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U.S. Latinos in College and University STEM Programs: Technology, Engineering and Math

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Keywords: STEM·hispanics·mentoring.

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Abstract- Colleges and universities across the United States (U.S.) are placing greater emphases on Science, Technology, Engineering, and Math (STEM) college programs. The purpose of this paper is to assess whether Hispanics, the largest ethnic population in the U.S., are prepared for jobs in the growing fields of science and technology. Three research questions are presented in this paper: Are Hispanic students majoring in science, technology, engineering, and math programs? What college majors are Hispanics choosing? Will mentoring programs encourage Hispanic students to enter STEM programs? Blacks/African Americans and Whites serve as comparison groups. Results suggest Hispanics lag behind other ethnic groups at all levels of education and may not be adequately prepared for jobs in the fields of science and technology.

Keywords: *STEM-hispanics-mentoring.*

I. TIMELINESS AND IMPORTANCE OF THE STUDY

This study of Hispanics in science and technology is timely and significant for two reasons. First, Hispanics are the largest minority group in the United States [1] and, second, this increased growth suggests that revisions in the literature must be made to reflect recent education and employment trends of Hispanics, particularly in the fields of science and technology.

a) Clarification and Definitions

Data for this study were collected from three primary ethnographic categories as used by the US Census: White, Hispanic, and Black/African American. The term Hispanic is used wherever other researchers and government sources use the word Hispanic and where data have not been separated by specific ethnic group.

II. METHODOLOGY

To answer research questions this study used a qualitative approach. Qualitative studies are necessary to explore critical factors that may be used to support quantitative models. An important advantage of using qualitative methods lies in its strength to uncover more detailed information about people's experiences [2]. Historic seminal employment studies were analyzed that focused on White males in business and industry as well as from women's studies.

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III. LITERATURE REVIEW

Hispanics are the largest ethnic minority group in the United States [1], and their numbers undoubtedly will be augmented by President Obama's recent executive order (EO) prohibiting the deportation of 5 million illegal immigrants. The president signed the EO on November 20, 2014 [3,4].

Although Hispanics are the largest ethnic minority in the United States, research completed by Mintz and Krymkowski [5] found that, despite passage of the historic 1964 Civil Rights Act legislation enacted fifty years ago, White males and females continue to dominate the U.S. workforce, including science and technology. Mintz and Krymkowski reported that, "...results suggest that white men have maintained their advantage in the occupational hierarchy...and that white women have made more progress than any other group" (p. 31). Important provisions of the Civil Rights Act (Public Law 88-352 78 Stat. 241) made it illegal for employers to discriminate on the basis of gender and race in employment hiring, promotions, and termination. Women are nearly 50% of the U.S. workforce; however, less than 25% of them are employed by STEM companies and only 14% are employed in the field of engineering [6].

The literature suggests that the prospects for women in STEM fields are good, as they are for Hispanics; however, it is clear that Hispanics are not proportionally represented in STEM fields. *ETS Policy Notes* commenting on remarks made by Indiana University's Jorge Chapa, Director of the Latino Studies Program wrote that Professor Chapa "...described a leaky pipeline, where graduate degree recipients from the nation's colleges and universities do not reflect the racial and ethnic diversity of the population. Demographic and educational trends confirm that the percentage of Latinos decreases at each higher education stage in the pipeline" [7]. The question then becomes, if Hispanics are not majoring in STEM programs, what subjects/degrees do they pursue?

a) Hispanic Students More Likely to Earn Education Degrees

Data compiled by the Integrated Postsecondary Education Data System Completion Survey (IPEDS) for the academic years 1999-2000 illustrate that Hispanic students primarily earn bachelor's degrees in the social

sciences, business, psychology, and education. Conversely, Hispanic students are less likely to earn undergraduate degrees in biological and life sciences, computer and information sciences, engineering, the health professions, and related sciences. These undergraduate discrepancies continue at masters and doctoral levels. In sum, Hispanic students are more likely to major in Colleges of Education and earn education degrees. They are less likely to earn master's

degree in the health professions, engineering, computer information sciences, and business [8].

These conclusions are supported by U.S. education demographics that show Hispanics and Blacks lag behind other groups in graduation rates at all levels of higher education: bachelors, masters, and doctoral programs. Table 1 below illustrates graduation rates for all college majors, including science and technology.

