

UNIVERSITY OF CALIFORNIA

Los Angeles

Bonding, Bridging, and Linking: Investigating
Collaborative Approaches Towards Expanding the Representation of
African American and Latinx Students Pursuing Graduate Study in STEM

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requirements for the degree Doctor of Education

by

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ABSTRACT OF THE DISSERTATION

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Professor Robert A. Rhoads, Chair

This multi-site case study explored collaborative interpersonal and organizational relationships among university administrators, business leaders, and nonprofit stakeholders at three University of California campuses (UCLA, UC Berkeley, and UC Davis). These stakeholders engaged in efforts to expand African American and Latinx representation in STEM graduate programs. Inside California's selective public research universities, African Americans and Latinx students comprise only 14 percent of graduate students enrolled across all disciplines. Globalization, shifting demographics, and scarce financial resources have shifted the landscape for diversity in higher education and tasked institutions within the UC system to develop strategies to achieve truly diverse student populations.

This study employed a theoretical framework based upon theories of social systems, collaborative complexity, and social capital to investigate URM recruitment for graduate study in a “STEM College.” Using a statewide sample drawn from participants linked to three University of California campuses, data was collected and analyzed from semi-structured interviews in order to compose three case studies. Case study is a valuable technique because of its rich detail. Moreover, case study allows the researcher to learn more about developing and implementing a new program or strategy.

There were four key findings from this research. First, stakeholders intentionally collaborated to achieve shared goals in conducting outreach to prospective underrepresented minority (URM) graduate students. Second, stakeholders collaborated to identify and provide research and job opportunities for URM students enrolled in STEM graduate programs. Third, the financial resources and power dynamics of business leaders’ relationships as alumni and with school leadership, gave them additional leverage to influence diversity strategies at the three campuses studied. Fourth, stakeholders collaborated in designing support services to mitigate social isolation many of the URM students encountered on the campuses studied. As a result of this study, campus administrators, business leaders, and nonprofit influencers and advocates now have information about multi-faceted, collaborative approaches designed to increase enrollment of African American and Latinx candidates in STEM graduate programs at UC campuses.

The dissertation of Kimberly Freeman is approved.

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DEDICATION

This dissertation is dedicated to my angels – my late father and brother. Your spirits are the wind beneath my wings.

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Chapter One: INTRODUCTION

“[S]tudent body diversity promotes learning outcomes and better prepares students for an increasingly diverse workforce and society, and better prepares them as professionals...Our country’s most selective institutions must remain both diverse and selective.” (Justice Sandra Day O’Connor writing for the majority in *Grutter v. Bollinger*, 539 U.S. 306, 123 S.Ct. 2325, 2003)

Statement of the Problem

Preparing for an Increasingly Diverse Workforce and Society

While underrepresented minority¹ (URM) enrollment is a diversity, equity, and inclusion issue at each progressive stage of the education pipeline (Oguntebi, Shcherbakova, & Wooten, 2012), African American and Latinx students are significantly underrepresented in graduate programs (Garces, 2012a; King, 2014; Kidder & Gandara, 2015). In fact, URMs comprised 22.2 percent of first time doctoral, masters, and professional school students across the nation in 2015 (Council of Graduate School Report, 2016). Additionally, underrepresentation in higher education persists even though census projections indicate racial and ethnic “minorities” will comprise over 50 percent of the overall U.S. population by 2050 (Garces & Mickey-Pabello, 2015; Hurtado, 2007; Oguntebi et al., 2012). Specifically, the Latinx share of the U.S. population is predicted to reach 24 percent by 2065 (Hurtado, 2007; U.S. Census, 2014).

Such low numbers concern public policy and education leaders since underrepresented minorities are more likely to attend public colleges and universities: in California, 93 percent of transfer students admitted to University of California (UC) campuses were from California community colleges; nationwide, nearly 25 percent of Latinx PhDs were first enrolled in

¹ Underrepresented Minority (URM) is defined as African American, Latinx, or Native American (Heller et al., 2014; PPIC, 2016; UCOP, 2016).

community colleges (Solorzano, Rivas, & Velez, 2005); and public colleges and universities award nearly 41 percent of all baccalaureate or graduate level degrees/certificates overall (American Academy of Arts & Sciences, 2015). Inside California's top public research universities only 14 percent of graduate students enrolled were from underrepresented groups in 2016 (UC Office of the President Data). This underrepresentation happens despite African Americans and Latinx students (now the largest group in the State) comprising more than 45 percent of California's population (Public Policy Institute of California (PPIC), 2016; Santos, Cabrera, & Fosnacht, 2010). African Americans are extremely underrepresented in graduate programs; the five-year average (2011–2015) for enrollment of African Americans in UC academic doctoral programs is 2.9 percent (UCOP data).

Because diversity in higher education has multiple meanings, Garces and Jayakumar (2014) contend that proper representation of people of color in higher education signals that diversity is valued. Relatedly, university leaders have espoused the belief that commitment to and implementation of effective diversity [management] practices (Weisinger & Salipante, 2005) in graduate enrollment might lead to student body populations that mirror society-at-large (Douglass, 1998; Kidder & Gandara, 2015; Thompson & Campbell, 2012). This is a representational view of diversity that is rooted in social justice. Some scholars refer to representational diversity as the first path of diversity management, which focuses on a discrimination and fairness paradigm and equates diversity with equal opportunity and affirmative action (Thomas & Ely, 1996; Weisinger & Salipante, 2005).

Then again, education researchers are finding that a singular focus on representational diversity is not enough to address the systemic under-enrollment issues outlined above. Thomas and Ely's second path of diversity management emphasizes an access and legitimacy paradigm.

A third path embraces a learning and effectiveness paradigm. Additional studies support these two concepts. First, Hu-Dehart (2000) asserts, “A diverse student body is necessary for challenging an institutional environment that excludes multicultural life experiences” (as cited in Aguirre & Martinez, 2002, p.55). Likewise, diversity in the classroom trains college students to function in a pluralistic and global society (Bowen & Bok, 1998; Hurtado, 2007; Marcy, 2004; Oguntebi, et al., 2012; Posselt, 2016). Thus, when representational, interactional, and educational diversity goals are achieved in higher education, individuals develop the capacity to work effectively and get along well with people from different races and cultures (Bowen & Book, 1998). There is one caveat though: to successfully complete college and graduate school, students need the reassurances that a positive campus racial climate can offer (as cited in Garces & Jayakumar, 2014; Hurtado, 1994, 2007). Therefore, in the context of a positive campus racial climate, this triad of diversity management paths demonstrates the “systemness” (Fullan, 2016) of diversity (and equity and inclusion) and provides greater rationale to support URM outreach at selective² universities.

Selective Institutions Must Remain Diverse and Selective

In recent years, and as demographic trends reshape American higher education, selectivity has taken on greater significance (Alon & Tienda 2007; Chapa & De La Rosa, 2006). Where URM students are enrolling in graduate school is as much an issue as how many of them are enrolling in graduate school altogether. Evidently, qualified minority students over-enroll at broad access colleges, yet under-enroll at selective universities. Although an abundance of

² “Selective [universities] are those in the top three categories of selectivity as determined by Barron’s Profiles of American Colleges. These [universities] admit students who score in the top 35 percent of college-entry exams” (Carnevale & Fasules, 2017, p.13).

research regarding selectivity details what is happening at undergraduate institutions, key insights from this research can still inform education leaders concerned with URM enrollment in graduate schools.

To begin with, only 26,000 of Latinx students who score in the top half of the nation's high school students attend one of the nation's 500 selective colleges. Said another way, only 15 percent of first-year Latinx students enroll in selective colleges compared with 65 percent enrolling in broad access colleges (Carnevale & Fasules, 2017). Similarly, African Americans attend non-selective colleges and universities (e.g., for-profit colleges and universities) in larger proportion than all other groups. Where a URM student attends school matters because research shows that the average student (1000 on the SAT) has a 77 percent chance of graduating if attending a selective school. This chance represents a 26 percentage-point advantage over graduating from a broad access school where the average SAT is 900 (Carnevale & Fasules, 2017). Melguizo (2010) also confirms a slight increase in college completion rates for students attending selective 4-year universities.

But the news is not all bad. Carnevale and Fasules (2017) describe improvement in Latinx students closing the achievement gap – postsecondary degree attainment for Latinx students stands at 45 percent. Nevertheless, Latinx students still lag behind Whites (74 percent) and African Americans (66 percent) when it comes to postsecondary attainment. Relatedly, the US Department of Education (2017) reports that 49.6 percent of Latinx students and 35.8 percent of African Americans who enroll at four-year colleges complete their degrees within 6 years, while 60.7 percent of Whites complete their four-year degrees within the same time period.

Underrepresentation in STEM Impacts Available Workforce

For as much as anti-affirmative action policies passed at the state government level impact higher education admissions, these policies also impact availability of a workforce with the skills to compete in the knowledge economy. Leydesdorff (2010) writes about the Triple Helix Model of the knowledge economy: government, higher education, and industry. The reality is that these three institutions are networked by institutional relationships that constrain each other's behavior and functional relationships that shape each other's expectations (Leydesdorff, 2010). When it comes to underrepresentation in public universities and the workforce, government, higher education, and industry are inextricably linked. Consequently, what happens at selective public universities affects the available workforce.

The ties between education and the economy are hardly new phenomena. Dating back nearly 200 years, "the history of [public] higher education reflect[ed] an on-going tension and debate over the role of markets and the way higher education [would] serve society" (Kezar, 2004, p. 455). Proponents of student body diversity often cite the relationship between access to higher education and success in the economy (Rhoads, Saenz, & Carducci, 2005). It is fair to presume that underrepresentation can also impact economic opportunity in the long run. Dale and Krueger (2011) cited a Stanford University and Mathematica Policy Research study indicating that students with parents having less education, as well as African American and Latinx students, attain higher postgraduate earnings by attending more selective universities versus their peers who attend less-selective universities. In addition, researchers estimate that 2.5 million additional US jobs will require a graduate degree by 2018 (UCLA data). Moreover, many occupations in today's knowledge economy increasingly require masters or professional degrees.

Despite this knowledge, numerous research studies cite substantial minority underrepresentation in the STEM fields alone (Anderson, Carreon, Friedman, Baumeister, Afifi, Nakazona, & Davidson, 2007; Gazley, Remich, Naffziger-Hirsh, Keller, Campbell, & McGee, 2014; Heller, Hurtado Rua, Mazumdar, Moon, Bardes, & Gotto, 2014; Thompson & Campbell, 2012). As a matter of fact, Latinx students comprise only 7 percent of workers in jobs that require a graduate degree (Carnevale & Fasules, 2017), and they are less likely to work in STEM occupations compared to the average worker. Trends like these are alarming for the knowledge-based economy since many employers use graduate degrees as a screening tool for choosing among applicants for jobs (Bowen & Bok, 1998).

In states like California, the economic ramifications of such small numbers of underrepresented minorities earning masters and professional degrees are acute. Sectoral shifts in California's economy from manufacturing to [professional] services and faster population growth demand employees with more advanced education (Garces, 2012; PPIC, 2016). More to the point, Silicon Valley, Silicon Beach, and a thriving healthcare/bio-tech ecosystem in San Diego are all located in California. Researchers predict that increasing the number of minorities in STEM has the potential to reduce racial income gaps given the large labor market returns that minorities receive in STEM fields (as cited in Hill, 2017). Without attention to this problem, declines in URM enrollment in graduate schools over time will enlarge socioeconomic inequities for URMs in the state.

Underrepresentation in STEM Impacts Knowledge Production and Research

Faculty and administrators have cause for concern, too, since graduate education is the pathway to careers and leadership in many fields, including the professoriate. For example, researchers note that African Americans, Native Americans and Latinx students comprise less

than 7 percent of all U.S. faculty in business and management education (Oguntebi et al., 2007). Within the university, doctoral students, in particular, are critical to an institution's ability to produce knowledge and research (Holley, 2013). Producing graduates with masters, professional, and doctoral degrees aligns with UC's mission, extends faculty outreach to students, and helps with teaching load. In spite of this, the number of underrepresented minorities that hold faculty positions is small.

On a more promising note though, over the past twenty years the number of doctorates awarded nationally to African Americans has grown by 70 percent and has nearly doubled for Latinx doctorate recipients. In general, doctorates awarded to African Americans were 4.1 percent in 1994 and 6.4 percent in 2014; likewise, doctorates awarded to Latinx students were 3.3 percent in 1994 and 6.5 percent in 2014 (NSF, 2016). These trends are particularly important in California since UC campuses are the top universities producing Latinx doctorates (Kidder & Gandara, 2013). Still, to keep pace with rising numbers of undergraduate students admitted to these campuses, UC needs to attract larger numbers of graduate students and to add many more particularly from these underrepresented groups. By comparison, Asians and Whites are more likely to have completed an undergraduate degree (NSF, 2016), thus forming a bigger pool of potential graduate students.

Unfortunately, the problem of underrepresentation of minorities in graduate schools is a complex social problem that spans multiple sectors (Senge, Hamilton, & Kania, 2015; Siegel, 2007; van Tulder, Seitanidi, Crane, & Brammer, 2015). Therefore, educating a diverse graduate population can support opportunities in the workforce and higher education long-term (Bowen & Bok, 1998; UC Guidelines for Enhancing Race and Gender, 2016).

Background of the Problem

Opinions Vary for Why URM Enrollment in Graduate School is Low

As several studies indicate, tension and debate arise when admissions policy prioritizes traditional academic standards without regard to admitting students from a broad range of society (Douglass, 1998; Melguizo, 2010; Santos, Cabrera, & Fosnacht, 2010). Under a traditional academic standards rationale, graduate admissions officers point to assumptions about merit and admissibility as hindering diversity in graduate schools (Alon & Tienda, 2007; Bowen & Bok, 1998; Cassuto, 2016; Posselt, 2016; Schneider & Segura, 2014; Sternberg, 2007). Moreover, often-cited reasons for low URM enrollment in higher education are personal attributes such as educational experience, motivation, awareness and social environment (Oguntebi, et al., 2012). Always at issue, heavy reliance on GPA and standardized test scores impacts representation (Alon & Tienda, 2007, Garces, 2012a; Heller et al., 2014). No matter what the reason is, all of these merit- and access-based arguments (Melguizo, 2010) are situated in a web of broader governance, legislative, and Supreme Court actions with serious implications for URM students applying to UC graduate schools.

