

# Bridging Success for STEM Students of Color: Factors that Predict Interactions with Institutional Agents at Community Colleges HSI and Non-HSI

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*The racial and ethnic gap in educational attainment in STEM fields is a central topic in the national conversation. This study investigated the factors that promote or hinder the frequency of interaction between institutional agents (faculty and advisors) and STEM students of color at HSI and non-HSI community colleges. Publicly available data (BPS:04/09) was utilized and the sample was comprised of approximately 1,170 community college STEM students of color (Asian, Black, and Latinx). This study conducted a descriptive statistics analysis and three regression analyses predicting the frequency of interaction with (a) faculty informally, (b) faculty academically outside of class, and (c) advisors to discuss academic plans. The descriptive analysis indicated some observable differences in the frequency of interaction at HSI and non-HSI community colleges. However, none of the regression analyses found attending an HSI to be significant after controlling for independent variables.*

Keywords: STEM; students of color; institutional agents; community college; Hispanic Serving Institution (HSI)

The racial and ethnic gap in educational attainment in science, technology, engineering, and mathematics (STEM) fields is a central topic in the national postsecondary education conversation

(Carpi, Ronan, Falconer, & Lents, 2017; Covington, Chavis, & Perry, 2017; Jorstad, Starobin, Chen, & Kollasch, 2017; National Science Foundation [NSF], 2017a, 2017b). The STEM

educational attainment inequity is most problematic when advocating for a just and fair society across race and ethnicity in the United States. It not only affects people of color aspirations and opportunities for upward mobility (Mau, 2003; Pascarella & Terenzini, 2005), but also negatively impacts the workforce, the economy, and the ability for the U.S. to compete globally (Brown, 2016; Figueroa, 2015; Figueroa, Hurtado, Cobian, Wilkins, & Lewis-White, 2016; Hinojosa, Rapaport, Jaciw, LiCalsi, & Zacamy, 2016). This problem becomes more prominent when noticing the disproportionate underrepresentation of students of color enrolled in and completing STEM degrees (Nevarez, 2015; NSF, 2017b).

One main area of interest to address the problem of underrepresentation of students of color in STEM fields is to better understand what promotes or hinders students' relationships with faculty and academic advisors (Dika, Pando, & Tempest, 2016; Dika, Pando, Tempest, Foxx, & Allen, 2015; Herrera, 2016; Herrera, Hernandez Chapar, & Kovats Sánchez, 2017; Hroch, 2016; Jorstad et al., 2017). Research draws attention to the role faculty and academic advisors play in students' learning outcomes and success (Thorngren, Nelson, Baker, Zuck, & Koltz, 2013; Smith & Allen, 2014; Trolan, Jach, Hanson, & Pascarella, 2016; Waiwaiole, 2015).

Community colleges provide access for nearly half of all the U.S. undergraduate population every year and they serve "a disproportionate number of low-income, immigrant, first-generation, and ethnic-minority students"

(Bailey, Jaggars, & Jenkins, 2015, p. 1). Interestingly, these two-year public institutions employ a disproportionate number of part-time faculty (Nakajima, Dembo, & Mossler, 2012; Porchea, Allen, Robbins, & Phelps, 2010; Rogers, 2015). Institutions designated Hispanic Serving Institutions (HSI) are recognized as minority-serving academic institutions and play a key role in creating a pathway for their students of color, accounting for at least 44% of enrollment (American Association of Community Colleges [AACCC], 2018; Conrad & Gasman, 2017). When focusing on STEM educational pathways, HSIs are vital in increasing graduation rates (NSF, 2017b).

