OVERVIEW OF HISPANICS IN SCIENCE, MATHEMATICS, ENGINEERING AND TECHNOLOGY (STEM): K-16 REPRESENTATION, PREPARATION AND PARTICIPATION

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The purpose of the following paper is to summarize what is currently known regarding Hispanic students in STEM. We begin with a summary of pre-college circumstances known to influence Latino/a students' decisions to major in STEM as undergraduate students. A synthesis of what is known to date regarding the factors impacting the retention of Hispanic students in STEM fields is then provided. We conclude with key recommendations for research, policy and practice.

A focus on science, technology, engineering and mathematics (hereinafter referred to as STEM) fields in education is needed for the United States to maintain its competitive position in a global economy (Chen & Weko, 2009). Analysts predict that the United States needs to produce approximately one million more STEM professionals over the next ten years, which equates to increasing the number of students earning STEM degrees by nearly 35% per year over current rates (President's Council of Advisors on Science and Technology, 2012). Colleges and universities are therefore facing an unprecedented need to increase the number of undergraduate students who are interested in majoring in STEM disciplines (Wang, 2012). There is a large portion of students who are currently not fully participating in science and engineering (Sevo, 2009). The United States currently has one of the lowest rates of STEM to non-STEM bachelor's degree production worldwide, with STEM accounting for 17% of all degrees awarded in the United States in 2002 compared to the international average of 26% (Kuenzi, 2008).

The demand for skilled workers in STEM fields will be difficult, if not impossible, to meet if the nation's future mathematicians, scientists, engineers, information technologists, computer programmers, and health care workers do not reflect the diversity of the population (Institute for Higher Education Policy (IHEP), 2010). Hispanics are the fastest growing and youngest group in the United States. It is estimated that Hispanics will comprise 30 percent of the U.S. population by 2040 and will be the majority group in several states (U.S. Census Bureau, 2008). At the same time however, Hispanic students are underrepresented in STEM fields (U.S. Commission on Civil Rights, 2010). As such, filling the pool of qualified applicants for employment in STEM fields will require a growing number of Hispanic students studying STEM fields and earning STEM degrees (Oakes, 1990). Increasing the percentage of Hispanics and other traditionally underrepresented minorities in STEM occupations is not only ethically

and morally correct, as these groups deserve equal access to STEM fields, but allows minority groups to serve as role models and mentors for younger members of their own ethnic/racial group (Bonous-Hammarth, 2000; Grandy, 1998).

Current representation of Hispanics in STEM

The number of students (both Hispanic and non-Hispanic) enrolling in STEM fields is on the rise. Enrollment in STEM fields from 1995-1996 to 2003-2004 increased 21 percent, compared to an increase of 11 percent in non-STEM areas. During that same time, the percent of Hispanic students enrolling in STEM fields increased by 33 percent, representing nearly ten percent of students in STEM fields (United States Government Accountability Office, 2005). At the same time however, disproportionately low numbers of Hispanics currently persist in STEM (Oakes, 1990; Young, 2005). Although Hispanic students have been shown to be equally likely as White students to major in STEM, they are significantly less likely to earn a degree or certificate in a STEM field (Chen & Weko, 2009). According to recent data from the Higher Education Research Institute (2010), 16 percent of Hispanic students who began college in 2004 as STEM majors completed a STEM degree by 2009, compared to 25 percent of White students.

Data from the Integrated Postsecondary Education Data System (IPEDS) Completion Survey for the 1999-2000 academic year points out that the most popular majors in which Hispanic students earned bachelor's degrees are in the social sciences, business, psychology, and education. In contrast, Hispanic students are less likely to earn undergraduate degrees in biological and life sciences, computer and information sciences, engineering, and the health professions and related sciences. These discrepancies that exist at the undergraduate level are also seen at the master's and doctoral levels, as Hispanic students are more likely to earn degrees in education and are less likely to earn a master's degree in the health professions, engineering, computer information sciences, and business (Llagas & Snyder, 2003).