Proposition 209 Impacts

Race as a factor in admissions withstood roughly 30 years of admissions practice (Rhoads, Saenz, & Carducci, 2005). However, in 1996 voters passed Proposition (“Prop”) 209 banning race-based affirmative action programs in admissions, financial aid, and hiring throughout the public sector (Biegel, Kim, & Welner, 2016; Douglass, 1998; Lipson, 2011; Santos, Cabrera, & Fosnacht, 2010). The prior year, UC Regents passed SP-1, a resolution to eliminate race, religion, sex, color, ethnicity or national origin as criteria for admission to its campuses. Over 20 years since its passage, the legacy of Prop 209 continues to overshadow so

many of the outreach and recruitment efforts undertaken in California. This anti-affirmative action policy has led to severe declines in URM enrollment in undergraduate and graduate programs (Biegel, Kim & Welner, 2016; Lipson, 2011; Santos, Cabrera, & Fosnacht, 2010). Case in point, undergraduate enrollment of African American and Latinx students dropped by over 50 percent at UCLA and UC Berkeley immediately following the passage of Prop 209 (King, 2014; Kidder & Gandara, 2015). Moreover, research shows that affirmative action bans have led to the greatest reductions in science-related fields of engineering, the natural sciences, and the social sciences (Garces, 2013; Hill, 2017).

The effect of affirmative action bans on student body diversity contradicts viewpoints colleges and universities articulate regarding the value of diversity in higher education. Consistent with Thomas and Ely's (1996) third path toward pluralism described earlier, most graduate programs today espouse in their mission statements that diverse student bodies reflect the "balanced interest and the richness of our society" (Posselt, 2016, p. 9). Moreover, according to Douglass (1998), "Affirmative action and specifically the use of race as a factor in admissions, is historically consistent with the larger effort by the University of California to admit students from a broad range of society" (p. 939).

Admitting Students from a Broad Range of Society

The Supreme Court decision (*The Regents of the University of California v. Bakke*, 1978) introduced diversity as a term used to describe racial representation. One definition of diversity is representation in one social system of people with distinctly different group affiliations of cultural significance (e.g., race, gender, religion, and culture, and can include nondemographic variables) (as cited in Weisinger & Salipante, 2005). In the wake of Prop 209's passage, colleges and universities have adopted the diversity rationale as a framework for URM

recruitment, whereby diversity encompasses a broad range of qualifications and characteristics. Race or ethnicity is a single element (Garces, 2014). Essentially, the diversity rationale suggests that colleges and universities may consider race in making admissions decisions so long as the intent is to enhance student body diversity as a means of strengthening the learning experience.

While the “Powell Compromise” articulates that cultivating a diverse student body serves a compelling interest (Garces, 2014; Garces & Jayakumar, 2014), at the same time the diversity rationale weakens social justice arguments for affirmative action in favor of educational diversity benefits (Rhoads, Saenz, & Carducci, 2005). Today, UC is permitted to use outreach programs to reach particular groups, insofar as the programs’ benefits are also available to other groups, and the special efforts to reach the targeted groups are deemed necessary (UC Guidelines for Enhancing Diversity, 2016). In short, campuses may make special efforts to reach particular groups, so long as the same information is available in some way to all regardless of race or ethnicity (UC Guidelines for Enhancing Diversity, 2016).

Building Relationships with Community-Based Organizations

Even with all the current resources being allocated to outreach, the URM numbers remain extremely low. Increasingly, colleges and universities are looking to various collective actions, such as networking and collaboration, to pool resources to address the complex social problem of minority underrepresentation in higher education (Thomas, Cooper, & Quinn, 2002). Universities also construct collaborative programs with other parties within industry, government, and the community as a strategy for improving access to higher education (Domina & Ruzek, 2012).

These cross-sectoral collaborations at times have better aligned URM outreach with workforce and community needs. For instance, cross-sectoral outreach programs can connect

URM students to resources in the form of businesses and alumni who can advise and mentor them about careers and majors. In addition, with California's population currently at 39 percent Latinx, UC's proximity to a sizeable Latinx population suggests that establishing outreach programs that include extramural experiences for URMs within the community might improve numbers of URMs opting for graduate study.

As California's selective public universities look to diversify their student bodies in the future, admissions and student affairs administrators face key barriers to collaboration. First, the anti-affirmative action backlash curbs available tools that institutions possess to realize the goal of racial and ethnic diversity (Garces, 2014). Second, graduate admissions and student affairs administrators view the overall culture of recruitment as a barrier to attracting larger numbers of graduate students of all backgrounds (Anderson et al., 2007; Thompson & Campbell, 2013; National Science Foundation, 2016). Third, undergraduate administrators lack knowledge about existing outreach programs at the graduate level to encourage URM student involvement (Timar, Ogawa, & Orillion, 2002). Most importantly, and according to URM students, scholarships/financial aid and the presence of other URM students remains important in attracting URM students to choose certain schools for graduate study (Anderson et al., 2007). Consequently, a public research institution's perceived commitment to diversity, which is situated in public policy, organizational, and cultural contexts, can encourage or discourage a minority student's application and enrollment (Garces & Jayakumar, 2014). In other words, representational diversity alone won't solve the diversity problem; however, a campus ecosystem supported by intentional practices and interventions, which augment cross-racial interactions and strengthen campus racial climates, will (Chun & Evans, 2015).

Collaboration as practice holds promise because “one of the single lessons to be drawn from the diversity movement of the last decade is that colleges and universities do not pursue their diversity-related interests in a vacuum” (Siegel, 2005, p. 519). Hence, this dissertation sought to link policy to practice in finding collaborative strategies that address underrepresentation and build cross-sectoral relationships that benefit URM outreach.

Problem Studied

This multi-site case study explored approaches to collaboration as a means of increasing URM enrollment in graduate schools from the point of view of administrators, business leaders, and nonprofit leaders at three selective California public research universities: UCLA, UC Berkeley, and UC Davis. The largest of the three by population size is UCLA, a campus located in West Los Angeles. The second campus chosen is UC Berkeley, located in the San Francisco Bay Area. The third campus is UC Davis, located in Northern California. All three are selective campuses by definition. Furthermore, Hill (2017) categorizes UCLA and UC Berkeley as highly selective, while UC Davis is defined as moderately selective, on the basis of test scores of incoming students. By studying collaborative approaches among stakeholders, my research was conducted to inform existing and future outreach programs that focus on relationships among population characteristics, state-level policy factors, and proportion of URM enrollment (Anderson et al., 2007).

A number of terms are used interchangeably in the literature to represent the idea of collective action, including the following: partnership, collaboration, cooperation, networks, coordination, alliances, sponsors, or supporters (Babiak & Thibault, 2009; Glatter, 2003). In this study, collaboration was used most often. Collaboration was defined as “a process through

which parties who see different aspects of a problem can constructively explore their differences and search for solutions that go beyond their own limited vision of what is possible” (as cited in Cloutier & Langley, p. 104).

Collaboration at times can be in response to environmental complexity (Schneider, Wickert, & Marti, 2017). More importantly, collaboration also encourages individuals to view problems from a systems perspective. Systems research describes three core capabilities required for performance: 1) an ability to see the larger system; 2) an ability to foster reflection and more generative conversations; 3) an ability to shift the collective focus from reactive problem-solving to co-creating a future (Senge et al., 2015). In solving a complex social problem like underrepresentation, universities, businesses, and nonprofits create collaborative complexity using joint structures and processes to simplify complexity of their respective and potentially overlapping environments, (Schneider et al., 2017).

Moreover, this study was needed because extremely low numbers of minority students and high variability across graduate degree programs limit scholars’ abilities to understand the effects of affirmative action bans at the graduate schools level (Garces 2012a, 2013). Table 1 shows the percentages of African American, American Indian, and Latinx students enrolled in doctoral, masters, and professional degree programs over six years (2011-2016) by ethnicity across the entire 10-campus UC system.

Table 1. UC Fall Graduate Degrees Headcount by Ethnicity

	2011	2012	2013	2014	2015	2016
All Students	49,760	49,700	50,409	51,553	52,587	54,057
African American	3.0 %	3.2 %	3.3 %	3.4 %	3.5 %	3.6 %

	2011	2012	2013	2014	2015	2016
American Indian	.8 %	.8 %	.9 %	.9 %	.9 %	.9 %
Latinx	8 %	8.3 %	8.4 %	8.7 %	8.7 %	9.1 %
%URM	12 %	12 %	13 %	13 %	13 %	13.6 %

(Source: Data compiled from University of California Office of the President website, www.ucop.edu.)

Existing Interventions/Gaps

Since the passage of Proposition 209, there are many ways that California universities have sought to recruit URM undergraduate and graduate students (Kidder & Gandara, 2015). UC has expanded outreach and employed comprehensive admissions review in order to increase the enrollment of URMs (Kidder & Gandara, 2015; Santos et al., 2010). Additionally, financial investments have been made in undergraduate initiatives such as the Early Academic Outreach Program (EAOP) and Mathematics, Science, Engineering, Achievement (MESA) academic preparation program and graduate initiatives with schools having large undergraduate student of color populations such as Historically Black Colleges and Universities (HBCUs), California Community Colleges, and California State Universities (CSUs). Whatever the strategy, developing a diverse applicant pool is likely to involve conducting extensive outreach (UC Guidelines, 2006).

With these initiatives as background, administrators, business leaders, and nonprofit leaders concerned with increasing the numbers of African American and Latinx students at the graduate school level needed to know how applicant desirability was constructed, how these decisions were made, and what such choices mean for society (Posselt, 2016). Relatedly, a 2016 Council on Graduate School report indicated that more research on graduate education is needed

in order to address America’s national capacity to innovate and to prepare graduate students to compete globally. While studies have documented what is happening within these collaborations, more research was needed on what is happening across them and how cross-sectoral relationships are leveraged to attract more underrepresented minorities for graduate study. The definition of cross-sector collaboration is generally accepted to be “the linking or sharing of information, resources, activities, and capabilities by organizations in two or more sectors to achieve jointly an outcome that could not be achieved by organizations in one sector separately” (Bryson, Crosby, & Stone, 2015, p. 648).

Additionally, numerous studies discuss how solving social problems through cross-sectoral collaboration were challenging to implement and sustain (Domina & Ruzek, 2012; Dorado, Giles, & Welch, 2009; Le Ber, & Branzei, 2012; van Tulder, R. et al., 2015). Therefore, it was important to investigate how collaborative relationships in “STEM Colleges” at UCLA, UC Berkeley, and UC Davis operate. In addition to informing existing outreach programs, studying outreach programs was necessary in order to establish best practices for developing future URM recruitment partnerships at UC.

Research Questions

With the preceding in mind, my dissertation centered on the following research questions:

1. What roles do collaborative relationships play among higher education STEM administrators, business leaders, and nonprofit leaders in their efforts to bolster strategies for expanding representation of African American and Latinx graduate students in STEM?

2. How do higher education STEM administrators, business leaders, and nonprofit leaders see working together as helpful in addressing key challenges and barriers URM students face in persisting to graduate school in STEM?
3. How do higher education STEM administrators, business leaders, and nonprofit leaders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

Overview of the Research Design

Exploring collaboration required a qualitative design, as qualitative design allows for examination of people, processes, and programs (Wholey, Hatry, & Newcomer, 1994). Furthermore, cross-sectional, multi-site case studies offered an opportunity to examine graduate school outreach across multiple sites and multiple programs in order to demonstrate variability in approaches to addressing the issue of URM graduate school outreach at UC. By interpreting and analyzing the experiences of multiple stakeholders across “STEM Colleges” (a pseudonym for an academic unit found on all three campuses) at three University of California campuses, I identified essential features, processes, and obstacles that university administrators may need to address in creating collaborations to attract URM students. Data was collected by analyzing documents, including diversity-related institutional planning documents, visiting the three campuses, and conducting interviews with campus administrators, business leaders, and nonprofit leaders.

The public universities in this study were chosen because California’s public universities have long been the subject of widespread public debate around affirmative action due to statewide propositions, lawsuits, and changing demographics. Moreover, underrepresented minorities are more likely to attend public colleges and universities (Marichal, 2009; American

Academy of Arts & Sciences, 2015). These campuses were also purposefully chosen because of selectivity, student profile, location, and the presence of diversity practitioners tasked with increasing URM enrollment in graduate schools. Also, according to a National Science Foundation (NSF) survey of earned doctorates, from 2012 to 2016 UC Berkeley, UCLA, and UC Davis ranked, #1, #2, and #11, respectively, among top 20 doctorate-granting institutions for Hispanic/Latinx doctorate recipients. However, none of these institutions ranked in the top 20 doctorate-granting institutions for African American doctorate recipients. However, African Americans did earn 5.9% of the life sciences, 2.6% of the physical and earth sciences, 4.5% of the mathematics and computer sciences, and 4.1% of the engineering doctorates nationwide in 2016 (NSF data).

Given the size of these campuses and the complexity that studying a variety of graduate programs can pose, the scope of this study was limited to analyzing URM outreach within each of UCLA, UC Berkeley, and UC Davis' "STEM Colleges." Also, for a number of reasons "STEM Colleges" provide ample opportunities to explore outreach programs. First, a closer connection to economic and private industry goals exists within these academic units. Second, California's economy is undergoing sectoral shifts from manufacturing to professional services, like information technology, financial services, and consulting, and the need for employees with more advanced education, particularly in STEM disciplines, is rising (Garces, 2012; PPIC, 2016). Third, these "STEM Colleges" are commonly networked with business and industry through alumni, research, and teaching relationships.

The Significance of the Research for Solving the Problem

The intent of my research was to identify best practices for developing and implementing outreach programs and establishing collaborative interpersonal and organizational relationships

to support ongoing efforts aimed at increasing URM enrollment in graduate STEM studies. Because of difficulties in examining multiple and diverse interests, relationships within and across collaborative arrangements have rarely been empirically studied (Babiak, 2008). For this reason, this research was conducted to fill a gap that exists in education research on collaborative arrangements as a response to environmental complexity (Anderson, et al., 2007; Schneider et al., 2017). Further, Rhoads, Saenz, and Carducci (2005) note that the research was lacking on the role of collective action and ideology as key elements in large-scale reform processes such as affirmative action. Here again, this multi-site case study intended to fill a gap in research by examining the “systemness” (Fullan, 2011; Senge et al., 2015) of URM outreach with an emphasis on collaboration, partnership and relationship qualities.

With the findings from this research, I will provide campus outreach administrators with further knowledge to encourage enhancement and expansion of outreach programs as a strategy to recruit and admit URM graduate students. Additionally, the public will be engaged by presenting the findings of this study to higher education colleagues and to larger audiences through conference presentations and informal discussions at various professional meetings throughout the year.

Chapter Two: REVIEW OF THE LITERATURE

Introduction

Universities, as open systems, are impacted by demographics, changing values, and competitive dynamics in society (Gonzalez, 2010). Within these open systems, how complex problems like student body diversity are framed, studied, and discussed influence how they are understood (Burkhardt, & Ting, 2016). Relatedly, diversity definitions can serve as frames. For example, one definition of diversity is “the differences among cultural groups as well as identity differences among group members in relation to other groups” (as cited in Oguntebi, Shcherbakova, & Wooten, 2012, p. 476). In a similar fashion, another definition of diversity is representation in one social system of people with distinctly different group affiliations of cultural significance including race, gender, religion, and culture, and can include nondemographic variables (as cited in Weisinger & Salipante, 2005). In this study, racial diversity is the defining group affiliation that frames the discussion about minority underrepresentation in graduate school.