In reviewing the literature, a lack of studies that identify the factors that influence the frequency of interaction at community colleges, HSIs and non-HSIs, was uncovered. Thus, this study addresses this gap. More specifically, this study answers the following research questions: (a) Is there a difference in the frequency of institutional agent-student interaction between STEM students of color attending two-year HSIs compared to two-year non-HSIs? (b) What student background characteristics, academic and social experiences, and institutional characteristic (i.e., attendance at an HSI) influence the frequency of informal or social interactions with faculty outside of the classroom or office for community college STEM students of color? (c) What student background characteristics, academic and social experiences, and institutional characteristic (i.e., attendance at an HSI) influence the frequency of interactions about academic

matters with faculty outside of class (including email) for community college STEM students of color? (d) What student background characteristics, academic and social experiences, and institutional characteristic (i.e., attendance at an HSI) influence the frequency of interactions with academic advisors concerning academic plans for community college STEM students of color?

## Literature Review

### Underrepresentation in STEM Disciplines

Bailey and Alfonso (2005) found that “completion rates for African-American, Hispanic, Native American, and low-income students are lower than the overall numbers “in STEM-related areas (p. 5). In addition, data from the National Center for Education Statistics (NCES) showed that many students enter STEM majors at some point within six years of entering postsecondary education (Chen, 2013, p. iv). However, the attrition rates for community college STEM students are high (Bahr, Jackson, McNaughtan, Oster, & Gross, 2016; Baird, Buchinsky, & Sovero, 2016).

### Faculty and STEM Students of Color Interactions

Research over the previous 20 years has evidenced the connection of student-faculty interaction with “academic performance, persistence, and academic and personal growth for URM students in STEM disciplines” (Dika et al., 2016, p. 3; see also Cole, 2008; Cole & Griffin,

2013; Hinojosa et al., 2016; Hurtado et al., 2011). For example, frequent interaction between students of color in STEM and their faculty is linked to higher grades, academic performance and self-efficacy (Anaya & Cole, 2001; Cole, 2008; Cole & Espinoza, 2008; Micari & Pazos, 2012; Vogt, 2008). In addition, other positive outcomes of student-faculty interactions for STEM students are higher levels of satisfaction in career development, scientific reasoning, intellectual ability, and problem solving. Intellectual ability and problem solving were found to be the most significant gains for students of color (Eimers, 2001; Pascarella & Terenzini, 2005). Interestingly, research found that Latinx and Black students have higher resistance in initiating contact with faculty as they do not want to be perceived negatively or stereotyped (Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Noel & Smith, 1996; Schwitzer, Griffin, Ancis, & Thomas, 1999). These studies also confirm that male students of color prefer to interact with faculty within the same race. Similarly, Dayton, Gonzalez-Vasquez, Martinez, and Plum (2004) found that the ethnicity of faculty and the Latinx students’ perception of faculty’s authentic care, increases their feeling of validation on campus

### Academic Advisors and STEM Students of Color Interactions

Academic advisors play a crucial role in addressing the needs of students of color (Estrada et al., 2016; Tsui, 2007). Academic advisor interactions with STEM students has been found to be a key

element in STEM interventions to support students of color (Tsui, 2007). Tsui (2007) argued that aggressive academic advising is imperative for STEM students of color because they are at higher risk of dropping out. Nonetheless, these interactions can also become a barrier to STEM students of color satisfaction and success if they perceive them to be negative (Museus & Ravello, 2010). For example, Brazziel and Brazziel (2001) identified poor academic advisement as a students of color reason to drop out of STEM majors. This finding supports the work of Packard and Jeffers (2013) that linked lack of accurate information by the initial advisor in the first semester to delays in transfer progress, loss of motivation, and increase in uncertainty for community college STEM students. In addition, Martin (2014) found that STEM students of color perceived that academic advising had little impact on their GPA but was important to their satisfaction with the institution.

### **Challenges for Interactions at Community Colleges**

For community college students, interacting with faculty and advisors might be difficult as their overall opportunities to engage in the institution decrease because of their additional responsibilities, such as family and work (Jacoby, 2014; Lundberg, 2014), and because of organizational structure (Deil-Amen, 2011). For example, research shows that at community colleges students' interactions with institutional agents outside of class happen infrequently (Abu, Adera,

Kamsani, & Ametepee, 2012). A main reason is the disproportionate number of part-time faculty employed at community colleges. Currently, they account for approximately 77% of all faculty and teach about 58% of all classes (Center for Community College Student Engagement [CCCSE], 2014). Part-time faculty encounter several challenges for frequency of interaction with students (Nakajima et al., 2012; Nica, 2018).