Federal STEM Initiatives

The importance of increasing the number of undergraduate Hispanic students completing degrees in science, mathematics and engineering has been recognized by Congress in the Goals 2000 Educate America Act (section 102, 5Biii). In response, the federal government has allocated billions of dollars to increase funding earmarked for post-secondary STEM programs such as the Louis Stokes Alliance for Minority Participation (LSAMP), Federal TRIO Programs and the Minority Engineering Programs (MEP) (United States Government Accountability Office, 2005). Although federal STEM programs may provide critical support for a select group

of minority students in the form of summer programs, internships and career counseling, they do not address the underlying structural and institutional problems influencing the underrepresentation of Hispanic and African American students in STEM fields. Moreover, there are limits to the number of students these programs can serve. As such, STEM policy makers and institutional leaders cannot rely on federal programs alone to increase the number of STEM degrees earned by Latino/as (Bensimon & Dowd, 2012).

Role of Hispanic Serving Institutions

Minority Serving Institutions (MSI's) have been identified as key intermediaries to improve the availability, quality and diversity of the STEM pipeline (IHEP, 2010). Hispanic Serving Institutions[1] (HSI's) in particular, have the potential to increase the number of STEM degrees awarded to Hispanic students, as about half of all Hispanic undergraduate students currently attend Hispanic Serving Institutions (Dowd, Malcolm, & Bensimon, 2009) and 40 percent of the undergraduate degrees awarded to Hispanics are granted by HSI's (Dowd, Malcolm & Macias, 2010). Further, a fifth of all bachelor's degrees awarded to Hispanic students in STEM majors are from HSI's (Dowd, Malcolm & Macias, 2010). It should be noted that due to the large concentration of Hispanic students in community colleges, over half (53%) of all HSIs are community colleges (Benitez & DeAro, 2004).

Factors Influencing the Representation of Hispanic Students in STEM Majors

The majority of STEM research to date has focused on predicting persistence and degree attainment rather than students' interest in and choice to major in STEM (Wang, 2012). However, as the following section demonstrates, there is a growing body of work to support the relative importance of K-12 academic experiences, cognitive factors, and socio-cultural factors influencing Hispanic students' decisions to major in STEM as undergraduate students.

Academic Experiences

Mathematical and science training at the elementary and secondary levels has been shown to influence the academic preparation of students as well as their interests in high school mathematics and science coursework and in pursing a STEM career (Eamon, 2005; United States Government Accountability Office, 2005). Further, there is evidence that the number of mathematics, science, and English courses taken by high school students serves as a major predictor of choosing a STEM college major (Astin & Astin, 1992; Simpson, 2001). This fact,

[1] A Hispanic Serving Institution (HSI) is defined as a college or university that has at least 25% Hispanic full-time enrollment, of which at least 50% are low income (Bordes & Arredondo, 2005).

while positive for non-minority students, creates a barrier for many minority students due to a lack of resources needed to foster their learning in science and mathematics (Peng, Wright, & Hill, 1995; Auerbach, 2004). Unfortunately, the quality of the academic preparation many Hispanic students receive is negatively impacted by disparities in teacher quality, school funding, and monies spent on instructional resources. Hispanic students are more likely to be taught science by teachers who did not major in that field or by inexperienced teachers. Hispanic students are also more likely than White students to be exposed to funding inequities in the K-12 educational system (Young, 2005). Overall, the current system used for funding school districts is not equal across districts and Hispanic students are less likely to have access to challenging, high-quality math instruction, further discouraging an interest in mathematics or science (Berry, 2005; Chacon, 2000; Triana & Rodriguez, 1993).

The type of institution that a student selects to attend has also been cited as a factor influencing access to and participation in STEM fields for Hispanic students. Students who attend a four-year institution and arrive on campus with a strong research focus have been shown to be more likely to major in engineering as opposed to majoring in business or the physical sciences (Astin, 1993). Unfortunately, less than half of Hispanic students who graduate from high school qualify to enroll at a four-year institution immediately following graduation (President's Advisory Commission, 2002). In turn, the majority of Hispanic students (68%) attend a community college, thereby decreasing their odds of majoring in STEM (Pew Hispanic Center, 2005).

