture. For example, the report by the Tomas Rivera Policy Institute claims that parents may have gendered-based expectations and stereotypes that they bring with them from their origin country. This directly relates to idea that Hispanic families discourage Hispanic females to pursue careers in STEM. However, Parrado and Flippen found in a research on the effects of migration among Hispanic behavior that it is not their culture that has innate gender role definitions but rather it is a byproduct of migrating to an unknown environment and therefore being lest trusting of the receiving society. Parrado and Flippen provide evidence that the dynamics attributed to Hispanic culture tend to emerges with migration.

Moller et al. provides another culturally charged explanation for Hispanic behavior in the realm of STEM education. The authors of the article claim that Latino parents are less likely than other parents to question or challenge teacher's educational decisions and perspectives. This is another example that yields a similar misconception that a culture is the determinant of Hispanic parent's behavior. This explanation does not help understand Hispanic underrepresentation of Hispanics in STEM because it offers a superficial explanation that fails to acknowledge the effects of migration on Hispanic behavior. As previously mentioned Hispanic migrant parents are unfamiliar with the new environment and may therefore rely on teachers as educational authority figures for their children because of their unfamiliarity with the U.S. educational system.

As a result, scholars should be careful when associating Hispanic underrepresentation in STEM fields to culture because these explanations perpetuate ethnic stereotypes that may influence the kinds of programs created to cater to Hispanic incorporation in STEM fields that may increase perceive racial and ethnic discrimination by prospective Hispanic STEM workers which is further elaborated in the next section.

Perceived Racial/Ethnic Discrimination

Some argue that Hispanic students lack the academic preparation to major in STEM due to their consistent underperformance in mathematics and science evidence by low grade, test scores, or standardized exams. However, research indicates that Hispanic students' performance in mathematics is almost comparable with White students in elementary school (Moller, Mickelson, Stearns, Banejree, & Bottia 2013, Reardon & Galindo 2009). Increased perceived

racial or ethnic discrimination offers a valid explanation for the ethnic gap in achievement in STEM fields as time progresses. This idea is supported by the argument by Dasgupata—"the mere experience of underrepresentation in a negatively stereotypes performance context is likely to trigger recognized notions stereotype threat rather it is consciously or internalized (as cited in Rice et al. 2013).

The current qualitative research based on interviews with Hispanic student in STEM show that perceived racial and ethnic discrimination does affect academic performance and decisions to continue pursuing a career in STEM. For example, Cole explains how individual perceptions of campus climate including interaction with diverse peers influenced STEM student's GPA's. An interesting finding in Cole's study was that students attending diversity functions such as racial or cultural awareness workshops negatively influenced their GPA. As a result, careful considerations should be made when creating diversity-related functions. Cole describes how negative correlations between Latino students' intellectual self-concept and attending diversity-related functions/ activities were likely the result of students feeling alienated within their college campuses.

The in-depth research regarding perceived racial and ethnic discrimination offers a well-supported explanation as to why Hispanics are underrepresented in STEM fields. From these findings, educators and policy makers may make better informed decisions when trying to implement methods to encourage Hispanic participation in STEM fields.

According to Cole, in order promote STEM diversity, events should focus on facilitating student and faculty interaction by organizing social events and campus-wide lectures that link to courses.

Conclusion

The literature reviewed provides overlapping explanations as to why Hispanics are underrepresented in STEM fields. The explanations relate to the following factors: lack of mentorship and parental involvement, socioeconomic challenges, lower levels of educational readiness, cultural barriers, and/or perceived ethnic discrimination. The qualitative research support the explanation regarding lack of mentorship and parental involvement, socioeconomic challenges, lower levels of educational readiness, and/or perceived ethnic discrimination. On the other hand, culturally based explanations do not help explain Hispanic underrepresentation is STEM. Research on the effects of migration better the effects of perceived racial and ethnic discrimination explain the behaviors described in the literature as being innate to Hispanic cultures.

Scholars should be careful with how they explain social behaviors such as underrepresentation of Hispanics in STEM because these explanations provide insight as to what methods and policies should be implemented in order to increase Hispanic participation in STEM fields. This literature review emphasizes the importance of studying the factors of success cases in order to key in on the methods that currently work and how they may improve to further succeed in increasing Hispanic presence in STEM fields.

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