Embedded within the definition of diversity are what Thomas and Ely (1996) present as three paradigms: discrimination and fairness, access and legitimacy, and learning and effectiveness. These paradigms are dynamic and in many ways undergird broader discussions about the power of education to transform society. Policy makers and education leaders sometimes advance a pluralistic viewpoint that education reform serves as a way to foster greater social inclusion while increasing economic performance in a globalized, knowledge-based

society³ (Leydesdorff, 2010; Thomas, Cooper & Quinn, 2002). At other times, stakeholders frame the role of higher education as society's effort to deliver economic growth and social security for its population (Rhoads et al., 2005; Schulze-Cleven & Olson, 2017). Either way, markets and marketization dominate higher education worldviews, with more prominence being granted to universities' participation in the economy than to their role in society (Apple, 2000; Lohmann, 2004; Suspitsyna, 2012). Thus, the power of education to transform society is at the core of what Apple (2000) describes as "a site of struggle and compromise" (p. 59).

This literature review proceeds in the following manner. The first section provides critical background of the external environment and internal context that has influenced policymaking from the passage of the Civil Rights Act of 1964⁴ to present. During this time, stakeholders within higher education movements have grappled with charting a path to greater diversity, equity, and inclusion of underrepresented minorities in higher education ranging from social justice to an educational diversity rationale in admission policy. The next section provides a comparison of some URM outreach programs at colleges and universities around the country. While the outcomes of these programs vary, there are nonetheless key structural and strategic insights to be gained from how these collaborations are designed and implemented. The literature review concludes by posing a theoretical framework for outreach to URM candidates based on social systems theory, collaborative complexity, and social capital. This theoretical framework may prompt ideas for administrators looking to design and implement impactful URM outreach programs, anchored by collaboration, in the future.

³ In a knowledge-based economy, the main institutions are the university, industry, and government (as cited in Leydesdorff, 2010).

⁴ The 1964 Civil Rights act supplied the statutory strength to enforce the ban on race- and gender-based discrimination in all programs at public or private institutions receiving federal funds.

External Environment and Internal Context

Origins of Affirmative Action

For better or worse, social movements and worldviews are how we make meaning in life (Creswell, 2014; Marichal, 2009; Simsek & Louis, 1994). While the origins of the term *affirmative action* are found in Executive Order 10925 initiated by President John F. Kennedy (Chun & Evans, 2015), affirmative action post-Civil Right Act of 1964 was both a set of policies aimed at advancing educational and employment opportunities and a social movement concerned with increasing educational and economic opportunities for members of underrepresented groups (Chun & Evans, 2015; Douglass, 1998; Rhoads et al., 2005).

Initially, affirmative action served as a means of greater social inclusion in higher education in response to turmoil on college campuses and civil unrests in American cities (Chun & Evans, 2015; Garces, 2012a; Lipson, 2011; Marichal, 2009; Rhoads, et al., 2005; Schmidt 2007). Around the same time, formal policy adoption of race and ethnicity as factors in the admissions process by the University of California emerged from the worldview that affirmative action in graduate enrollment might lead to student body populations that mirror society-at-large (Douglass, 1998). In short, affirmative action policy existed for two reasons: first, to redress past discrimination by colleges, and second to offer opportunities to people who might not get them otherwise (Chun & Evans, 2015; Lipson, 2011; Schmidt, 2007).

During the 1970s, enrollment in higher education of African Americans and Latinx students increased substantially (Hurtado, 1994). Most importantly, higher education administrators operated with the belief that creating educational pathways for minorities would lead to better quality of life and build strong leaders, economically, politically, and socially

(Hurtado, 2007). As a result, the number of master's degrees awarded during this time to African Americans increased by 40 percent (Lipson, 2011). Also during this period, cross-sectoral collaboration emerged as a strategy for outreach and recruitment. In yet another example of the Triple Helix model described earlier, selective colleges realized a commitment to recruiting and educating minority students by attracting financial capital from businesses, philanthropies, and federal agencies. Notably, while higher education was pursuing paths of fairness, access and legitimacy through affirmative action as a movement, business and organizations were managing affirmative action policy through "commitment on the part of organizations to recruit, retain, reward, and promote a heterogeneous mix of productive, motivated, and committed workers including people of color, whites, females, and the physically challenged" (as cited in Weisinger & Salipante, 2005, p. 31).

The Push for Educational Diversity

Diversity as a term used to describe racial representation in education first appeared in the Supreme Court decision, *Regents of the University of California v. Bakke* (1978). This case involved a challenge to UC Davis' medical school regarding its consideration of race in its admissions decisions (Garces, 2014). In defense of its policy, UC Davis represented that "race as a factor in admissions was needed to obtain the educational benefits that flow from having an ethnically diverse student body" (Garces, 2014). Before the Civil Rights movement, UC's earliest attempts at "diversity" meant selecting students on the basis of differences in ideas or points of view versus race and ethnicity (Bowen & Bok, 1998; Oguntebi et al., 2012; Posselt, 2016).

This push for cognitive diversity occurred at a time when race/ethnicity, gender, and religious diversity were practically nonexistent in the student body's composition on these

campuses. Even still, while public universities made admissions decisions openly considering race and ethnicity as a factor (Bowen & Bok, 1998; Lipson, 2011), there was less reflection on the benefits that racial and ethnic diversity might bring to educational or interactional settings (Garces, 2014). Later, Hurtado (2007) would link diversity with educational goals⁵ (Bowen, 1977) and civic goals as a way to advance social progress.

A consequence of the Powell Compromise was that across the higher education and business sectors, the framework for diversity shifted from its social justice roots to one that emphasized race-neutral curricular and interactional diversity rationale (Moses & Chang, 2006; Marichal, 2009; Lipson, 2011; Schmidt, 2007; Schneider & Segura, 2014). Similar to the Powell Compromise, Marichal (2009) contends that a need to accommodate changing demands instigates frame[work] evolution. Accommodation of this kind resembles the coercive isomorphism⁶ concept previously established by DiMaggio and Powell (1983).

Proposition 209 Bans Affirmative Action as a Policy

Through a series of policy actions, California became the first state in the nation to ban race-based affirmative action programs in admissions, financial aid, and hiring throughout the public sector (Biegel et al., 2016; Hill, 2017; Lipson, 2011). First, the UC Regents passed a resolution to eliminate race, religion, sex, color, ethnicity or national origin as criteria for admission to its campuses in 1995. This resolution further altered the proportion of students admitted to UC on the basis of academic criteria alone (King, 2014; Timar et al., 2002). Next,

⁵ *cognitive learning*, i.e., expanding knowledge and intellectual powers; *affective development*, i.e., enhancing moral, religious, and emotional interests and sensibilities; and *practical competence*, i.e., improving performance in citizenship, work, family life, consumer choice, health, and other practical affairs (Bowen, 1977).

⁶ Coercive isomorphism results from both formal and informal pressures exerted on organizations by other organizations upon which they are dependent and by cultural expectations in the society within which organizations function (DiMaggio and Powell, 1983, p. 196).

voters in California passed Proposition 209, the affirmative action ban. Together these policies would have a chilling effect on undergraduate and graduate admissions to the UC's most selective campuses.

After passage of each, undergraduate enrollment of African American and Latinx students dropped by over 50 percent at UCLA and at UC Berkeley (Garces & Jayakumar, 2014; Kidder & Gandara, 2015; King, 2014; Santos, Cabrera, & Fosnacht, 2010). Similarly, bans implemented in Florida (One Florida Initiative), Texas (*Hopwood v. State of Texas*, 1996), and Washington (Initiative 200) caused declines in underrepresented minorities at selective public universities at major public research universities (Lipson, 2011; Garces, 2012b). Findings from quantitative studies show declines in racial and ethnic student body diversity in the professional fields of law and medicine (Kidder, 2003). Likewise, a quasi-experimental study by Garces (2012b) documents declines in the representation of students of color across all graduate studies, outside the fields of law and medicine. Overall, across the four states, URM students represent 12 percent of the graduate student population on average (Garces, 2012b); California's 2016 URM population is 14 percent.

Besides ballot initiatives, legal cases also framed by worldviews altered access to selective colleges and universities for URM students. In the early 2000's, *Grutter v. Bollinger*, the University of Michigan Law School case which defended affirmative action's use in limited circumstances, emphasized the need for colleges and universities to consider race. This defense in some ways mirrored earlier social justice and structural rationales for diversity. In other ways, like Justice Powell writing for the majority, Justice O'Connor heightened the focus on the educational benefits of diversity as well as the societal benefits of training leaders with "legitimacy in the eyes of the citizenry" (*Grutter*, 539 U.S. at 333). Additionally, the *Grutter*

decision was important because the Supreme Court provided seminal language further advancing diversity efforts specifically aimed at minority enrollment in graduate schools.

In many ways, Justice O'Connor's opinion strikes a similar tone to Apple's view of education as a site of "struggle and compromise." The opinion drew attention to the need to balance economic reasons for diversity with social inclusion. In fact, thirty-two companies filed an *amicus curiae* in *Grutter* using more than a decade of scientific evidence citing how they partner with university staff and national and minority professional organizations to train and recruit talent at colleges and universities across the country (Rhoads et al., 2005; Siegel 2007). Some educational scholars properly questioned whether deliberate shifts in strategy were nothing more than savvy legal strategies (Moses & Chang, 2006). Critics wanted to avoid over-reliance upon educational benefits to the exclusion of recognizing historical legacies and other patterns of racial discrimination (Garces & Jayakumar, 2014).

URM Outreach Strategies

Against a backdrop of policy shifts regarding representational, interactional, and educational diversity in higher education, selective state universities in California have increasingly relied upon collaboration to improve access for URM students. The rise in collaboration is due, in part, to universities recognizing that they alone cannot solve the problem of lack of diversity within their institutions (Siegel, 2007). Moreover, just as collaborative fixes for underrepresentation vary state-to-state given the decentralized nature of U.S. higher education policy (Garces, 2012b), these approaches also vary campus-to-campus. This variability makes generalizing to all selective public universities a challenge. Even still, before exploring the merits of collaboration for URM outreach, discussing various approaches to collaboration within existing outreach programs is beneficial. The next sections discuss three

studies, Anderson et al. (2007), Hurtado (1994), and Thompson and Campbell (2012) that were similar to this study of outreach to URMs for graduate study in STEM.

Seeing the Larger System: Context, Perceived Commitment, and Campus Climate

Anderson et al. (2007) describes a 2003 study of factors influencing proportion of URMs in dental school. This study is one of the first to present findings that link the relationships among population characteristics, state-level policy factors, and proportion of URM enrollment. Using a comprehensive framework methodology, the researchers find that the community or the larger environment in which the school is located, characteristics of the school itself, and the nature of community-based dental education (CDBE) within the dental school matter when conducting URM recruitment. This study used graduate student data collected from 33 percent private and 67 percent public universities. The study highlights a University of Pennsylvania program whose attributes include “an administration and mission committed to a diverse student body, scholarships and financial aid, partnerships with two historically Black colleges, and a program directed at URM high school seniors” (p. 995).

According to the study, while students choose a school on the basis of its environment or location, the characteristics of the school, and the curriculum they expect to experience, schools choose students based on student’s academic profile as well as how well they will fit into the characteristics and curriculum of the school. The same study finds that graduate schools located in counties with higher percentages of African American and Latinx persons recruit higher proportions of African American and Latinx students (Anderson et al., 2007). This private school example is from a quantitative study conducted 15 years ago, so it would be important to update this research.

Much like Anderson et al., Hurtado (1994) finds that environment, characteristics, and curriculum play a role in student success. Hurtado conducted a longitudinal study of African American and [Latinx] students that examined graduate school racial climates and academic self-concept among minority graduate students during the 1970s. By reviewing national studies on minority enrollment in graduate school, Hurtado explains that faculty expectations and attitudes and quality of interaction are paramount to student success in graduate studies. Thus, relationships and personal interactions hold weight in addition to contextual factors, like policy setting and location, when it comes to URM enrollment. Hence, the story of what happens once a URM enrolls in a school can help with recruitment since student success is also how URMs often decide if a graduate school is a right fit for them (Anderson et al, 2002; Hurtado, 1994).

In another study, Thompson and Campbell (2012) conduct a quantitative study examining systemic practices aimed at diversity and institutional culture in graduate school at a private East Coast university. The theme of institutional culture as a driver of diversity is instructive. In contrast to Hurtado's analysis of faculty relationships with students, Thompson and Campbell describe faculty relationships with a government agency as enabling URM recruitment. More importantly, the latter faculty-driven relationships function in a way that faculty are already familiar with because of research-based scientific collaborations held between the two partners. Compiling the insights from all of the studies reveals a framework for structuring collaborations that includes context, perceived commitment to diversity, community or larger environment in which the school is located, characteristics of the school itself, relationships and interactions, and institutional culture.

Shifting the Collective Focus: Organizational Capabilities

Necessarily, collaborating with external stakeholders on outreach removes traditional boundaries that restrict access to higher education for URM students (Holley, 2009; Siegel, 2007, 2010). Once again, the Thompson and Campbell (2012) study examines pre- and post-implementation of a collaboration called the “Initiative to Maximize Student Development (IMSD)” at a private university. In an effort to address some of these boundaries, the researchers question whether or not developing institutional collaborations that create systems of tailored student support, engage faculty, and generate shared institutional goals across parties enhance URM access and success. Like the previous studies, Thompson and Campbell (2012) document the importance of engaged faculty and student support. Unlike the previous studies though, their collaborative model emphasizes the importance of shared goals.

Within the private school’s partnership, relationships between faculty members at participating institutions and program directors are established in a manner similar to research-based scientific collaborations administered by faculty. Empirical results for the nine PhD programs in the study show that approximately 30 percent student diversity was achieved through the Pathobiology PhD program over a 5-year period and 21 percent in biomedical PhD programs overall, even though nationally URM enrollment was approximately 10 percent. Notably, this was the only collaboration reviewed that took on institutional weaknesses as partial explain for low URM enrollment (Thompson & Campbell, 2012). Finally, although the study did detail specifics of the admissions process, only a handful of empirical studies exist on what is important to admissions decision makers at the graduate level and why (Posselt, 2016).

Theoretical Framework

Collaboration is key in solving many complex social problems (Bryson, Crosby, & Stone, 2015). More importantly, Senge et al. (2015) assert, “ [Complex social] problems like climate change, destruction of ecosystems, growing scarcity of water... require *unprecedented collaboration* among different organizations” (p. 28). Underrepresentation of minority students in graduate school may not be too much different from the complex social problems listed. Therefore, this study develops a theoretical framework based upon theories of social systems, collaborative complexity, and social capital for better understanding how to shape URM recruitment for graduate study in STEM within UC. A useful typology for framing social systems that has been used throughout this proposal is Senge, Hamilton, and Kania’s three core components of systems capabilities required for performance: 1) an ability to see the larger system; 2) an ability to foster reflection and more generative conversations; 3) an ability to shift the collective focus from reactive problem-solving to co-creating a future.