Table 1 : Degrees conferred by gender and race/ethnicity 2010-2011

	Total	Men	Women
Bachelor's	1,707,984	729,309 (42.70%)	978,675 (57.30%)
White, Non-Hispanic	1,097,684 (64.30%)	480,786 (43.80%)	616,898 (56.20%)
Black	160,073 (9.40%)	54,585 (34.10%)	105,488 (65.90%)
Hispanic	142,816 (8.40%)	56,127 (39.30%)	86,689 (60.70%)
Asian	108,557 (6.40%)	49,719 (45.80%)	58,838 (54.20%)
American Indian and Alaska Native	11,051 (0.60%)	4,431 (40.10%)	6,620 (59.90%)
Native Hawaiian and Pacific Islander	3,976 (0.20%)	1,574 (39.60%)	2,402 (60.40%)
Other*	183,827 (10.76%)	81,786 (44.5%)	102,040 (55.5%)
Master's	727,623	290,322 (39.90%)	437,301 (60.10%)
White, Non-Hispanic	409,014 (56.20%)	155,425 (38%)	253,589 (62%)
Black	70,793 (9.70%)	20,672 (29.20%)	50,121 (70.80%)
Hispanic	41,311 (5.70%)	15,037 (36.40%)	26,274 (63.60%)
Asian	37,373 (5.10%)	17,079 (45.70%)	20,294 (54.30%)
American Indian and Alaska Native	3,485 (0.50%)	1,234 (35.40%)	2,251 (64.60%)
Native Hawaiian and Pacific Islander	1,189 (0.20%)	474 (39.90%)	715 (60.10%)
Other*	164,458 (22.60%)	79,978 (48.63%)	84,480 (51.4%)
Doctoral	163,517	79,469 (48.60%)	84,048 (51.40%)
White, Non-Hispanic	97,089 (59.40%)	47,088 (48.50%)	50,001 (51.50%)
Black	9,921 (6.10%)	3,472 (35%)	6,449 (65%)
Hispanic	7,918 (4.80%)	3,626 (45.80%)	4,292 (54.20%)
Asian	15,436 (9.40%)	6,776 (43.90%)	8,660 (56.10%)
American Indian and Alaska Native	873 (0.50%)	418 (47.90%)	455 (52.10%)
Native Hawaiian and Pacific Islander	316 (0.20%)	150 (47.50%)	166 (52.50%)
Other*	31,964 (19.5%)	18,040 (56.4%)	13,924 (43.6%)

*Other aggregates the categories of: 2 or more races, unknown and resident alien.

Source: Chronicle of Higher Education (2013).

The figures in Table I show that Whites earn a majority of bachelor's (64.30%), master's (56.20%) and doctoral (59.40%) degrees. In the bachelor's degree category, Hispanics, Blacks, and Asians have earned 8.40%, 9.4%, and 6.40% respectively. In the master's degree category, Hispanics, Blacks, and Asians have earned 5.70%, 9.70%, and 5.10% respectively. The tendency to lag behind Whites continues with Hispanics

and Blacks earning the fewest percentages of doctoral degrees at 4.80% and 6.10% respectively. Asians are a smaller percentage of the U.S. population; however, proportionately they fare better and have earned 9.40% of doctoral degrees.



b) *STEM Programs within Minority Serving (MSI's) Institutions*

Minority Serving Institutions (MSI's) are colleges and universities that were created to serve historically underrepresented ethnic minority students such as Hispanics and African American/Black students [9]. In the United States, Black colleges and universities set the precedent for MSI's. Black colleges and universities were established to educate African American students. Today, there are more than 100 historically Black colleges and universities in the United States. These colleges and universities were first created in 1837 to teach freed slaves to read and write [10].

In comparison to the early establishment of Black colleges and universities, the Hispanic Association of Colleges and Universities (HACU) were established relatively recently. HACU was established in 1986 and today represents more than 400 colleges and universities committed to Hispanic higher education success. Among HACU's member organizations are thirty-one states, Puerto Rico, and the District of Columbia and eight countries in Latin America, plus Spain and Portugal. Ironically, even though Hispanics are the largest minority group in the U.S. HACU's U.S. institutions represents less than 10% of higher education institutions nationwide, yet they are home to two-thirds of all Hispanic college students, enrolling in 2011 a total 4.5 million students [11].

The importance and significance of Hispanic Serving Institutions (HSI) is that they have been identified as key intermediaries to improve the availability, quality and diversity of the STEM pipeline [12]. Importantly, HSI's have the potential to increase the number of STEM degrees awarded to Hispanic students. Dowd, Malcolm & Bensimon [13] found that approximately half of all Hispanic undergraduate students currently attend Hispanic Serving Institutions. Of interest and importance are conclusions reached by Dowd et al. [14] that twenty percent (20%) of bachelor's degrees earned by Hispanic students enrolled in STEM majors are from HSI's.

c) *The Influences of Culture, Self-Esteem, and Self-Efficacy*

An abundance of research suggests that minority students, when compared to White students, have a tendency towards low self-esteem and self-efficacy when thinking about themselves as information technologists, scientists and mathematicians; therefore, Hispanics and Blacks tend to choose majors other than STEM programs [15,16]. Hispanic students are influenced by friends and peers—both of these factors have been shown to thwart or inhibit Hispanic students' decisions to major in subjects other than science, technology, engineering, and mathematics [17].