### **Theoretical Perspectives**

For this study, Stanton-Salazar's (1997) social capital framework and Pascarella's (1985) general model for assessing change were utilized.

### **Stanton-Salazar Social Capital Framework**

Stanton-Salazar (2011) described faculty and academic advisors as institutional agents working within the institution because they occupy positions of power and use it to better serve historically underrepresented students. These individuals become key socializing agents as they help students of color develop, network, and navigate college in pursue of their personal and academic goals. In addition, institutional agents use their connections and network capabilities (known as social capital) to develop structures that help and empower college students of color success (Garcia & Ramirez, 2018). Faculty and academic advisors are high-status agents within the institution who possess personal and professional resources

that can help STEM students of color achieve their academic goals.

### **Pascarella's General Model for Assessing Change**

Pascarella's general model for assessing change is a college impact model. Pascarella (1985) suggested that a student's growth and development are based on direct and indirect effects of five major sets of variables: (a) students' background and precollege characteristics, (b) the institution's structural and organizational types, (c) the campus culture or environment, (d) interactions with agents on the campus, and (e) the quality of the student's effort (see Figure 1). The five categories of variables impact student learning and cognitive development (Long, 2012; Pascarella, 1991; Pascarella & Terenzini, 2005; Terenzini, 1987). This model is specific in addressing the role of student and institutional agent interactions. It also highlights the importance of these interactions inside and outside of the classroom and their relationship to student's educational outcomes.

## **Methodology**

### **Data Source**

This study utilized publicly available national data derived from the 2004-2009 Beginning Postsecondary Students Longitudinal Study (BPS:04/09) available through the National Center for Education Statistics (NCES, 2009). For this study, students of color were defined as Asian, Black, and Latinx.

Asian students were chosen as the reference group to be compared to Black and Latinx students. These data were used to examine predictors of frequency of interaction with institutional agents from several domains that included background, academic, social, environmental, and institutional variables.

### **Analytical Sample**

The sample was approximately 1,170 students who self-identified as students of color enrolled in STEM majors at community colleges. This study adopted a definition of STEM based on the U.S. Department of Education (2015), the NSF (2017a, 2017b), and the National Institutes of Health (NIH, 2017). In this study, STEM definition included psychology majors (NSF, 2017a, 2017b) as well as health professions (NIH, 2017).

### **Description of Variables**

A conceptual model is presented to explain the process of the selection of variables. The outcome (dependent) variable for this study is frequency of interaction (DV). There are three items on frequency of interaction with institutional agents in the data set instrument that were utilized in this study: (a) interaction with faculty informally, (b) interaction with faculty outside of class (including email), and (c) interaction with academic advisors. These three types of interactions were measured by students answering whether or how often: (a) they had interactions or social contact with faculty outside of the classroom and the office, (b) they talked with

faculty about academic matters outside of class time (including email), and (c) they met with an advisor concerning academic plans.

The independent variables (IV) were organized following Pascarella’s (1985) model which identified sets of variables that are predicted to influence students’ outcomes placing an emphasis on institutional environments (see Figure 1).

**Data Analyses**

The statistical analyses consisted of a descriptive analysis to answer research question (1), and three multiple-linear regression analyses to answer research questions (2, 3, and 4). Several steps were employed in the regression model building. First, descriptive analyses were conducted to investigate the

data. Second, cross tabulations were obtained for the dependent variable and crucial independent variables. Lastly, three linear regression analyses were conducted using several independent variables organized into five sequential variable blocks: (a) demographic characteristics, (b) pre-college factors, (c) academic integration, (d) social integration, and (e) institutional context (e.g. enrollment at an HSI). All the variables in these regression analyses were analyzed with the Powerstats software.