According to Luhmann’s social systems theory, the purpose of social systems is to reduce complexity (Schneider, Wickert, and Marti, 2017; Valentinov, 2012). For this reason, a social system is necessarily less complex than its environment. Reducing complexity makes human action possible (Valentinov, 2012). This is an idea that is similar to Schein’s (2010) work on typologies. Typologies are how we abstract reality in order to simplify lived experiences. Linking these two concepts, systems then are how we abstract reality in order to simplify lived experiences. Having this perspective allows for universities as social systems to be seen as less complex than the environments that surround them. Similarly, researchers Schneider, Wickert, and Marti, (2017), in applying social systems theory to organizations, conclude that

organizations respond to environmental complexity, i.e., the number of items or elements that must be dealt with simultaneously by organizations, by changing their structures, processes, rules or routines. Their work also points out that the connections between these elements are relevant.

Efficient collaboration reduces the *complexity differential*. Schneider et al. (2017) also assert that all social systems are defined by a complexity differential, i.e., the difference between the complexity of the system and the complexity of its environment. It is likely that a complexity differential is created between the diversity management paradigms that the internal environment of the university espouses and the diversity management paradigms in the external environment from which URM candidates are drawn. Therefore, confronting underrepresentation of minorities in graduate schools is about managing this complexity differential that the normative and positive aspects that representational, interactional, and educational diversity frameworks pose.

Collaboration Versus Competition

In further exploring what collaboration means, Longoria (2005) cites studies by Walter and Petr (2000) and Graham and Barter (1999). According to Walter and Petr, collaboration simply means working together. Building upon Walter and Petr's definition, Graham and Barter contend that collaboration has four relational properties: relationship between two or more entities, exists within a larger structure, stakeholders can be individuals, groups, organizations, or societies linked together; and the relationship exists within a bounded system. Moreover, in the absence of collaboration, competition can ensue. Bolman and Deal's (2008) political frame theorizes that we compete on the basis of our values for scarce resources. In this way, competition raises issues where diversity is concerned, especially because under a neoliberal framework, universities today are run more like businesses that compete in the marketplace for

students and faculty (Lohmann, 2004). Interestingly enough, Lohmann (2004) claims, “The university will die if it moves away from those of its non-businesslike qualities that are valuable” (p. 2). One such quality is training college students to function in a pluralistic and global society (Bowen & Bok, 1998; Hurtado, 2007; Marcy, 2004; Oguntebi, et al., 2012; Posselt, 2016). Thus, reducing complexity differential caused by underrepresentation of minorities in graduate school aligns with the goals of education and allows the university to thrive.

Collaboration involves a complex, dynamic set of moving parts (Bryson, Crosby, & Stone, 2015; Gonzalez, J. A., 2010). Babiak and Thibault (2009) divide challenges with collaboration into two separate categories: structure and strategy. Structural challenges are described as “governance, roles, and responsibilities guiding the partnerships and with the complexity of partnership forms and structures” (p. 117). And Bolman and Deal (2008) confirm, “The right structure depends on prevailing circumstances and considers an organization’s goals, strategies, technology, people, and environment” (p. 68).

Strategic challenges are defined as “collaboration versus competition and changes in mission and objectives through the duration of the relationship” (Babiak & Thibault, 2009, p. 117). Tensions arise in collaborations when stakeholders are not aligned over what the fundamental purpose of the collaboration is (Cloutier and Langley, 2015). Purpose is defined by shared values (Cloutier & Langley, 2015). In addition, Babiak and Thibault (2009) find that even when stakeholders are in a collaborative arrangement, they compete among themselves for scarce resources, legitimacy, and power. Similarly, another study indicates that stakeholders possess three attributes: *power* – the degree to which one can influence another to do something; *urgency* – the degree to which stakeholder claims call for immediate action; and *legitimacy* – the degree to which perceived actions of an entity are desirable, proper, or appropriate within some

socially constructed system of norms, values, belief, and definitions (Jongbloed et al, 2008). Sometimes, collaborations function like coalitions. These findings along with Bolman and Deal's view that power and conflict is at the center of organizational decision-making are some of complexities that impede the collaborative process. According to Bolman and Deal, conflict is normal among coalitions.

In addition to power and conflict, collaborators often fail to get things done because they over-rely on rationale and do not commit enough to building relationships (Bolman & Deal, 2008). Senge (2015) and Siegel (2010) discuss how solving a complex social challenge requires acknowledgement of a basic interdependence. Within the literature reviewed, there was agreement that relationships between stakeholders mature over time (Ryan, & O'Malley, 2016). As relationships mature, one might expect more acknowledgement of basic interdependence.

Indeed, the power of collaboration derives from engaging people across boundaries. Outreach programs engage different partners across boundaries, thus allowing administrators to see complex social problems from different points of view. According to Senge et al. (2015), this boundary spanning is exactly what is needed for systemic change. Moreover, Le Ber and Branzei (2010) find that relationship processes support or undermine innovation. As mentioned earlier, the diversity movement has shown that colleges and universities do not pursue their diversity-related interests in a vacuum (Siegel, 2007); therefore, neither should other sectoral partners. Moreover, not recognizing the interdependence of discrimination and fairness, access and legitimacy, and learning and effectiveness paradigms is a failure on the part any stakeholder when designing and implementing URM outreach programs.

The Importance of Relationships and Social Capital

Often, campus administrators operate under the premise that more can be achieved through networking and collaboration (Thomas et al., 2002). Collaboration assists organizations in building organizational capabilities through resource sharing, creation of joint educational programs, technology enhancement, and workforce preparation (Di Domenico et al., 2009; Amey, 2010). Relatedly, researchers point out the following elements of effective collaboration: joint vision and a shared set of goals, mutual benefits, clearly understood obligations, intellectual engagement in the current and future direction of the collaboration, and shared accountability and ownership. In a post-Prop 209 environment, some campuses, corporations, and community organizations frequently are not aligned in conducting outreach and in valuing of engagement with stakeholders to solve the underrepresentation of minorities in graduate schools.

Furthermore, Ryan and O'Malley find that successful relationships are influenced by stakeholders' abilities to "accommodate, adapt, learn, and co-create solutions" (p. 2). These researchers make the case that social capital is at the core of innovation and value creation in collaboration. Social capital is defined as:

The aggregate of the actual or potential resources which is linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other words, to membership in a group – which provides each of its members with the backing of the collectively-owned capital, a 'credential' which entitles them to credit, in the various senses of the word. (Bourdieu, 1986)

Similarly, Weisinger and Salipante (2010) present two definitions of social capital in their grounded theory study of diversity, social capital, and racial bridging: *bridging* and *bonding* social capital. Bridging social capital arises when "informal personal networks, formal associations, and other connections among socially dissimilar groups" (as cited in Weisinger &

Salipante, 2005, p. 33) are present. Weisinger & Salipante (2005) suggest that bridging social capital has value and therefore is a useful concept in analyzing diversity, particularly from the perspective of learning and effectiveness. In this instance, the learning and effectiveness is tied to relationships that administrators have with other partners (stakeholders) within the collaborative outreach program. The type of social capital that Ryan and O'Malley seem to be referencing is bridging *social capital*.

On the other hand, bonding social capital, the kind of social capital associated with group membership, can increase representational diversity within organizations. The importance of relationships with nonprofits in cross-sectoral URM outreach programs is that nonprofits can generate bonding social capital for students. In addition, outreach programs transmit the collectively owned capital Bourdieu describes, which is helpful to first-generation URM students applying to graduate school. In this way, safe spaces and support services for URM students operate like families. This family aspect is important. The National Science Foundation (2016) reports that approximately half of American Indian or Alaska Native and Black or African American, and more than 40 percent of Hispanic or Latinx doctorate recipients belong to families in which neither parent has been awarded a college degree. Moreover, URMs from these families may have lower expectations about attending graduate school. In contrast, roughly 75 percent of Asian and White doctorate recipients have at least one college-educated parent; 50 percent have at least one parent with an advanced degree.

Still another form of social capital is *linking social capital*. Woolcock and Narayan (2000) posit that linking social capital involves ties across different groups; however, linking social capital involves relationships that cross power relations (as cited in Schneider, 2009). Both Hurtado (1994) and Thomas and Campbell (2012) provide examples of power relations in

terms of student-faculty and faculty-government relations. Importantly, social capital extracted from these arrangements is essential for student success in graduate school. Thus, for many reasons bridging, bonding, and linking social capital are important drivers of relationships within this system.

Summary

As far back as 1990, UC officials indicated that population growth and increasing ethnic diversity and long-range demographics were the major trends determining students and faculty in California (All University Faculty Conference on Graduate Student and Faculty Affirmative Action, 1990). Over time, key Supreme Court decisions (*The Regents of the University of California v. Bakke* 1978 *Grutter v. Bollinger* 2003 *Fisher v. UT Austin* 2013) have ignited debate on the purpose of diversity in higher education at public universities. Often the rationale has espoused the educational benefits of diversity, benefits that extend to the marketplace and society-at-large.

In the presence of this shifting landscape for diversity in higher education, institutions are tasked with developing strategies to achieve truly diverse student populations (Brown, 2004). More research studying underrepresentation and corresponding outreach programs from a systems perspective is needed. Collaboration exists as a means of taking action as a group to enact social change (Holoien, 2013).

Moreover, currently available research does not explore the dynamics of stakeholder relationships embedded within these outreach programs. Amey et al. (2007) contend that it is critical for stakeholders to consider the process involved in establishing collaborations, how they function, and the factors that allow them to exist over time. With this project, my goal is to fill

the gaps in research and assist stakeholders in developing collaborative outreach strategies to increase underrepresented minority enrollment in graduate schools at UC campuses.

Chapter Three: METHODOLOGY

Introduction

African American and Latinx (URM) graduate student representation in STEM programs at California's public research universities is a complex social problem. Since the passage of Proposition 209, numbers of African American and Latinx students enrolled in graduate schools have seen a decline. Over time, these universities have attempted to recruit (and retain) URM students according to evolving diversity paradigms or policy and programmatic frameworks (Marichal, 2009; Thomas & Ely, 1996). With varying degrees of success, STEM administrators and faculty have employed recruitment strategies for African American and Latinx, such as comprehensive admissions review and expanded outreach, in order to increase the enrollment of URM students (Kidder & Gandara, 2015; Posselt, 2016). Furthermore, because colleges and universities do not pursue their diversity-related interests in isolation (Siegel, 2007), collaboration with partners across sectors has been seen as a way of optimizing limited resources and maximizing information sharing with African American and Latinx students interested in pursuing graduate degrees in STEM.

The purpose of this multi-site case study was to explore the role that collaborative approach played at three University of California campuses (UCLA, UC Berkeley, and UC Davis) in outreach to African American and Latinx STEM students interested in pursuing graduate school. Using a statewide sample of participants drawn from three sectors (higher education, business, and nonprofits), participants described, in their own words, how they collaborate with other stakeholders to increase the numbers of African American and Latinx

students at each progressive stage of the education pipeline leading to graduate study in STEM.

This research explored the following three questions:

1. What roles do collaborative relationships play among higher education STEM administrators, business leaders, and nonprofit leaders in their efforts to bolster strategies for expanding representation of African American and Latinx graduate students in STEM?
2. How do higher education STEM administrators, business leaders, and nonprofit leaders see working together as helpful in addressing key challenges and barriers URM students face in persisting to graduate school in STEM?
3. How do higher education STEM administrators, business leaders, and nonprofit leaders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

Research Rationale and Design

Cross-case analysis of collaborative relationships between STEM administrators, business leaders, and nonprofit leaders at three California public research universities formed the basis of this study. Within the field of qualitative research, case study as a method is popular because it involves in-depth examinations of people, processes, and programs (Wholey et al., 1994). Using multi-site case studies ensured disciplined, systemic inquiry of collaboration within graduate student outreach to African American and Latinx STEM students. In addition, examining this problem across multiple sites and multiple programs highlighted similarities and variability in approaches to addressing recruitment of African American and Latinx students for graduate study in STEM at highly selective public research universities.

According to Yin (2009), the essence of case study is that it tries to make clear a decision or a set of decisions, why they were taken, how they were implemented and with what result. Case study as a technique is valuable because it provides rich detail and allows the researcher to learn more about developing and implementing a new program or strategy (O'Sullivan & Rassel, 1995; Merriam & Tisdell, 2016). Likewise, the availability of multiple sources of information is a major strength of case study design (Hancock & Algozzine, 2017; O'Sullivan & Rassel, 1995). This level of understanding was necessary to answer my research questions. As the researcher, my goal was to simplify the analysis of these complex, dynamic systems by using the case study approach.

Perhaps the greatest strength of case study is its “intensive, holistic description and analysis of a single, bounded unit” (Merriam & Tisdell, 2016, p. 232). In this study, there were two units of observation. First, I observed initiatives and programs in “STEM Colleges” at three UC campuses; “STEM College” was a pseudonym for an academic unit found on all three campuses. Second, I observed three stakeholder groups, STEM administrators, businesses leaders, and nonprofit leaders within the programs/initiatives. In addition, there was one unit of analyses in this study. The unit of analysis was each campus. The three campuses represented both \geographically and politically bounded units. For instance, beyond the obvious geographic boundaries of each university, in this study, African American and Latinx outreach programs are bounded politically by the voter initiative passed in 1996 that ended race-based admissions in California’s public universities.

Conducting qualitative case study research was best since my goal was to understand the nuances of the collaborative approaches and the interpersonal relationships embedded in the outreach strategies. These case studies examined the views of participants in multiple positions

across multiple campuses in order to answer my research questions related to improving the pipeline for African American and Latinx graduate students in STEM fields. Qualitative research allowed me to understand how people interpret the [politically and geographically bounded] world around them and what meaning they attach to their experiences [in recruiting African American and Latinx students] (Merriam & Tisdell, 2016).

Strategies of Inquiry

Research Site and Site Selection

The focus of this study was African American and Latinx outreach initiatives and programs within “STEM Colleges” at three selective California public research universities. Garces and Jayakumar (2014) note that state context influences an institution’s perceived commitment to diversity and that this commitment can influence minority students’ applications and enrollment. Although underrepresentation of African American and Latinx graduate students in STEM has national implications, a greater urgency exists to address the graduate school pipeline for STEM. African Americans and Latinx people represent 45 percent of California’s population. Moreover, a well-established need exists to produce more workers with advanced degrees for California’s economic health and prosperity.

These sites were also selected since public research universities award nearly 41 percent of all baccalaureate or graduate level degrees/certificates (American Academy of Arts & Sciences, 2015). Additionally, the three universities in this study rank nationally within the top 50 public universities for graduate school in STEM according to US News & World Report (2018).

The three campuses vary in size, geographic location, and regional economy. On the one hand, the unique campus cultures showed variable approaches to African American and Latinx

outreach for graduate study at UC. On the other hand, the campuses faced similar statewide issues shaped by internal UC policies and external voter-initiated policies.