Cognitive Factors

Students' self-efficacy has been shown to be the strongest predictor of the consideration of mathematics as a career choice (Post-Krammer & Smith, 1986). Leslie, McClure and Oaxaca (1998) found that the probability of choosing engineering or science increases with students' perceptions that they possess a solid science/math background and in the belief that he or she has the ability to perform well in those courses. Additionally, the importance of self-efficacy in predicting performance and motivation in mathematics for Hispanic students was validated by Stevens, Olivarez, Lan, and Tallent-Runnels (2004). Unfortunately, Hispanic students (and minority students more generally) have been shown to have lower levels of self-efficacy when it comes to science and mathematics as compared to White students (Leslie, McClure & Oaxaca, 1998; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). Further, there is evidence that Hispanic students may have difficulty perceiving themselves as scientists, even when they express an

interest in science careers (Sorge, Newsom, & Hagerty, 2000).

Socio-Cultural Factors

Peer influence has also been shown to inspire students' decisions to major in a STEM field. Astin and Astin (1992) found that the most consistent environmental influence on a student's choice of major is the number of friends and peers that students possess or knew that were seeking a degree in that field of study. In addition to the overall influence that is exerted by peers to seek a STEM degree, among Latina students patterns of socialization differ for those aspiring toward more traditionally male-dominated careers (Reyes, Kobus, & Gillock, 1999). These female Hispanic students report a greater preference for socializing with a more heterogeneous group when compared to Latinas aspiring toward a traditionally female-dominated career. Perhaps the exposure to a more diverse group of aspirations, career possibilities and thoughts that are not gender-restricted may offer Latinas much more options including majoring in STEM fields.

The importance of a family support system for minority students in developing and encouraging a student's interest in science and mathematics as a career has been shown to be important (Catsambis, 1994). In fact, parental encouragement has been shown to be one of the strongest influences on Hispanic students' early educational aspirations (Arbona & Nora, 2007). Not surprisingly, Hispanic males living in households where at least one parent is engaged in engineering or physical science as an occupation are more likely to select engineering as a major (Leslie, McClure, & Oaxaca, 1998). The researchers concluded that having a parent working in an engineering or science-related field is instrumental in forming the belief among Hispanic males that a career in STEM is a realistic goal. In much the same fashion, Latina students who develop an early interest in highly male-dominated careers such as STEM fields are likely to have a better understanding of the steps needed to achieve their career goals and objectives (Reyes, Kobus, & Gillock, 1999).

Moreover, the anticipation of major social events in the lives of Hispanics has a consequence on their choice of majors. Leslie, McClure and Oaxaca (1998) found that for Hispanic men, marriage or plans for marriage had a positive influence on selecting engineering or science as a major. For Hispanic women, marriage plans were found to have the largest negative impact on the probability of majoring in the biological sciences. It could be argued that the anticipation of major family responsibilities may discourage Latinas from seeking what could be perceived as long academic careers such as medicine or doctoral programs.

Factors Specific to Latinas

Gender serves as one of the most powerful and robust predictors of choice of college major for minority students, as female minority students are much more likely to pursue liberal arts, health, public service or business degrees than STEM degree programs (Simpson, 2001). In turn, minority women are currently the most underrepresented group in the fields of science and mathematics. Despite this gross inequity, few researchers have attempted to understand how women of color perceive and experience science and mathematics. What is known is that differences in attitudes can be seen as early as junior high school, at which time Latina students may be more hesitant to ask questions during class discussions, less likely to report that they are looking forward to taking eighth grade mathematics classes, and are the least likely of any group to have STEM career aspirations (Catsambis, 1994). Several cultural features among Latinas may impact the choices they make as to what careers to pursue. Bowman (1993) and Marin (1993) found that Hispanic female students raised in a predominately patriarchal family structure are much more likely to consider STEM careers. Perhaps the encouragement from a father to his daughter to consider "male career options" may counter sexist attitudes that society might associate with specific careers in spite of displaying more traditional gender roles and adhering to loyalty and respect for family. Further, Reyes, Kobus, and Gillock (1999) also found that Latina students aspiring toward male-dominated careers preferred having "American" friends and preferred using English in conversation.