Stability within family units is another critical element to Hispanic and other minority students

pursuing STEM programs-of-study. Catsambis [18] found that having a strong family support system goes a long way to providing needed support and encouragement if minority students are to be successful in science and technology—or any career requiring an aptitude in technology. Mentoring together with familial and parental encouragement has been shown to exert positive motivational influences on youthful educational aspirations [19].

Decades ago, in their seminal research on career advancement and occupational mobility, Taussig & Joslyn [20] and Warner & Abegglen [21,22] found that White males positively benefit from having parents who have careers in business and industry; thereby providing essential early role models for their sons. In other words, businessmen are more likely to have sons who go into business. Similarly, and more recently, Leslie, McClure, and Oaxaca [23] reported that Hispanic males living in households where at least one parent is employed in engineering or the physical sciences are more likely to choose engineering as a college major. Like Warner & Abegglen decades before them, Leslie, McClure, and Oaxaca concluded that having at least one parent working in an engineering or science-related field is critical to forming positive attitudes among Hispanic males that leads them to believe that a STEM career is a "real option" for them and, indeed, is an achievable goal. Reyes, Kobus, & Gillock [24] reported that Hispanic females expressing early interest in STEM careers are more likely to be better informed, possess a stronger foundation and greater comprehension of the rigorous steps needed to succeed.

IV. MENTORING AND THE HISPANIC STUDENT

In her discussion of how and why women graduate students of colors choose a mentor, Marina [19] maintains that these students knowingly, or perhaps unknowingly, gain more confidence to lead and serve from a spiritual and cultural connection with members of their own ethnic group. In particular, Marina suggests that female graduate students of color often select a mentor based on a spiritual and cultural connection. Ortega and Craig [25] reported that professional Hispanics recognize the need for mentoring believing that mentoring will help their careers. Ortega and Craig concluded that more Whites than Hispanics or Blacks serve as mentors, reporting that just over half of the mentors in their study were White males. A plausible explanation is that there are more Whites in management position. The study also revealed that approximately 25% of all mentors were women, over one-quarter of mentors were Hispanic and that Hispanic and Black managers support formalized mentoring programs, perceiving that formalized mentoring programs will benefit their professional career development. These research results provide a basis for

growing optimism that more minorities and women may be encouraged to enter STEM programs.

a) *Asian Students Take the Lead in STEM Programs*

Within science and technology, the literature suggests that Asian students enrolled in U.S. universities dominate STEM programs. This may be due to a culture that values and encourages Asian students to major in STEM programs. Research shows that from 1989 to 2003, foreign students earned nearly 40% of U.S. S&E doctorates, with Asian students representing about 55% of this group. Students from EU countries have totaled about 10% of all foreign doctorate recipients in the U.S. Asians are not only choosing to major in science and technology, but many choose to remain in the U.S. and not return to their home countries. Government statistics indicate that up to 80% of foreign students remain in the U.S. The "stay rates" (the proportion of new foreign S&E doctorate holders planning to remain in the United States immediately upon degree conferral) have been rising for students from most Asian countries and the EU. For students from China and India, the stay rate has been 80% and higher since 1992. For all major Asian sources and the EU, over half of foreign student U.S. doctorate recipients remain in the U.S. [26]. These figures suggest that Asians are garnering U.S. college degrees that have prepared them to fill the critical need left by Hispanics and Blacks in science and technology job markets.

V. CONCLUSIONS AND RECOMMENDATIONS

Hispanics in the United States are not majoring in Science and Technology (STEM) fields and one consequence is that they are not prepared to enter the job markets offered by science and technology. The literature and government statistics show that Asians are choosing science and technology majors and graduating in large numbers from U.S. colleges and universities.

If Hispanics are to take their rightful places in these fields, they must be encouraged to major in STEM programs. The literature suggests that early interventions are needed at all levels in the K-12 system. At each grade level, Hispanics must be encouraged to take STEM classes that will adequately prepare and position them to be recruited and retained in schools and colleges and universities. Counselors should provide STEM career guidance, enhance student self-efficacy, and provide positive interactions between the student's family and colleges seeking to recruit them.

a) *Future Studies*

Future studies should include assessing best practices of successful Hispanic mentoring programs within high schools, colleges and universities. Best practices of private sector science and technology mentoring programs should also be studied to see what

works best to attract Hispanics into science and technology job markets. The growing population of Hispanics in the U.S. suggests a need to tap into this vast number of future employees to meet the needs of science and technology.

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