The largest of the three campuses was UCLA, located in southern California. Excluding non-Filipino Asian Americans,⁷ UCLA ranks high in awarding degrees to Latinx students, but not to other minority groups (Hune, Benkin, & Jordan, 1999, p. 3). UCLA is situated in Los Angeles, County. Los Angeles County is the largest county in the State of California by population, with over 10 million residents. The second campus chosen was UC Berkeley, the oldest campus in the UC system. Berkeley's geographic location near the Silicon Valley gives its students and graduates ready access to top experts, national labs, and cutting-edge companies. The third campus was UC Davis, also located in Northern California. A key feature of UC Davis is that the campus is ranked #24 nationally for doctorates earned by underrepresented minorities (includes African American and Latinx). Moreover, UC Davis recently received designation as an HSI (Hispanic Serving Institution). UC Berkeley, UCLA and UC Davis rank #1, #2, and #11, respectively in awarding PhDs to Latinx students.

Studying multiple sites allowed for comparing collaboration data across universities and among stakeholders (STEM administrators, business leaders, and nonprofit leaders) at individual, programmatic, and institutional levels, which is different from how most studies on African American and Latinx graduate outreach are designed. A benefit of investigating multiple sites was the ability to compare the efficacy of staffing arrangements to support the programs, budget needed to implement successful programs, and the level of community

⁷ Asian Americans are not considered underrepresented at UCLA as a whole, although Graduate Division does recognize that Asian Americans are underrepresented in certain areas, i.e., the humanities and social sciences (Hune, Benkin, & Jordan, 1999).

engagement needed to sustain programs. Studying multiple sites also made it possible to see if location mattered in attracting African American and Latinx students. Additionally, I collected data to understand how outreach programs at each of the three campuses reduced the complexity differential⁸ of recruiting African American and Latinx students for graduate study. There were many factors involved with reducing the complexity differential, such as environmental constraints, diversity in organizational aims, barriers in communication, difficulties in developing joint modes of operating, managing perceived power imbalances, building trust, and managing the logistics of working with geographically disbursed partners (Babiak & Thibault, 2009).

Regional metropolitan differences at each of these campus locations allowed for richer, deeper profiles of the respective African American and Latinx outreach programs. I was able to contextualize place/location as an element of collaborative program development and implementation. From the case studies, I attempted to uncover collaborative, strategic, and structural networks. These networks reflected context, perceived commitment to diversity, community or larger environment in which the school is located, characteristics of the school itself, relationships and interactions, and institutional culture. I identified similarities and differences in the collaborative practices for outreach to African American and Latinx students informed by strategies, goals, and relationships at the three UC campuses. I also used cross-case analysis to look for patterns and trends within the sectors and across institutions and programs.

Research Population and Sampling

To ensure that I recruited key stakeholders within the cases, I used purposeful sampling.

⁸ Social systems are defined by a *complexity differential*, i.e., the difference between the complexity of the system and the complexity of its environment (Schneider et al., 2017).

All of the interview participants from each sector were selected from my knowledge of the field, website research, and recommendations from STEM administrators at other UC campuses and within the UC Office of the President. Moreover, college STEM administrators were specifically selected who had responsibility for “strategic information resources management planning” (Wholey et al., 1994, p. 71). The other participants were selected after reviewing documents and websites for existing outreach programs at each campus. For example, some programs had advisory boards or steering committees. This information was often listed on the campus’ websites or in meeting minutes that often were found online. Selection criteria for interviewees included: job title; job description; years of service; relationship to equity, diversity, and inclusion strategy for department, school or campus; and referrals from peers and colleagues at other universities. Notably, all three campuses had dedicated diversity outreach staff within their graduate divisions. These individuals worked at a university level, versus a departmental level, to coordinate resources on behalf of the university for the purpose of increasing African American and Latinx enrollment. For context setting, I wanted to interview at least one of these staff members at each campus.

Over a period of 8 weeks, 17 interviews, each of roughly 40 minutes in length, were conducted with three stakeholder groups (STEM Administrator, business leader, nonprofit leader). These individuals were either employed by or associated with the three campuses. Eight STEM administrators (47%), five nonprofit leaders (29%), and four business leaders (24%) were interviewed. Titles varied within each stakeholder group. To protect anonymity, interview participants’ exact job titles were not included in the analyses.

For corporate representatives, when possible I cross-checked references to the programs on their corporate websites under the community involvement, corporate philanthropy, or

corporate social responsibility pages. I also read LinkedIn profiles and conducted Google searches to confirm positions, roles, and responsibilities of the desired participants as another way of checking to see if these are truly the people I want to engage in this study. For nonprofit partners, I researched their relationships with the campuses in the study through networking and reading reports produced by their organizations.

Table 2. Stakeholder Interview Summary

Campus Stakeholder	UC Berkeley	UC Davis	UCLA	Total
Nonprofit Leader	5			5
Business Leader		1		4
	1		2	
STEM Administrator	3	3	2	8
Total				17

Also, for ease in analyzing and grouping data, generic job descriptions were created from biographic information gathered during the interviews, LinkedIn profiles, institution and organization websites, and Bureau of Labor Statistics (BLS) occupation profiles.⁹ Table 3 summarizes the job categories by stakeholder group.

⁹ Bureau of Labor Statistics (BLS) May 2017 Occupation profiles, retrieved from https://www.bls.gov/oes/current/oes_stru.htm#11-0000

Table 3. Job Categories of Interview Participants by Stakeholder Group

Stakeholder Group	Generic Job Title	#	Generic Job Description
<i>STEM Administrators</i>	Vice Dean	4	Provide academic leadership for program development, planning, and decision making in the STEM department. (adopted from actual bio)
	Director	4	Advise students on academic issues and create, support, and assess nonacademic programs for students (adopted from Bureau of Labor Statistics Occupational Outlook Handbook)
<i>Business Leaders</i>	Vice President	3	Devise strategies and policies to ensure that an organization meets its goals. Plans, directs, and coordinates operational activities of companies and organizations. (adopted from Bureau of Labor Statistics)
	General Manager	1	Manage daily operations and plan the use of materials and human resources, but the job is too diverse and general in nature to be classified in any one functional area of management or administration. (adopted from Bureau of Labor Statistics)
<i>Nonprofit Leaders</i>	President	3	Devise strategies and policies to ensure that an organization meets its goals. Plans, directs, and coordinates operational activities of companies and organizations. (adopted from Bureau of Labor Statistics Occupational Outlook Handbook)
	Program Director	2	Work focuses on the innovative policies, practices, and tools designed to enhance the effectiveness and efficiency of systems for the formal and informal education of STEM students and professionals. (adopted from actual bio)

= number of interviews

Access

Because diversity in higher education is a relatively new yet growing field, more often than not, members of the diversity and inclusion community at universities know or are aware of each other, especially if they are working on the same campuses. As a former employee of the University of California, I had access to the senior leaders at three UC campuses who were responsible for African American and Latinx outreach programs for graduate study in STEM. In addition, because I was the chief diversity officer for a graduate program, within my professional network I had access to peers and colleagues with similar roles in “STEM Colleges” on the three campuses.

In addition, this network also had relationships with the key external contacts within the business and nonprofit community (O’Sullivan & Rassel, 1995). Using an Excel spreadsheet, I built a list of potential interviewees to contact via e-mail to request their participation in this study. I invited roughly 25 people to participate via individual e-mails, with an expectation of confirming 18 interview participants; 17 agreed. Once they agreed to participate, I then called or e-mailed them to set up the interviews. After securing a date and time, I followed up in writing to confirm their participation. In accordance with UCLA research policy, I sought expedited IRB approval through my home campus (UCLA).

Data Collection Techniques

Two data collection methods were used: 17 semi-structured interviews and document analysis. Together these two data collection methods helped me to compose larger themes related to key findings (Merriam & Tisdell, 2016). The data collection process was divided into three phases. My first step was to examine documents for any reference to, or statement made about, any collaboration such as alliance, cooperation, collaboration, network, partner, sponsor,

or supporter (Babiak & Thibault, 2009). I collected data from the institution's websites that described the general characteristics of each collaborative approach. This data included: collaboration name, mission, membership, meetings, functions, reporting structure, and activities. I later checked for the accuracy of information collected during my interviews. Additionally, while I was conducting the interviews I asked the participants to provide me with any written documentation not shared online that would further explain the general characteristics of the collaborative programs. Examples of this type of data included flyers, brochures, and written materials handed out to prospective graduate students.

I was looking for evidence of strong collaboration in areas such as structured meetings, alignment of philosophy on diversity and inclusion, strategy, and the development of trust and transparency (Chun & Evans, 2009). I also reviewed documents such as reports, descriptions, summaries, booklets, brochures, and organization charts, MOUs (memoranda of understanding) between partners, newsletters, newspaper articles, websites, and social media accounts. These documents and artifacts provided insights into what was known and espoused about programs and relationships on these university campuses (Merriam & Tisdell, 2016). During document review, I expected to find language connecting African American and Latinx outreach to university/business/nonprofit mission and strategy, African American and Latinx enrollment data, quotes and anecdotal information from stakeholders, opposing points of view regarding the merits of educational diversity as a rationale for outreach programs, what the leadership of the university and STEM administrators within departments were saying about diversity and inclusion, etc.

The second data collection method was semi-structured interviews with 17 individuals (see table 2). Semi-structured interviews are a fundamental qualitative research technique for

deeper learning about the experiences of others (Weiss, 1994). Semi-structured interviews allowed me to ask follow-up questions that built upon the responses received. At each site, I sought interviews with 3-4 STEM administrators and 2-3 business partners and/or nonprofit leaders. Specific data I was interested in collecting were participants' strategies, goals, and collaborative practices within their programs (Babiak & Thibault, 2009). Campus, business, and nonprofit participants in the collaboration were independently interviewed. With these interviews, I anticipated better understanding each interviewee's work and how collaboration supports or undermines African American and Latinx recruitment for graduate study in STEM. Asking good questions was an important aspect of acquiring meaningful data (Merriam & Tisdell, 2016).

In addition, semi-structured interviews provided a different angle to investigate outreach by offering respondents the opportunity, in their own words, to share African American and Latinx outreach strategies, goals, and collaborative practices, and challenges experienced such as environmental constraints, diversity in organizational aims, barriers in communication, and difficulties in building trust and managing the logistics of working with decentralized partners (Babiak & Thibault 2009). In particular, I wanted participants to discuss what worked for their institutions in terms of African American and Latinx outreach and how strategies to partner with other organizations differed across graduate programs, geographical locations, job functions, etc.

Notes were taken during the interviews; additionally, interviews were digitally recorded using a primary device (iPhone) and secondary device (handheld recorder). Each interview was then transcribed verbatim using a professional service (www.rev.com). While all of the interviews were carefully transcribed within 24 hours, I also took notes on my computer during the interview and wrote down as much as I could remember about the interview as a form of

memoing. As Merriam and Tisdell (2016) suggest, post-interview notes permitted me to monitor the process of data collection and to begin some pre-analysis of the information collected. I also thoroughly read each transcript and offered to share a copy with my interviewees to check for accuracy.

Interviews allowed me to compare what I uncovered in document review with what respondents said about the elements of collaborative programs and successful collaboration within graduate student outreach. I pilot-tested the interview protocol with colleagues who were not part of this study, but who work in similar positions to the informants at colleges, in companies, and in nonprofits. I then refined my interview protocol by eliminating confusion about meaning and language. Protocols are attached as Appendix A. During the data collection phase of my study, I visited all three campuses. Visiting the campuses in-person gave me observational data to describe the setting and to write the introduction for each case study.

Data Management and Analysis

Data was managed locally on a laptop and backed-up weekly on an external hard drive. Moreover, written documents were copied when necessary. Paper documents were stored in binders and coded using the themes that emerged from document analysis and the semi-structured interviews.

Using content analysis, I analyzed written documents and transcripts to determine frequency and variety of messages and to confirm hypotheses (Merriam & Tisdell, 2016). This analysis technique uncovered the explicit and implicit contextual issues and key relationships found in outreach programs for African American and Latinx pursuing graduate degrees in STEM at public research universities and highlight challenges and opportunities unique to public research universities. For example, To get a sense of what kinds of STEM programs were

available for underrepresented minority students at Berkeley, I surveyed the university's diversity website. UC Berkeley had recently conducted a qualitative assessment of 118 STEM programs on its campus.

Additionally, data analysis involved coding and analysis of the key documents and the interview transcripts. I scanned websites and other documents to arrive at basic themes by which to code the interviews. Additionally, I reviewed the audio recordings of the interviews following each interview. As part of writing up the individual campus case studies, I then read each transcript and checked for emergent themes in addition to the themes I created from the document analyses. Coding data allowed me to organize the data so that I could easily review, analyze, and interpret it (Merriam & Tisdell, 2016).

I analyzed the data using a couple of approaches. Key phrases and codes were first analyzed using coding software (Quirkos), a Microsoft Excel spreadsheet, and a matrix created in Microsoft Word. I also went back and re-analyzed documents after the interviews in order to check that what was shared in the interviews matched what I found in the documents. Next, after coding the data I created an outline to begin organizing data into groups in order to write up the case studies. The outline followed the schema of a logic model: inputs, activities, outputs, outcomes, and impact (Yin, 2009; Alkin, 2009). These analytical techniques assisted me with writing up my case studies.

Narratives of African American and Latinx outreach for each campus – from the perspectives of STEM administrators, business leaders, and nonprofit leaders – were developed from the rich qualitative data collected through these multiple data collection methods. Also, I used direct quotes in some cases, which allowed for rich, deep descriptions. The narratives cohesively integrated the data into an aggregate, comprehensive view at the campus level of

programs for African American and Latinx graduate outreach in California's public research universities.

Limitations

Three limitations existed for this study. The first limitation was anonymity. Protecting the anonymity of interview subjects was a concern throughout the interview process because discussing race was a sensitive topic,. In addition to protecting the anonymity of the interview subjects, another challenge was keeping the programs and academic units anonymous. This organizational challenge prevented me from contextualizing the programs studied. A second limitation was specifying when an interview subject was referring to graduate student outreach versus undergraduate outreach. In many instances, comments about outreach strategy at both levels were inextricably linked. Third, because a limited number of partners collaborating exist across these three sectors, finding partners to study was also a limitation of this study.

Credibility and Trustworthiness

For several reasons, establishing credibility and trust was key given the nature of qualitative research. First, case study as a qualitative method presents problems with generalizability (Harreveld et al., 2016). In response to this concern, three sites – rather than one – were chosen. Similarly, case studies are often hard to replicate and require careful documentation of what was done, how, and why (O'Sullivan & Rassel, 1995). By studying more than one site and more than one sector's approach to outreach, I determined patterns and trends that may be expanded to the larger population.