Factors Influencing the Retention of Hispanic Students in STEM Majors

Although a major emphasis in the literature is the recruitment of Hispanic students into STEM majors and careers, an equal amount of attention should also be paid to research on Hispanic student persistence in the major (Fenske, Porter & DuBrock, 2000). The following section provides a summary of the socio-demographic variables, pre-college experiences, environmental pull factors, perceptions/attitudes, college experiences and institutional variables shown to be related to STEM degree attainment among Hispanic students.

Gender

Findings to date suggest that there is a relationship between a students' gender and both college grade point average and whether or not Hispanic students earn a STEM undergraduate degree. Work by Cole and Espinoza (2008) found that gender predicted college grade point average among STEM majors. It is notable that although Latinas have been consistently found to be less likely to earn a STEM degree (e.g., Crisp, Nora and Taggart, 2010), findings by Cole and

Espinoza suggest that Latina students may on the whole earn higher grades than Latinos. This finding suggests that the challenges faced by females in STEM may be less academic and more a product of socio-cultural or other issues.

Pre-college Factors

There is also a growing body of evidence to show that pre-college characteristics play an important role in explaining differences in STEM persistence across ethnic groups, as differences in STEM persistence have been shown to disappear when pre-college characteristics are controlled (Chang, Sharkness, Newman & Hurtado, 2010). Among Latina/o and other minority groups, the likelihood of persisting in a STEM major has been shown to be strongly related to various pre-college experiences and behaviors including standardized test scores (Garcia & Hurtado, 2011), high school percentile (Crisp, Nora & Taggart, 2010), high school GPA (Herrera & Hurtado, 2011) as well as the number of advanced placement courses taken in STEM fields prior to college (Griffith, 2010). It is important to note pre-college experiences and behaviors are interrelated. Research by Barton (2003) reveals that Hispanic students who earned a SAT math score of 550 or higher reported higher levels of participation in science and mathematics clubs, were enrolled in decidedly more advanced placement courses, and were subsequently more likely to remain in college and dedicated to earning a degree in a STEM field.

Environmental Pull Factors

Financial concerns, family responsibilities and full-time work commitments have all been shown to be factors external to the college that "pull" Hispanic students away from STEM fields. Because science, engineering and mathematics degrees often take longer to complete than other college majors, financial aid takes on added importance in retaining students in those programs (Barton, 2003; Fenske, Porter, & DuBrock, 2000). As such, the importance of financial aid on keeping Hispanic students interested and enrolled in STEM majors/careers cannot be overstated. The availability of adequate financial resources has been rated as one of the top five factors related to the persistence of minority engineering students by The National Action Council for Minorities in Engineering (Landis, 1985). More recently, Hurtado, Han, Saenz, Espinosa, Cabrera and Cerna (2007) found that Hispanic and African American science students who had concerns regarding financing their college and family responsibilities that interfered with their education were less likely to feel that they are able to successfully manage their academic environment during the first year of college. Additionally, financial concerns were shown to negatively influence minority science students' sense of belonging during the first year.

Conversely, as one would expect, the numbers of hours per week spent doing homework or studying was found to have a positive impact on minority science students' adjustment in college (Hurtado, et al., 2007). Furthermore, recent findings by Chang, Sharkness, Newman & Hurtado (2010) indicate that working full-time may serve to decrease the likelihood that Hispanic and African American students will persist in a STEM major as undergraduates.

Attitudes/Perceptions

Hispanic students' attitudes and perceptions of both themselves and the academic environment have been shown to influence students' decisions to remain in a STEM major during college. To begin with, Chang, Sharkness, Newman and Hurtado (2010) found that having a high academic self-concept serves to increase Hispanic and African American students' odds of persisting in a STEM major. There is also some evidence that personal values and personality traits influence persistence in STEM. Findings by Herrera and Hurtado (2011) suggest that the degree to which Hispanic and African American students feel it is important to enroll in college to gain career training may be positively related to retaining STEM interest. At the same time, students who express the importance of leadership potential are less likely to retain their STEM career interests.