**Limitations**

The results generalizability must be considered under certain limitations. All the frequency of interaction variables are measured in a 3-point scale (never, sometimes, often), which limits

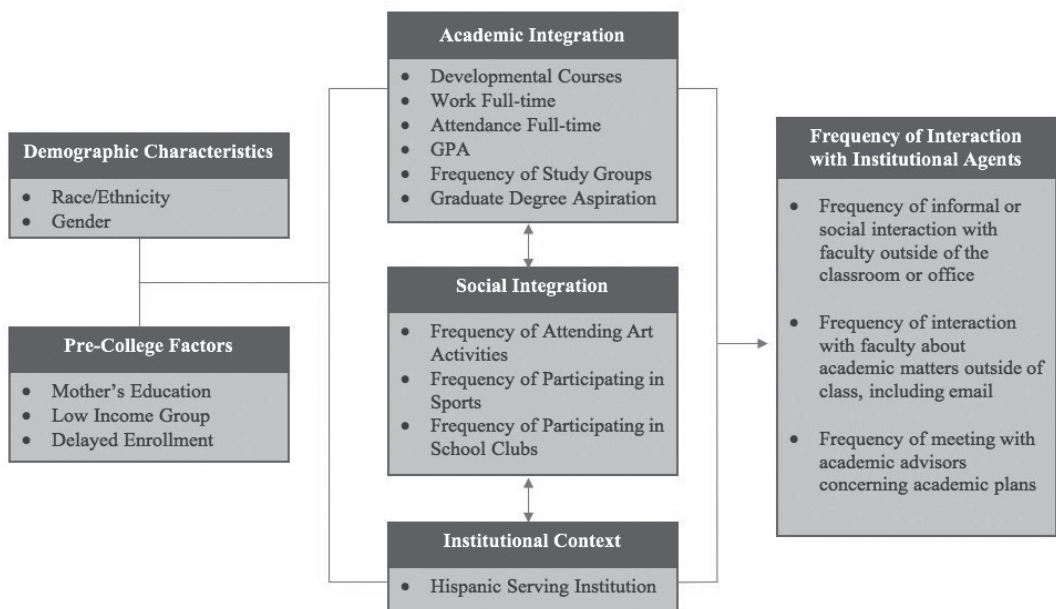


Figure 1. Conceptual model to examine STEM students of color frequency of interaction with institutional agents at community college HSIs and non-HSIs.



variability as students are restricted with their answers. In addition, only frequency and not quality of interaction was analyzed. The sample analyzed is limited to only Asians, Latinx, and Black students, which creates the filter variable of students of color.

## Results

### Descriptive Statistics

The demographic profile of the sample is 51.9% Black, 39% Latinx, and 14.1% Asian. Overall, STEM students of color in community colleges are approximately 34.4% male and 65.6% female. Among STEM students of color, 14.6% begin their postsecondary education at an HSI compared to a non-HSI community college. Noteworthy is the finding that among Asian, Black, and Latinx community college STEM students, almost half of the Latinx students attend HSIs (46.5%) compared to Asian (34.9%) and Black (9.2%) students. In addition, there are almost twice as many female students of color (65.6%) compared to men of color (34.4%) in STEM majors at community colleges.

To answer research question 1, the results indicated that there are observable differences of the frequency of interaction. STEM students of color enrolled in HSIs have more frequent communication with faculty about academic matters outside the classroom than their non-HSI peers (76.4% and 69.2%). In contrast, HSI STEM students of color have fewer social or informal interactions with faculty outside of class (24.2% compared to 33.5%), and fewer

encounters with academic advisors compared to non-HSI students (60.6% and 64% respectively). Overall, non-HSI students of color in STEM have more interactions with institutional agents than their peers attending an HSI community college.

### Regression Analyses

Each regression analysis was comprised of five models which separate the 17 variables into five blocks. Each regression analysis shows correlations, and unstandardized and standardized regression coefficients. The final model of the regression analyses indicated that the variables entered in the model explained 14% ( $R^2=.138$ ) of the variance in the frequency of informal or social interaction with faculty outside of class or office, 12% ( $R^2=.117$ ) of the variance in the frequency of informal interaction with faculty about academic matters outside of the class, and 14% ( $R^2=.143$ ) of the variance in the frequency of interaction with academic advisors among community college STEM students of color.