Another concern with case studies is biased views. Case studies are subject to observer bias, due to the nature of how data is collected. By their nature, "a distant, objective stance is not feasible" (Harreveld, 2016, p. 66). In reality, producing socially desirable findings in this project

was a possible credibility threat because of my affiliation with UC and relationships within arenas involved in African American and Latinx programs. This insider positioning could have contributed to researcher bias. To avoid this, I took steps to avoid the possibility that participants might not elaborate on a particular issue or topic, assuming that I already understood. I continually asked participants to explain their points of view and ask for examples to clarify what they were saying. I intentionally tried to set aside my assumptions about the topic of the interview so as not to direct the subject in an overly biased manner. On the other hand, insider positioning did my study in terms of access and *a priori* knowledge. Also, using a triangulated approach interviewing business leaders and nonprofit leaders established credibility for the responses to my research questions.

One difficulty in gathering valid data is that when humans are part of the research a tendency exists for participants to resist or hide embarrassing or controversial data or to give socially desirable responses to questions (Schein, 2010). To get sound and reliable data the researcher needs to find the method that encourages participants to “tell it like it is” (Schein, 2010, p. 180). I protected the confidentiality of my interviewees by creating pseudonyms when reporting findings. Developing a good coding system was also important to trustworthiness.

Moreover, to address any reactivity on the part of the interviewees, I triangulated the data, sources, people, and collection methods by comparing data across institutions and sectors. Creswell (2014) maintains that triangulation assists researchers in comparing and contrasting data for consistency. Also, as an additional credibility and trustworthiness measure, some of my interviewees could be considered insiders (key informants) within the campus programs, and their length of time in their positions, roles within the campus, and breadth of knowledge about outreach to African American and Latinx students helped to clarify and decipher data when

needed (Schein, 2010). Some qualitative researchers define this practice of clarifying and deciphering as “member checks.” To ensure that the interview participants provided honest answers, I built trust upfront by asking open-ended questions and asking them to describe their career paths that led them to working on STEM pipeline issues. I also reiterated my plan to use pseudonyms to protect confidentiality.

As stated earlier, I triangulated data sources by interviewing staff and STEM administrators, business leaders, and nonprofit leaders and comparing their respective answers. Using this multitude of approaches lessened the probability of collecting insufficient evidence to support the conclusions. Studying multiple sites and spending time carefully crafting my research design and sampling strategies to develop a purposeful sample were part of my plan to ensure that I had a credible study. I also asked participants for recommendations of others to speak with in their networks to follow up on topics and themes that came up during the interviews. Because the study was designed and conducted systematically, readers can determine which findings apply to their own institutions, a process known as *user generalizability*.

Ethical Issues

Initially, the greatest potential ethical issue I faced was being employed at one of the sites in the study. I was able to overcome this potential issue by taking a position at another university before I began my data collection. Generally speaking, as a practitioner in diversity I did recognize that the programs studied at each of the institutions could be made vulnerable by revealing data to me as the researcher. According to Schein (2010), I had an obligation to fully understand the potential impact of this study on the organizations with whom I was working. To ensure confidentiality and address privacy concerns, I secured permission from respondents prior

to conducting interviews. I sent a detailed e-mail regarding my study and opened each interview by reading a confidentiality statement. After transcribing and analyzing data, I created code identifiers and pseudonyms to avoid inadvertently revealing participant names in writing up my findings. When necessary, only the interview subject's general job description was used in referencing his/her interview. In addition to coding the data, I aggregated data when practicable so that it was impossible to determine the source. Because geography was an essential context for my study, identifying the three campuses had to remain in my study. However, in the findings chapter, campus interview participants were given pseudonyms.

Summary

As part of ongoing efforts aimed at increasing African American and Latinx enrollment in graduate studies at the University of California, my research explored collaborative approaches from the points of view of STEM administrators and business and nonprofit leaders tasked with creating and implementing African American and Latinx outreach programs for graduate study in "STEM Colleges." This multi-site case study differed from traditional studies of underrepresentation because it examined African American and Latinx outreach through systems theory, collaboration, and social capital lenses of STEM administrators, business leaders, and nonprofit leaders. Case study as a method was appropriate for this study because it involved in-depth examinations of people, processes, and programs (Wholey et al., 1994). Moreover, a multi-site case study was the preferred design given its power to capture all the nuances of perception and evaluation in each case and to make comparisons between California public research universities. Research findings hopefully will provide campus STEM administrators, business leaders, and nonprofit influencers and advocates with the evidence needed to consider continuance of multi-faceted outreach programs informed by collaborative relationships as a way

to increase enrollment of African American and Latinx candidates in STEM graduate programs at UC campuses.

Chapter Four: FINDINGS

Overview

Introduction

Researchers Bryson, Crosby, Stone (2015) define cross-sector collaboration as “linking or sharing of information, resources, activities, and capabilities by organizations in two or more sectors to achieve jointly an outcome that could not be achieved by organizations in one sector separately” (p. 648). In this study, I investigated how cross-sector collaboration joins together capabilities, activities, information, and resources among education, businesses, and nonprofit leaders in order to recruit African American and Latinx graduate students in a “STEM College”¹⁰ at three UC campuses. The sites selected were UCLA, UC Berkeley, and UC Davis. As discussed in Chapter Two, collaboration has four relational properties: 1) a relationship between two or more entities; that 2) exists within a larger structure; in which 3) stakeholders can be individuals, groups, organizations, or societies linked together; and 4) the relationship exists within a bounded system (Graham & Barter, 1999).

Probing these cross-sector collaborative relationships meant collecting data from universities, nonprofits, and businesses to answer the following three research questions:

1. What roles do collaborative relationships play among higher education STEM administrators, business leaders, and nonprofit leaders in their efforts to bolster strategies

¹⁰ “STEM College” was a pseudonym for an academic unit found on all three campuses. I used this fictitious name to better conceal the actual identity of the school/college, and to further protect the anonymity of my research participants.

for expanding representation of African American and Latinx graduate students in STEM?

2. How do higher education STEM administrators, business leaders, and nonprofit leaders see working together as helpful in addressing key challenges and barriers URM students face in persisting to graduate school in STEM?
3. How do higher education STEM administrators, business leaders, and nonprofit leaders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

There were four significant findings drawn from these three case studies. First, collaborative relationships among these three stakeholder groups increase capabilities to achieve representational diversity at the graduate school level. In two of the three cases, I found that from both an administrator and a business leader standpoint, having strong collaborative relationships with faculty mattered in setting priorities for increasing representational diversity in their “STEM Colleges.” Since prior research experience as an applicant increases a student’s chances of getting admitted to graduate school, faculty members hold the keys to prized research opportunities that can unlock graduate school opportunities in STEM for many students. Relatedly, the collaborative relationships between universities and industry often facilitate research opportunities for URM students. Through partnerships with university faculty conducting research that aligns with their business strategies, businesses provide a needed financial resource that simultaneously supports graduate students in “STEM Colleges” at these three campuses.

A second related finding was that at the advanced stage of the pipeline, relationships and focus narrowed among stakeholders, which constrained capacity for increasing the numbers of URM students. For many years, administrators, business leaders, and nonprofit leaders have invested collaboratively across sectors at each progressive stage of the education pipeline – K-12, California Community Colleges, California State Universities, and the University of California – to address underrepresentation of African American and Latinx STEM students in graduate study at UC Berkeley, UCLA and UC Davis. Up until graduate school, relationships are one-to-many; however, when a student is applying to graduate school, one-on-one relationships take priority. Thus, what was once described as a “pipeline,” now resembles a pyramid.

Furthermore, another finding all three cases was the manner in which company representatives’ active involvement on campus influenced conditions for advancing institutions’ goals of achieving diversity in STEM. Companies invested in a multitude of strategies to combat the problem of low African American and Latinx representation in STEM degree programs at public universities. For example, in addition to their relationships with faculty members, business leaders in this study (who also were alumni of these universities) had key relationships with other administrative leaders, including deans in the “STEM Colleges” investigated. These relationships helped business leaders pick from among the many different activities within the “STEM Colleges” to support with philanthropic resources.

Still another finding was that collaborative relationships between administrators and students reduced the complexity differential – the difference between the complexity of the system and the complexity of its environment – for prospective URM graduate students in STEM. In a number of ways, the complexity differential is compounded by an information gap.

Underrepresented students of color – many of whom are the first in their families to go to college, not to mention graduate school – face a double bind. In addition to academic support, these students are challenged to navigate higher education with a need for social support to successfully compete in their chosen STEM majors. In the “STEM Colleges” at all three universities studied, administrators bridged information gaps by forming alliances with community-based organizations, faculty, and business leaders.

These four findings will be explored in more detail throughout the remainder of this chapter. The first section of this chapter gives case context for all three cases. The second, third and fourth sections provide case studies of collaborative relationships within the “STEM Colleges” at each of the three campuses. The fifth section is a cross-case analysis of the three sites. The sixth section summarizes the findings.

Case Context

In this study, STEM administrators and business leaders were linked directly to one of the three campuses; however, nonprofit leaders were not. Instead, they were seen as grassroots advocates and influencers running organizations that served URM students, within the STEM pipeline network. As a grassroots example, one nonprofit leader interviewed ran a statewide, community-based organization aimed at enhancing educational opportunities through cultural, social and academic interventions. With its particular emphasis on African American students, this organization had a 20-year track record of ensuring college and graduate school access for students. The nonprofit’s work primarily focused on the K-12 stage of the pipeline.

Moreover, these grassroots nonprofit leaders frequently served as subject matter experts advocating for changes to the STEM pipeline in the national and state policy/political arenas. For the latter type of nonprofit leader, their strategic insights about kindergarten to career (“K to

Gray”) pipeline development complemented the on-campus, tactical and operational knowledge of campus STEM administrators and the workforce preparation knowledge of business leaders. In short, what happens at each progressive stage of education matters in gaining admission to graduate school in STEM. Therefore, the roles that nonprofit organizations played in linking stakeholders to stages of the pipeline network were essential to the study.

Over half of the 17 people interviewed (59%) were UC alumni. Nearly thirty percent of the interviewees (29%) held a masters degree only and nearly half (47%) of them held PhDs. In addition, eight of the interviewees (47%) were STEM graduates. Seventy-six percent of the interview participants had either attended a campus impacted by Proposition 209 and/or worked for their organization at the time that the initiative was passed by voters in 1996. The racial and gender composition of the group interviewed was 60 percent African American, 76 percent people of color (POC), and 70 percent female. Participants in this study had years of service in their respective roles ranging from less than four years to over 30 years. As a group, they averaged nearly 22 years of service across all three campuses and stakeholder categories. Alumni perspectives, experience with Prop 209, and representing minoritized groups meant that participants had perspectives that were beneficial to this study.

The next three sections are individual case studies about collaborative relationships or attracting URM graduate students at UCLA, UC Berkeley and UC Davis “STEM Colleges.”

Case Study: UCLA

Overview

Introduction

With a bewildered look on his face, the father turned to me and asked, “Pardon me. Can you tell me where the Math Science Building is?” The weather outside was typical – just another sunny Saturday morning in Southern California. Although he might have been squinting because of the sun, one thing was for sure, this Latinx dad and his teenage daughter were lost and clearly in need of some directions. With just a few minutes to spare, they were in a rush to get to a STEM outreach event. Before stopping to ask for directions, they walked east along Bruin Walk, past the iconic Bruin Bear and Ackerman Student Union. A haphazard stack of day-old Daily Bruin newspapers barely clung to the shelves of the kiosk along the route, some of them fading in the bright sun.

A few of the newspapers that had fallen to the ground now lined the walkway and crunched underfoot as the father, daughter and other passersby hurriedly walked through this center section of campus. This section of campus is a crossroads of sorts, and is a place where students converge throughout the week for conversation and community. With its sprawling campus, it is not surprising that anyone who was unfamiliar with navigating the maze of brick buildings that make up UCLA could be lost. Looking back, I could not help but think of the powerful metaphor that emerged from this encounter. This might not be the last time this student, and potential STEM major, would need direction to navigate the maze of programs and initiatives aimed at expanding the STEM pipeline for minority students.

Background

I interviewed two STEM directors, Maurice and Greta (see Table 4 for list of pseudonyms), and two vice presidents at Fortune 500 companies, Vaughn and Raquel (pseudonyms). One of the STEM directors, Greta, worked in student services and the other, Maurice, held a part-time academic appointment within this “STEM College” in addition to his administrative duties. The vice presidents, Vaughn and Raquel, were UCLA alumni with STEM degrees and they each served as the primary contacts for their companies with this particular “STEM College.” They worked with campus and community partners to identify potential future employees and to build awareness for jobs in their respective companies. In addition, Raquel served on an alumni association board for the university. Her involvement on this board gave her access to other alumni beyond the “STEM College.” Together, these business leaders’ deep engagement within the “STEM College” as former students, and through their positions of authority in their respective companies, gave them distinct vantage points.

Additionally, one of the business leaders interviewed, Raquel, also volunteered with “Community-Based Cultural Organization.” This nonprofit was a statewide, community-based organization aimed at enhancing educational opportunities through cultural, social, and academic interventions. Like the other nonprofits in this study, the work of this organization was not tied to any one UC campus studied. Instead, as a group, the nonprofits spanned the boundaries of each campus and were either statewide or national in scope. While all of the nonprofits regularly worked with administrators and student leaders at each of the campuses in this study, as policy influencers and advocates their individual and collective responses added a systems view to the remarks of the campus and business leaders interviewed. Table 4 summarizes the pseudonyms given to the participants in this case study.

Table 4. UCLA Case Pseudonyms

Name	Role	Responsibilities
“Maurice”	STEM Administrator with academic appointment	His responsibilities included mentoring and advising students on research projects in STEM; teaching part-time.
“Greta”	STEM Administrator, student services	Her responsibilities included recruitment, retention, development, and graduation of underrepresented students in STEM.
“Vaughn”	Business Leader (Vice President, Marketing)	His responsibilities included spearheading business services and technology advancements, formulating key efficiency strategies and initiatives, leading teams to deliver significant business results, and serving as an effective change agent.
“Raquel”	Business Leader (Vice President, Customer Services)	Her responsibilities included overseeing her company’s relationships with its major industrial, commercial, and government customers.
“Dee”	Grassroots nonprofit leader	Founder of “Community-Based Cultural Organization.”

Shaping Strategy, Addressing Challenges and Barriers, and Building Relationships

Key findings that emerged from my interviews with UCLA stakeholders were the important roles that organizational capabilities, boundary spanning, entrepreneurial approaches, information- and resource-sharing, and networking played in bolstering underrepresented student populations in the STEM pipeline. The following sections cover each of these themes in more detail.

Organizational Capabilities

At UCLA, leadership’s commitment to diversity sent a strong signal to faculty, students, and external partners about “STEM College’s” commitment to representational diversity. Not

surprisingly, nearly all of the stakeholders interviewed felt that representational diversity mattered to the leadership at UCLA. Vaughn, a Fortune 500 executive and UCLA contact for the College commented, “Just working with [departmental] diversity program[s] isn't enough. You [need] to have not only the Dean associated with it [diversity outreach], but you also [need] to have the faculty [involved].” Vaughn believed that leadership involvement from Deans and faculty members sent a strong signal to URM students that the institution was committed to their success and development as students. Raquel, another business leader, agreed and emphasized what having a diverse Dean in charge of the “STEM College” meant to her. In Raquel’s opinion, “[Diverse Deans] really reach[ed] out in a different way [in] pushing the envelope on diversity.”