Empirical findings suggest that Hispanic and non-Hispanic students have equally positive attitudes and similar aspirations for STEM majors/careers. However, as minority students progress through college, their interest in mathematics and science has been shown to weaken as academic achievement in these classes declines (Peng, Wright, & Hill, 1995). Persistence in a STEM major has also been shown to be related to the perceived quality of instruction (United States Government Accountability Office, 2005). Conversely, satisfaction with the quality of a student's academic program has been cited as a leading factor in degree attainment for both minority and non-minority students (Eimers, 2001). Findings provided by the Educational Testing Service (1989) note that when high achieving minority students perceive their science, mathematics or engineering coursework as enjoyable, students are much more likely to persist in their chosen field (as cited in Barton, 2003). Further, a study by Herrera and Hurtado (2011) recently found that satisfaction with math and science coursework was the only variable related to perceptions of the environment that significantly predicted Hispanic and African American students' retained interest in STEM. Finally, work by Hurtado and colleagues reveals that minority students' feelings they will be successful in managing the academic environment as

well as the likelihood of persisting in STEM may be negatively influenced by perceptions of a hostile racial climate (Garcia & Hurtado, 2011; Hurtado et al., 2007).

College Experiences

A variety of college experiences have been shown to be related to outcomes among Latino/a STEM majors including: (1) participating in an undergraduate research program, (2) participating in a club related to students' major, (3) time spent studying alone or with others, (4) engagement with faculty, (5) academic advising from upper-classmen, (6) enrolling in key gatekeeper courses during the first year, and (7) aspirations toward attending medical school. The positive influence of minority students participating in undergraduate research programs is well documented (Astin & Astin, 1992; Chang, Sharkness, Newman & Hurtado, 2010; Garcia & Hurtado, 2011; Herrera & Hurtado, 2011; Jones, Barlow & Villarejo, 2010). Additionally, as one would expect, there is a good amount of evidence to suggest that joining a STEM related club and/or studying (alone or with others) may serve to retain minority students in STEM (Chang, Sharkness, Newman & Hurtado, 2010; Garcia & Hurtado, 2011; Herrera & Hurtado, 2011). Time studying with other students may or may not be negatively related to Latino/a STEM major's grade point average however (Cole & Espinoza, 2008).

In contrast, there is less agreement as to whether engagement/interactions with faculty may be beneficial or harmful to minority students' interest in STEM. While some studies have found a positive relationship between faculty engagement and STEM outcomes among minority students (Cole & Espinoza, 2008; Grandy, 1998), more recent findings have found faculty interactions to be negatively associated with persistence in STEM (Chang, Sharkness, Newman & Hurtado, 2010; Garcia & Hurtado, 2011). At the same time, receiving advice or other forms of support from peers, upper-classmen, graduate students and/or teaching assistants have all been shown to positively shape minority students' sense of belonging (Hurtado et al., 2007). Moreover, findings by Hurtado et al. (2007) suggest that interactions with peers of diverse racial backgrounds has a positive influence on minority science majors' sense of belonging during the first year of college.

Research findings also suggest that minority students may face challenges in "gatekeeper" courses. Some introductory science and mathematics courses may serve to discourage students' interest in a STEM degree as a result of highly competitive classroom environments or an absence of engaging pedagogy that promotes active participation (Gainen, 1995; Seymour & Hewitt, 1997). For instance, recent findings by Crisp, Nora and Taggart (2010)

found that the odds of earning a STEM degree were lower for students enrolled in Algebra I or higher or Biology I or higher in their first semester.

Institutional Variables

As is the case with other student outcomes, the type of institution that students attend appears to influence student persistence in STEM fields. Astin and Astin (1992) first established that students attending small four-year institutions were more likely than not to persist in their science majors. Additionally, early work by Grandy (1998) showed that minority students who enrolled in four-year colleges as opposed to attending a community college during their sophomore year were more likely to complete a STEM major. More recent work by Herrera and Hurtado (2011) suggests that while attending a private institution may serve to promote persistence in STEM among minority students, attending a selective institution (as measured by average SAT score) may have a negative impact on minority persistence in STEM. This finding suggests that selective institutions may be less supportive of STEM students from underrepresented groups. Additionally, Hurtado et al. (2007) found that after controlling for student ability, Hispanic and African American science majors attending selective institutions had lower assessments of their sense of academic success. Further, a negative relationship was found between institutional selectivity and minority science students' sense of belonging during the first year of college.