**Summary of combined findings between the three regressions.** Across the three regression analyses to answer research questions 2, 3 and 4, there are two main findings that are noteworthy to this study. First, after controlling for all variables, the academic integration variable “frequency of study group” showed to be statistically significant at the same level ( $p < .001$ ) across each regression. In every case, whether STEM students of color were interacting socially or about academic matters outside the

classroom with faculty or whether they were interacting with academic advisors, frequently of study group showed to be a positive predictor for frequency of interaction. This means that the more STEM students of color participate in study groups, the more likely they are to interact with institutional agents at community colleges. Second, the social integration index variable, which is comprised of three items—attending fine arts activities, participating in sports and participating in clubs—was also found to be statistically significant at the same level ( $p < .001$ ) across the three regressions after controlling for all the variables. The social integration index is also a positive predictor for frequency of interaction. The more community college STEM students of color attend fine art activities, participate in sports and/or clubs, the more likely they are to interact frequently with institutional agents. Other than these two variables, demographic variables, working full-time, enrolling full-time, aspiring to a graduate degree, and GPA were found statistically significant, but these findings were not consistent and constant across the three regressions. Jointly, the three regression analyses found that frequently studying in groups, attending fine art activities, participating in sports and/or participating in clubs are positive predictors for frequency of interaction between community college STEM students of color and institutional agents on campus. While the differences in the frequency of interaction between STEM students of color and institutional agents who attend a two-year HSI compared to a two-year non-HSI are concerning, the

regression models show that after controlling for demographics and precollege experiences, and academic and social experiences, students attending an HSI do not have significantly lower levels of interaction. Thus, the observed differences across institutional context shown in the descriptive statistics are mediated by these other factors.

### **Implications for Policy and Practice**

Frequency of interaction with institutional agents outside of the classroom has been shown to be meager (Archuleta-Lucero, 2015; Carrasco-Nungaray, 2011; Dika et al., 2016; Hernandez Chapar, 2016; Kim, 2010), especially for STEM students of color. As this study demonstrated, almost 70% of STEM students of color never met informally or socially with faculty during their first year at a community college. Even more pronounced is the disconnect between those students attending an HSI compared to a non-HSI. Although more than half of STEM students of color at community colleges interacted with faculty about academic matters, it is important to notice that this type of interaction includes the use of email, which may account for the increment in the frequency of interaction. Curiously, this type of frequency of interaction happened more for STEM students of color attending a community college HSI compared to a non-HSI. This could mean that faculty at HSIs provide a more welcoming environment for students of color in which they feel motivated to interact



with faculty regarding their academic concerns.

Perhaps the most salient finding is that almost 40% of STEM students of color attending an HSI never met with an academic advisor compared to 36% at a non-HSI community college. This suggests that four out of ten students attending a Hispanic serving community college do not have an academic plan developed with an academic advisor. This situation leaves students with what Bailey et al. (2015) referred to as cafeteria-style, self-service model which provides “an array of often-disconnected courses, programs, and support services that students are expected to navigate mostly on their own” (p. 3). These findings on the insufficient frequency of interaction between STEM students of color and institutional agents at Hispanic serving community colleges are thought provoking in what it means for an institution to be designated HSI.

### **Implications for Institutional Agents**

Community college faculty can provide opportunities to foster interactions by encouraging STEM students of color to engage with their campus community by offering learning communities, collaborative learning experiences (e.g., group projects), research opportunities, and participation at conferences and competitions that are focused on a students’ specific STEM fields. Interestingly, the findings in this study underline the importance of the student-centered teaching approach, particularly for STEM students of color as studying

in groups and communicating outside the classroom increases the possibility for frequently interacting with institutional agents. Unfortunately, research shows that in STEM fields, faculty is mostly White (Flaherty, 2017) and relies heavily on lecturing (Eagan, 2016). Consequently, professional development should be intentional in training faculty on developing cultural competency, incorporating culturally relevant pedagogy utilizing student-centered techniques, and creating a welcoming and engaging environment (inside and outside the classroom) where STEM students of color feel a sense of belonging and validation (Garcia & Okhidoi, 2015; Ladson-Billings, 2014).