Along with leadership commitment from deans and faculty members, Vaughn shared that leadership commitment from student services administrators was important. “[Within this particular “STEM College” at UCLA], they're very committed to the students and to their development.” He reasoned that “if these [URM] students aren't embraced, they're going to continue to feel like outliers and who wants to feel that way? Who can excel in an environment where you're not even feeling like you're wanted? That you are a guest in someone else's home?” Moreover, for Vaughn’s company the “STEM College” leaders’ commitment to diversity helped him make strategic decisions about his company’s level of financial support and engagement on campus:

“It's easy to [support the university] when I see [a deep level] of commitment [from student services administrators and academic leadership]. And it's easy for me to be an advocate to the Dean and departments...for the students and the program... the data speak for themselves.”

Deans, faculty, and administrators create a climate in which URM students can thrive.

Greta, a senior administrator within the “STEM College,” further explained how relationships with faculty mattered to her in setting priorities for representational diversity and in making URM students feel included. She worked collaboratively with one faculty administrator, in particular, to find fellowship opportunities for URM students applying for graduate school in this STEM College. Because of this faculty administrator’s influence, all URM students who [were] admitted to the “STEM College [were now] nominated for this [Graduate School Fellowship in STEM]. Prior to this linking of capabilities between Greta and the professor, few URM students were in the fellowship pool. According to Greta, “For a long time, it was hard to get [URM] students nominated for [the fellowship].” Moreover, according to her, getting URM students to attend graduate school in the “STEM College” at UCLA depended upon securing fellowships such as this one for these students. Greta’s relationship with faculty leadership was important in helping her to set strategy and accomplish her goals. In summary, regardless of position within or outside of UCLA, respondents believed that UCLA’s leaders supported diverse representation in STEM majors and that this support was critical in increasing STEM enrollment for underrepresented minorities.

Boundary Spanning Across the Sectors

Study participants also believed that relationships between businesses and universities help to grow the pipeline too. A common strategy for recruiting talent was for business leaders like Raquel to get involved in the community (volunteer) as an official representative for their companies. Through her volunteerism in the community, Raquel was connected with Dee’s nonprofit. She reiterated that the purpose of Dee’s nonprofit was “to focus on preparing African American students to be admitted to the top undergraduate and graduate school programs in the nation, with an emphasis on STEM.” During my interview with her, Raquel explained how she

became a volunteer. She noted that her involvement in the community “kind of coincided with becoming an officer [in her company].”

I became an officer in 2007. At that time, [a senior officer in my company] in charge of placing executives on boards approached me [about getting involved in the community]. She had a [process] for identifying organizations that [my company] wanted to have a particular strategic relationship with. She [looked for organizations that] might fit with my interest and background and skills.

In addition to her membership on the corporate advisory board of the “STEM College,” Raquel was spanning boundaries and volunteering in the community with nonprofits like Dee’s in order to build the pipeline for minority students in STEM.

Besides working externally with community-based organizations, business leaders like Raquel and Vaughn had ties to student organizations internal to the “STEM College.” Moreover, in Vaughn’s case, his true passion was to serve the community as a volunteer, mentoring students in STEM. As business leaders assigned to UCLA on behalf of their companies, Raquel and Vaughn developed relationships within these student networks. Student organizations like the “Society of Black STEM Students” and the “National Society of Hispanics in STEM,” with their local collegiate chapters on the UCLA campus, were natural allies for companies. Raquel and Vaughn’s interests were in convincing these students that “there’s a valuable career with [Company]” or “[in] encourag[ing] these young people to come work for [Company] when they graduate.” Raquel pointed out:

“Recently, more [companies] have come to the table to reach out and partner with these [URM] students, helping them with their projects, helping them with internships...If you don’t have the businesses – the companies – willingly and actively engag[ing], then [you won’t develop the workforce you need].”

Working with student-run organizations was an intentional strategy for preparing URM students to be in the workforce. Companies saw engaging with students involved in student organizations as one way to “teach them about careers.”

Boundary spanning also happened when collaborating on research was involved. Both of the STEM directors interviewed, Greta and Maurice, spoke extensively about research at the undergraduate level as being essential to earning a spot in a STEM graduate program. Research was a gateway to studying STEM in graduate school. During my interview with her, Greta also discussed how she collaborated with faculty to identify research opportunities for undergraduates. Research connected URM students to faculty members who could mentor these students. She had two strategies for partnering with faculty that involved providing small research grants.

In some cases, whenever students excelled in certain classes and were invited by faculty members to do research for them, Greta offered small grants to support them. In other cases, Greta encouraged students to proactively look for faculty members that these students wanted to do research with. If by chance the professor said there was no money for the research project, Greta instructed students to say, “Don't worry about it. I have my own.” Greta chuckled during her interview that this strategy worked because, according to her, “there's no faculty member that's not going to take free work, right?”

Greta further acknowledged:

[Recruiting for graduate school] is so different...from undergrad. It's just so different because you're really looking at a [STEM] faculty member overseeing, whether it's an MS or PhD student, overseeing the student's graduate degree...It is so dependent on faculty mentor, a faculty advisor.

In her role of providing student services to STEM majors, Greta's philosophy was "to get [students] into research early as a way [for them] *to do* STEM, as opposed to listening about it." In my interview with her, Greta proudly cited recent successes of nearly 40 percent of URM undergraduate students enrolled in the "STEM College" continuing on to graduate school in STEM. Even better – from Greta's perspective – was the fact that 47 percent of those students going on to graduate school from the "STEM College" chose UCLA for the graduate studies.

In addition to Greta, corporate executives took note of the role faculty played in moving students through the pipeline. With ties to UCLA as both an alumnus and a corporate representative, Vaughn gave an example of how his company used research opportunities to build the STEM pipeline for graduate students and potential hires:

We had a program called [University Cooperation Agreements]...unrestricted funds were given at \$25-30K a year...The money was strictly meant for building relationships with colleges and universities around research. The program worked like this... Go out, find university people [professors and the research scientists] that were mentoring...students of color in [research]...[the catch for the professor was] you couldn't get the money unless you had a [Company STEM professional] that was your partner. ... The goal was [to build] relationships, to use those relationships to encourage students to do research and to go back to school, [and to show students that they] could not only be in academia but [they] could also be in the industry...and [they could] still pursue [their] Masters and PhD.

Vaughn's company had an intentional strategy to collaborate with faculty members in order to bridge a graduate student's on-campus research experience with applied research in industry. Connections between industry and faculty facilitated opportunities for students that may not have otherwise have happened without these carefully cultivated relationships in a post-Prop 209 era.

Entrepreneurial Approaches to Collaborating

STEM directors like Maurice and Greta had entrepreneurial approaches to increase representation of URMs. Maurice discussed how he “look[ed] for different opportunities where they exist[ed],” but often they [the strategies] were “mostly ad-hoc.” Similarly, Greta stated:

“We [faculty and staff] do a lot of different things together [to recruit and retain URM graduate students], [with most of it being] ad-hoc [at] times... we [faculty and staff] are always interacting... Even in the hallways, we'll stop and start solving a problem, sometimes, we're talking about next steps [for admitting and retaining URM graduate students].”

Being entrepreneurial and trying different things was necessary to come up with new ways of increasing representation.

Greta also created opportunities for URM students by linking up with nonprofits, corporations, and faculty members to “open up research and fellowship opportunities.” Administrators like her “[took] note of the challenges with interpretations of [Proposition 209] outside of UCLA.” According to Greta, “the one thing [post-Prop 209] that we do... is partner with the [Graduates in STEM] fellowship program [to find URM students].” [Graduates in STEM] was a national program that provides fellowship money secured from industry partners for Master’s and PhD degrees in STEM. The program covered recruitment, retention, and professional development for underrepresented minority students attending graduate school in STEM.

Greta’s entrepreneurial spirit came across through how she used her connections with industry to create opportunities for research and fellowships for URM graduate students.

Working with industry is a little different. One thing we do with the industry is work with our undergrads to find them [summer internship] positions [in] corporations. When we get somebody into, say, [large, Silicon Valley-based tech company that is an industry partner], and [the student has] graduate [school potential], we make sure that [we connect this student with] the [Graduate Fellowship in STEM] company representative.

Linking students to the business leaders who were “Graduates in STEM” industry partners made the difference between a student receiving fellowship money for graduate school or not. According to Greta, these business leaders were the decision makers who “[go] to all the meetings, make the selections, interface with the incoming [fellows], etc.” She advised the undergraduate students to know whom these business leaders were, “We instruct these students that they need to [build] the relationship with this [representative] at the start of their internships.” Greta understood the role that building these relationships played in increasing the numbers of URM students in graduate school. Together, the entrepreneurial approaches to collaborating with business leaders and faculty members led to URM students receiving financial aid and research fellowships for graduate study in STEM.

Sharing of Information and Resources

In addition to organizational capabilities, entrepreneurial approaches, and boundary spanning, information and resource sharing help to grow the pipeline for URM students applying to STEM graduate programs. Maurice, an administrator and part-time instructor, lamented how “a lot of times, students take a couple of years to find their footing and figure out what they want to do or sort of get motivated to want to actually work toward something.” To be sure, this lag between figuring out what you want to do and preparing for the rigors of STEM graduate studies is not specific to URM students. According to Maurice, “It’s not just true of underrepresented students, it’s true across the board.” His advice to URM students though was to focus on their academic records. In his words:

There's a premium on being able to maintain a strong GPA. [W]hat I find is that a lot of times, by the time the [URM] students realize ‘okay, I want to go to graduate school,’ they may or may not have the [academic] record that would put them there.

Preparing for admission to graduate school early during one's undergraduate STEM studies is key.

Another stakeholder interviewed, Dee, was the president of a statewide, community-based organization aimed at enhancing educational opportunities for African Americans through cultural, social and academic interventions. This organization had a 20-year track record of ensuring college and graduate school access for primarily African American students. When I asked Dee about strategies used by her group to build the pipeline of URM students, without hesitation she brought up the group's work with undergraduate students. Dee knew that getting URM students into graduate school started much earlier than the point at which a student was about to graduate with a four-year degree. She remarked, "Some of the strategies that we use for our undergraduate and graduate students [are] not really that dissimilar. [It is important] to...mak[e] our students aware and giv[e] them information and tools so that they can prepare [for graduate school]." She also gave this example:

We [connect] students with professionals in the [STEM College] and students [go] to seminars and workshops that will help them with their test preparation for the [GRE]. [We] also expose them to [careers in] these fields so that they can be sure that these are careers and interests that they really are interested in... [We want them to] have a really good working knowledge of what [a STEM] career is and what it takes to get [into graduate school].

Regardless of education level, Dee knew that sharing of resources and information were key elements of getting into graduate school, especially for URM students.

Throughout the interview, all of the stakeholders raised the theme of improving the quality of the undergraduate population. Because of her organization's cultural, social, and academic programming and its relationships with other stakeholders across the state, Dee and her volunteers gave students as much information about college and graduate school as possible.

Importantly, if she did not have the information, she connected them with people on campus who did. In Dee's own words, "Once [students] are on a campus, we try to connect them with campus resources, and other professionals who can also serve as mentors, [as well as give them] a sense of support for their pursuits [and interests]." To facilitate these connections, throughout the year Dee intentionally cultivated relationships with administrators, other community-based organizations, and public officials up and down the state and built a network of support for the students served by her program. Dee's actions within her nonprofit and across the state, with UCLA and the other two campuses studied, were examples of bonding¹¹ and bridging¹² forms of social capital in use.

Both Dee and Raquel, the business leader who volunteered with Dee's nonprofit, felt that sharing information was essential for URM students to understand how to navigate college, apply for graduate school, and eventually secure jobs in STEM fields. Dee expressed that in her opinion, universities were not making enough of an effort to dispel the myths and misinformation about getting into graduate school, especially for URM students. She recommended, "For graduate school, there would have to be more of an effort made when students walk in the door." Likewise, Raquel strongly believed in mentoring young professionals. Her alumni involvement at UCLA gave her opportunities to share "her career stories through speaking engagements, [sponsorships], and participating in [community events]."

Dee and Raquel were not the only stakeholders to talk about sharing of resources and information. When I delved further into collaborative practices, Greta said there were two ways

¹¹ The kind of social capital associated with group membership.

¹² Bridging social capital involves slow, careful fostering of trusting relationships across groups; bridging social capital involves loosely coupled interaction between social groups.

to think about it: 1) developing potential graduate students from among incoming freshman and transfer students and 2) attracting URM students from other universities around the country. In setting strategy for increasing URM graduate students in STEM, Greta first asked, “What do we do to develop incoming freshman group and transfers to aim towards grad[uate] school? To me, producing those who want to go [to graduate school] is a really important thing.” The second question he asked in attracting them to UCLA was, “Who are they? [Because of underrepresentation] of course, you focus on [strategies to recruit] Latinx students and African American students.”

Greta further explained how to develop these students:

We run a class that's called *Introduction to [STEM] Disciplines* for freshmen. Twenty percent of their grade is a [team-based] research project that is no different than [projects] our graduate students [complete]. [Right from the start], they [students] are thrown right into research labs...Last year we had 56 participants and this year we have 75.

Here again, faculty members are key to this development opportunity with students. According to Greta:

We work with faculty and make a deal ... The deal is whenever you [apply for] NSF [funding], we [as student services staff will] write a supporting letter [in exchange for] student slots in your research for our freshmen and certainly upperclassmen.

Whether it was helping students prepare academically, sharing information about STEM fields or creating opportunities for students to conduct research with faculty members, all of these were examples of how administrators, nonprofit leaders, and business leaders work collaboratively to increase the numbers of URM students in STEM graduate programs.

The Importance of Networks

All of the UCLA stakeholders emphasized the importance of being well networked. In particular, three examples stood out. Maurice, who had less than five years of service at UCLA

in the “STEM College” studied, talked about student-to-faculty networks. When asked about his involvement in STEM outreach, he answered, “There's one of several ways that I get involved but more so on sort of my own initiative.” He spoke about working with the UC-HBCU Initiative. Getting involved through his own initiative stemmed from the fact that he was an HBCU graduate and familiar with many of the campuses that were part of the Initiative. According to Maurice, the UC-HBCU Initiative was a program that funded undergraduate students from Historically Black Colleges and Universities to do research at different UC campuses. Maurice explained how the program worked:

If you show that you're well networked with an HBCU, [you get] funded to bring a couple of [undergraduate] students every summer for 3 summers to do research. [Often students who participate receive funding to attend] graduate school at any of the UC campuses.

The key phrase in Maurice’s comments was “show[ing] that you’re well-networked.” I reviewed the UCOP website to confirm the program description. The description read:

Through the UC-HBCU Initiative, the Office of the President encourages UC faculty to actively engage in collaboration and cooperation with faculty and students at HBCUs. Such efforts serve to strengthen and enrich our mission of teaching, research, and public service.