Researchers have also begun to explore institutional factors (beyond institutional type) that influence students' decisions to persist in a STEM major. Although not specific to Hispanic students, Eagan, Hurtado and Chang (2010) found that the number of undergraduate research opportunities offered by institutions was significantly and positively related to the STEM degree completion rate at the institution. Results also showed that institutions that offered more retention programs for all students had higher STEM completion rates, relative to non-STEM degrees awarded. However, this effect was no longer significant when institutional selectivity was added to the model. Additionally, work by Griffith (2010) identified several institutional level variables that were related to minority students' decision to persist in STEM to their sophomore and/or senior year including the ratio of undergraduate to graduate students, the percentage of female faculty in STEM, research and educational expenditures, and the percentage of minority doctoral students. Additionally, recent work by Herrera and Hurtado (2011) found that minority students' retained interest in STEM to be influenced by the percentage of students in STEM majors at an institution.

Recommendations for Research

Although there is a growing body of work to explain the factors influencing Hispanic and other minority students' decisions to major and persist in STEM, there is still a great deal of work to be done. In the bullets below, we offer key recommendations for work that we feel is needed to advance this line of research.

- ✓ Additional research is needed to extend what is known regarding the factors that predict persistence for Latino/a students with an interest in STEM (both before and after college matriculation). In particular, research is recommended that explores additional socio-cultural variables influencing Hispanic students decisions to major and persist in STEM.
- ✓ There is also a need for the development of theoretical frameworks to explain Hispanic students' decisions to major in and persist in STEM.
- ✓ The large majority of studies to date have ignored the institutional context in studying STEM retention (Eagan, Hurtado & Chang, 2010). Research is therefore needed to better understand the interactive effects of Hispanic students and their environments.
- ✓ Malcom (2010) notes that the role of community colleges in the STEM pipeline has been largely absent from discourse. Her analysis of the National Science Foundation's 2003 National Survey of Recent College Graduates (NSRCG) indicates that 61 percent of Hispanic STEM bachelor's degree recipients attended a community college at some point during the undergraduate career. As such, we concur with Malcom that there is a critical need for research that helps to explain how community colleges serve as institutional pathways for Hispanic students interested in STEM fields.
- ✓ There is also limited empirical evidence to explain how HSI's may serve to promote or hinder STEM completion for Hispanic students. Garcia and Hurtado (2011) note that with the increase of HSI's, research is needed to understand how these institutions can contribute to the STEM pipeline for Latino/as. As such, we recommend research that extends the work of Crisp, Nora and Taggart (2010). Specifically, we suggest work that is able to draw upon a national sample of Hispanic students attending HSI's to understand the role HSI's play in access and persistence in STEM.
- ✓ We also recommend research be conducted to examine enrollment withdrawal patterns, especially for gatekeeper courses. For example, expanding the work of Tyson et al. (2007) to the college level, research is recommended to examine the role of course taking patterns and ''gatekeeper'' courses on STEM outcomes for Hispanic students (at both HSIs and

non-HSI's).

Key Recommendations for Policy and Practice

An examination of salient factors and influences on Hispanic students' retained interest in STEM careers has key policy implications for higher education initiatives seeking to increase minority participation in scientific fields (Herrera & Hurtado, 2011). We offer the following recommendations based on the above-mentioned empirical findings and recent policy reports by researchers at USC.

Early intervention

One clear implication of the findings presented is that interventions aimed at Hispanic students must begin as early as possible so that career aspirations in science, technology, engineering and mathematics fields are formed and sustained throughout the K-12 system. Specifically, issues related to career choices, student academic self-efficacy, interactions between family and the student's school, and discussions focused on the importance of math and science college preparatory courses should be addressed and engaged in as early as elementary school (Fouad, 1995; Ramirez, Laurel & Rodriguez-Aguilar, 1999). The main intent of such interventions is to emphasize the affective sphere of influence on student attitudes, aspirations and self-esteem related to STEM areas.