Community college academic advisors need professional development not only to become knowledgeable and resourceful for STEM students, but most importantly, to improve their interpersonal skills and cultural competency (CCCSE, 2018). Moreover, research has demonstrated that providing intrusive academic advising helps STEM students of color succeed as they have a higher risk of dropping out (Tsui, 2007). Thus, academic advisors ought to be trained on this proactive effort to contact students several times during the school year instead of one or two times or when the students have academic challenges. As research has shown, humanized, equitable, holistic, and proactive academic advising promotes students of color success (Museus & Ravello, 2010). In addition, it is imperative that academic advisors appear to be available to students or at least to make them feel

validated and important as individuals and not as numbers.

### Implications for Administrators and Practitioners

When faculty feel engaged and integrated in the campus community, they are more likely to find enjoyment in teaching, participating in professional growth, and serving their institutions (Nakamura & Csikszentmihalyi, 2005). Thus, faculty are more likely to positively interact with students and in turn support students' success (Cox, McIntosh, Terenzini, Reason, & Quaye, 2010; Kuh & Hu, 2001; Pascarella & Terenzini, 2005; Thirolf, 2017). Unfortunately, 77% of community college faculty are left to feel unimportant, excluded, and disengaged with their institutions (CCCSE, 2014; McGlynn, 2014; Thirolf, 2017). Part-time faculty teach more than half of all the courses at community colleges, but little has been done to meet their needs and to support them into becoming institutional agents for their students (Kezar, 2012; Pons, Burnett, Williams, & Paredes, 2017). Their integration and engagement is imperative in increasing student-faculty interaction that supports students' success and degree attainment (CCCSE, 2014). By validating, integrating, engaging, developing, and mentoring part-time faculty, STEM students of color will have more opportunities for social integration and engagement in the campus community and within their majors. Thus, their interactions with institutional agents will increase. Policymakers, researchers, and institutions ought to intentionally

address part-time faculty needs and their unique challenges to serve their students.

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## Appendix

### Description of Dependent and Independent Variables

*Variables and Measures*

Variables	Description
<b>Dependent Variable</b>	
Frequency of informal or social interaction with faculty outside of the classroom or office (2003-04)	0=never, 3=often
Frequency of interaction with faculty about academic matters outside of class, including email (2003-04)	0=never, 3=often
Frequency of meeting with an academic advisors concerning academic plans (2003-04)	0=never, 3=often
<b>Independent Variables</b>	
<b>Block 1 - Demographic Characteristics</b>	
Asian (Reference)	0=no, 1=yes
Latinx	0=no, 1=yes
Black	0=no, 1=yes
Gender: Female	1= male, 2= female
<b>Block 2 - Pre-College Factors</b>	
Mother's highest level of education	1=High school or less, 4=Some grad or degree
Number of years delayed enrollment into postsecondary education	0=did not delay, 4=10 years or more
Total income	1=less than \$39,999, 4=\$100,000 or more
<b>Block 3 - Academic Integration</b>	
Took any developmental course	0=no, 1=yes
Worked Full Time	0=no, 1=yes
Attended Full-Time	0=no, 1=yes
Frequency of studying in groups outside of class	0=never, 3=often
Master's or above expected	0=no, 1=yes
Grade point average	0=less than 2.0 (D), 2=3.0 or more (B to A)
<b>Block 4 - Social Integration</b>	
Frequency of participating in fine arts activities	0=never, 3=often
Frequency of participating in school clubs	0=never, 3=often
Frequency of participating in school sports	0=never, 3=often
<b>Block 5 - Institutional Context</b>	
Hispanic Serving Institution (2003-04)	0=no, 1=yes
<b>Filter variables</b>	
Declared a STEM major through 2009	0=no, 1=yes
Two-year public college	0=no, 1=yes
Students of Color (Asian, Black, or Latinx)	0=no, 1=yes