Participation and achievement at all educational levels

There is no doubt that increasing Hispanic representation in STEM fields involves improving their high school achievement, their completion rates, their entry into a postsecondary institution and, ultimately, their degree attainment (Barton, 2003). Improvement must begin by reducing the initial achievement gaps that currently exist even at the kindergarten level. Substantial evidence establishes that early intervention in the form of preschool programs that focus on pre-literacy skills and support for healthy development effectively eliminates the achievement gap before children enter the educational system (Gandara, 2006). Participation and success in mathematics and science in middle school leads to participation and success in mathematics and science in high school. The key to increasing the number of STEM majors and graduates at the undergraduate level is to increase the overall mathematics and science competencies among all high school students, namely Hispanics and African Americans (Astin & Astin, 1992).

Family and peer influence should not be overlooked

Although academic preparation at all educational levels appears to be a necessary attribute for the successful entry of Hispanic students into the STEM workforce, it does not guarantee a successful outcome. The importance of family and culture must also be recognized (Ramirez, Laurel & Rodriguez-Aguilar, 1999). Family support and encouragement in different forms are critical to the development of STEM career aspirations on the part of Hispanic students and to the commitment to persist in the major (Leslie, McClure & Oaxaca, 1998). Educators must seek and find ways to engage minority parents in math and science projects and discussions (Hrabowski, 2003). Perhaps science projects that require the student and parent to work together could be part of after-school or summer programs. As for the role of peers in influencing others to consider math and science careers, Astin and Astin (1992) found that students choose a major based on the number of peers in that field, implying that the ability to recruit and retain Hispanic students in STEM fields is in part dependent on reaching a "critical" mass of Hispanics in each of these areas.

The role of institutional agents

A recent report by Bensimon and Dowd (2012) suggests that colleges and universities utilize "institutional agents" as a means of supplementing basic resources provided by the college to help minority students access opportunities and resources otherwise not available. Institutional agents are defined as individuals that occupy positions of power within colleges who utilize their human social and cultural capital in order to advocate and provide resources to non-Asian minority STEM students. Institutional agents' may provide students four types of support (direct, integrative, system developer, and system linkage and networking). Minority students may be given direct support when an institutional agent takes action directly on behalf of the student (e.g., providing knowledge related to navigating the college system or helping students gather information). Integrative support may also be provided by assisting students integrate into the cultural world of the college or professional world such as providing students the opportunity to present at a national conference. The third form of support, system developer, may be given to minority students when an institutional agent utilizes his or her resources to create programs or lobby for students. Institutional agents also provide system linkage and networking support to students such as recruiting underrepresented students into a STEM program.

The role of community colleges and HSI's

Efforts to increase Latino/a STEM participation and completion are highly dependent on the institutional capacity of both HSI's and community colleges to educate Hispanic students. Funding for faculty involvement in curricular innovation as well as collaborations among two and four-year institution faculty is essential for increasing educational opportunities for Hispanic students in STEM (Dowd, Malcom & Macias, 2010). For example, Grandy (1998) suggests that community colleges link minority students interested in STEM careers with minority faculty and advanced undergraduate and graduate students at nearby universities. One means of initiating those connections is by establishing a series of brown bag seminars, lectures or presentations by research faculty (minority and non-minority) where several classes during a specific time period would be required to attend.

Institutional benchmarking

Dowd, Malcom and Bensimon (2012) recommend that colleges and universities engage in performance, diagnostic, and process benchmarking in order to investigate the contextual conditions under which programs and practices are most likely to achieve the desired results on their campuses.

- Performance benchmarking involves colleges setting and monitoring performance goals using graduation rates or other indicators of success, disaggregated by race/ethnicity.
- Diagnostic or "best practices" benchmarking involves colleges and universities ensuring equitable participation of non-Asian minority students in STEM by comparing practices on their campus with policies and programs currently in use at other colleges shown to be effective.
- Process benchmarking involves faculty and administrators making guided site visits to exemplary institutions in an effort to learn information needed to adopt exemplary practices on their own campus

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