Student-to-faculty networks such as this one opened up opportunities to recruit URM students from across the country.

Similarly, Dee provided another example of networking by discussing student-to-administrator networks. According to Dee:

“I think the old adage “it’s not what you know, it's who you know” still holds true today...The sooner we ingrain that in the minds of our students we will reap way more benefits than we have in the past, because they cannot go to school in a silo, and they [have] to reach out, and not be afraid to network for what they need, and get information.

Once again, Dee was a big proponent of information and resource sharing. Networking for her meant improving the flow of vital information for URM students attending college and majoring in STEM.

The third example of valuable networks was student-to-student networks. Here again, Maurice discussed how valuable information about programs, initiatives, and fellowship opportunities was passed through these informal networks. Maurice shared:

So the way it work[s]... [the] information is sort of diffused into these informal, just-student networks through these other students that take a little bit more initiative... For example, at UCLA, the [American Society Students in STEM] is a really strong network ... there's a really strong culture there in terms of, if you can get plugged in, whether you're looking to graduate school, whether you're looking to try to find a job, trying to get connected with a particular company, there's a really strong network there where I feel like there's sort of a transfer of information from the [upperclassmen] to the younger students.

Unlike student-to-faculty or student-to-administrator networks, peer networks were more informal and perhaps of greatest benefit for students looking for unfiltered information about jobs, graduate school, etc.

These three examples illustrate a few of the ways student-to-faculty, student-to-administrator, and student-to-student networks enable information and opportunities for graduate study to be shared within the network of the “STEM College” at UCLA.

Summary

In summary, strategies, challenges, and barriers, and relationships were discussed at length with four stakeholders connected to UCLA. From the interviews, organizational capabilities, boundary spanning, entrepreneurial approaches, information and resource sharing, and networking emerged as themes that describe how to bolster underrepresented student populations in STEM. For instance, having the “STEM College’s” leadership onboard with outreach to URM students was an important signal to prospective students about UCLA’s commitment

to diversity. In addition, business leaders used their influence with campus leadership to open up research, internship, and fellowship opportunities for URM students. Even still, administrators employed entrepreneurial approaches to ensure that these opportunities were available to students. Lastly, administrators used bonding, bridging, and linking forms or social capital to help URM students navigate the college to graduate school to career segments of the STEM pipeline.

Case Study: UC Berkeley

Overview

Introduction

Geographically connected by a system of bridges, for San Francisco Bay Area residents bridges are a way of life and powerful symbols of linking one community to another in this part of the state. Taking a trip anywhere around the Bay Area likely will involve traveling over one of these iconic bridges. Five of the most well known bridges ever built span miles of territory and connect millions of Californians to one another and to institutions like the University of California, Berkeley.

Not surprisingly, bridges are powerful metaphors for higher education. In particular, bridges typify the many ways that campuses like UC Berkeley construct academic and social support systems for underrepresented minority students attending college and graduate school. On a campus such as Berkeley, some of these programs have long histories and were founded in the aftermath of the Civil Rights movement. Others are much younger by comparison and have their origins post-Proposition 209. As an example of the former, on a recent Saturday afternoon, URM alumni with PhDs in STEM fields met on the north side of Berkeley's campus to talk about their experiences being the first or one of a few URM STEM graduate students at UC

Berkeley while they were earning their degrees. The occasion was a 50th-anniversary symposium for a student organization that was for many of these alumni the bright spot in an otherwise lonely existence as STEM PhD students.

Situated in an auditorium with a panoramic view of the magnificent trees scattered throughout the campus, a panel of four alumni (2 men and 2 women), recounted their stories arriving on Cal's campus and in being shocked by the very small numbers of students who looked like them in their programs. They all had attended Berkeley between 1985 and 2010. The audience was filled with current undergraduate and STEM graduate students. During their opening remarks, one of the female panelists – the first African American woman to achieve a PhD in her field – remarked, “I can't believe we're still having this conversation [about too few URM graduate students in STEM]?” Judging from my interviews with stakeholders, she was not the only one who felt this way.

Background

To explore collaborative relationships at UC Berkeley in a “STEM College,” I interviewed three STEM directors and one general manager of a Fortune 500 company who had responsibility for university relations at UC Berkeley (see Table 5). The three STEM directors' roles focused on outreach, admissions, and student affairs. Moreover, their jobs connected them to prospective and current undergraduate and graduate students. The general manager was responsible for recruitment and campus relations at UC Berkeley. The nonprofit leaders interviewed were statewide and national leaders working on STEM pipeline issues. In addition, they were deeply engaged within California public policy circles and worked closely with Berkeley and the other campuses in this study. The average experience of this cohort was 18 years. To protect anonymity, I created pseudonyms for each interview participant.

Table 5. UC Berkeley Case Pseudonyms

Name	Role	Responsibilities
“Nicole”	Director, outreach	Her responsibilities covered event planning, student recruiting, program evaluation, and Admissions.
“Angela”	STEM Director, outreach and student services	Her responsibilities included designing and implementing strategic outreach, advising, retention, and professional development programs for current and prospective undergraduate and graduate students.
“Will”	STEM Director, admissions and student services	His responsibilities covered issues in recruitment, retention and graduation of women and minorities STEM. He reached out to diverse students from the admission process through graduate school to increase their awareness of opportunities and services.
“Marcia”	Business Leader (General Manager)	Her responsibilities included university relations. She developed on-campus recruitment strategies for engineers and scientists at the bachelor’s, master’s, and PhD levels.
“Isaiah”	Nonprofit Advocate	His organization provides policy advice on improving the conditions to equitably boost higher education outcomes to drive economic growth.
“Sasha”	Nonprofit Advocate	Her organization urges the adoption of strategies to close the achievement gap in pre-K through college for African American and Latinx students.
“Sandy”	Nonprofit Influencer	Her work focused on the innovative policies, practices, and tools designed to enhance the effectiveness and efficiency of systems for the formal and informal education of STEM students and professionals.

Shaping Strategy, Addressing Challenges and Barriers, and Building Relationships

Key findings that emerged from my interviews with UC Berkeley stakeholders were that creating systems change required grasping the enormity of the pipeline, community-based organizations help in attracting more African American students, in particular; that collaborating with campus partners to provide physical spaces for students to cope with their environment was important; that strategically collaborating across campus for funding opportunities, information-sharing, and resource-sharing was a vital strategy; and that spanning boundaries created networks locally and nationally that assist with recruitment. The following sections cover each of these themes in more detail.

Creating Systems Change

Three of the nonprofit leaders interviewed for this study attempted to unpack the role of collaborative relationships at each progressive stage of the pipeline. For example, Sandy was a senior program director at a national nonprofit based in DC who worked on STEM pipeline issues at a national level. As one would expect, she had a big picture perspective, given that she worked on these issues across the country.

I think a big key is the K-12 [stage of the pipeline], because if you don't get into undergraduate with some interest in STEM, then it's highly unlikely that you'll be going to graduate school, and a lot of the research shows that middle school and younger is really when people get turned off of STEM...I think it's this whole map really.

Sandy's remarks underscored the "systemness" of the progressive STEM pipeline.

Relatedly, Sasha, a self-described grassroots nonprofit leader, pointed out how building relationships with other nonprofit leaders factored in grasping the enormity of the education pipeline to create systemic change:

Our organization [builds] relationships with what we like to call the grass tops, which are organizational leaders – people who are heads of organizations/institutions – so that they

can utilize our research and our practical knowledge to help move systemic change. Either way, our goal really is recognizing, identifying institutional leaders. Institutional leaders and grasstops leaders. Sometimes we also call them influencers as well.

However, while systems change is important, a bottleneck occurs at the undergraduate stage of the pipeline.

According to Nicole, a longtime administrator at Berkeley who had experience working at another UC as well, starting at the undergraduate level, yield at Berkeley was a big issue for increasing the numbers of URM students in STEM. She shared that a big part of [increasing URM numbers] was not only finding the students, but also getting them to say yes once they were admitted. Nicole explained how the STEM pipeline is difficult to manage because, in her own words, “[Looking at] California public school students who are prepar[ed] for the competitiveness of [a STEM program] at Berkeley, the pipeline – the funnel – just really gets quite narrow.”

Moreover for prepared URM students, according to Nicole, “They are sought after by so many institutions, many of which... have resources that we don't have that they can offer students to encourage them to attend these [competing] universities.” Financial aid and fellowship resources are needed to retain these students. This was part of the reason why relationships with business leaders like Marcia, a 27-year veteran at her company, were important. Based on Marcia’s interview responses, business leaders like her resorted to “try[ing] a lot of new things” in order to achieve shared goals of diversifying the STEM pipeline. They (business leaders) used strategies such as building on-campus relationships and using philanthropic resources. Most importantly, as Marcia put it “finding common areas and common ground to work on” was critical to diversify the pipeline since resources were limited.

Building Relationships with Community-Based Organizations

Even with resources from business partners like Marcia, UC Berkeley still used a variety of approaches to find students. One approach was to link up with community-based organizations. Relationships with community-based organizations were key because of the small numbers of African American students. Nicole declared, “We do find that it's easier to locate students, particularly African American students through [building relationships with] community-based programs since [the numbers of African Americans on most high school campuses in California] are small.” Small numbers on most high school campuses should come as no surprise since African Americans are roughly 6 percent of the state population.¹³ Taking these low numbers into consideration, Nicole shared that “A lot of the [African American] students [attend] private schools. [By] reaching out to the community-based programs, we're able to kind of get a concentration of African American students that way.” In contrast, Nicole shared how Berkeley used more traditional outreach measures to recruit Latinx students such as partnering with public school districts. Despite cultivating relationships with community-based organizations and school districts, finding competitive students within those settings who could get admitted to STEM programs and then yielding them involved building collaborative relationships internally, as well. Once these URM students were admitted to Berkeley, Nicole carefully detailed the groups that she worked with on and off campus as part of Berkeley’s retention strategy – especially in STEM.

Apart from Nicole’s responses about recruitment and retention, Sandy—the nonprofit manager from back east—preferred to talk about pathways, recognizing that “people don't follow

¹³ Retrieved from <http://www.census.gov/>

this one single line.” Sandy explained how students “might drop out of something for a while, but then they might come back into it, and those are the crucial things to think about [with respect to recruitment and retention].” Sandy’s comments were a reminder of how important it was to network across sectors with a long view in mind.

Faculty Commitment

Developing a system to support students once enrolled was important to ensure that the environmental conditions existed for students to succeed. Not surprisingly, Nicole did question the commitment of faculty:

[Some] faculty don't really believe that these [URM] students are there [in college] and can compete or that they [students] got there on their own...[T]he faculty don't think they [students] belong and that certainly comes through in the way that they teach these [URM] students...

At the graduate level, a long-term administrator in STEM, Will, believed that generally faculty members could be most persuasive in recruiting URM students because of research opportunities. According to him, “In general, the faculty member can be the most powerful recruitment instrument, particularly if they're offering funding.” Also according to him, “Where you felt welcomed, the context – the fit— and the financial aid” also played into a student’s decision to attend a particular graduate program in STEM.

Once on campus, faculty engagement with URM students was important since they play a critical role in making URM students feel welcome in the campus environment, and more importantly, link students to research opportunities. By Nicole’s account, the role faculty play in making the environment inclusive was critical because “if you're [as a student] also dealing with the social dynamics of the classroom as it relates to your [professor], that's challenging.”

Similarly, Sasha spoke about how both faculty and staff had roles in providing a system of support.

It's providing broad academic, social, emotional supports... What we've seen is that college faculty [and staff] provide enrolled students ongoing supplementary and personalized academic and non-academic supports. They think about interventions and ways to support students who are falling through the cracks so they don't feel isolated [and that] they don't feel like they are in silos, particularly in the STEM fields.

Three-quarters of the Berkeley stakeholders interviewed agreed that relationships with faculty mattered in getting URM student to campus and keeping them there through graduate school.

Psychological Safety

Several stakeholders interviewed commented on providing a safe space for URM students within the “STEM College.” For example, nonprofit executive Sasha commented:

I think physical spaces are symbolic and powerful. Often times when we do think about just creating space for people to know there's a place to go, that someone has been thoughtful enough to craft, to build out physical space for people to make connections, formally and informally really. From my experience, actually informal space was sometimes more helpful because that's where we're able to put down our guards, unwind, and talk about what's really happening. Yeah, I think that can be really powerful.

Nicole's view on physical spaces was, “ That kind of familial environment is something I think URM students in particular need because culturally I think that [they] thrive better in that kind of environment.” Angela summed it up best:

I'd say [Having a safe space] was essential where graduate students were concerned because a lot of students coming from other campuses [where they had earned undergraduate degrees] had a very rude awakening when they got to Berkeley. I had one student who had done their bachelor's at an [HBCU¹⁴] say to me, "When I was at [HBCU] I was happy every day. I haven't been happy since I got here to Berkeley." That was how he summed up the campus climate and sort of the alienation he had. He would spend time in the [cultural space designed for URM]. That was sometimes just someplace you could go vent.

¹⁴ Historically Black Colleges & Universities

Nicole talked about the isolation and its impact on keeping students at Berkeley:

In many cases, if they [students] do come and they find [an] experience that's really [not] nurturing for them or they feel that they are in an environment [where] they are [not] welcome, then they leave. And they're not leaving because they're unable to compete. They're leaving because they're looking for a more inclusive and a more supportive environment for them.

Collaborating with campus partners to provide physical spaces for students was important in order for students who felt socially isolated to cope with their environment.

Even when physical spaces or formal staff support structures were not available, Angela pointed out that student groups did a lot of things to support outreach to URM students and to retain their URM peers in the pipeline. This level of student engagement in outreach and support services activities that were previously performed by full-time administrators – and that came and went in the unstable funding environment – concerned her. “It's too much of a distraction from your studies [as students] trying to carry all of this weight,” she said.

Peer relationships among administrators were discussed at length during the interviews too. Each of the three administrators that I interviewed mentioned one administrator, in particular, as being a “champion for making sure that he and his STEM department kept their eyes on diversity.” He [the administrator] made a point of letting URM students know that once they arrived on campus, they had an ally in him. These individuals, like the students’ peers, seemed critical to building a supportive environment in STEM for URM graduate students.

Additionally, Will discussed how administrators also had peer networks for the purposes of sharing information about promising students who might be a fit for research programs at their respective schools. These networks were both formal and informal and met periodically throughout the year. Will shared:

There are a lot of alliances with other universities. And I think it helps [to talk to peers]... on behalf of [students]. [When I talked to peers about students, I say something like], “[Jamal] is applying to your [graduate STEM] program. He hasn't heard [if he's been accepted or not]. Here's some new information about him that just came in in December.” Or, “Jamal has been admitted to your program, can you keep an eye out on [his application]?”

Similarly, Angela shared her experience of bonding with other STEM directors:

Another thing that was really powerful when I was STEM Director was that there were [STEM directors with whom I networked] at all the other UC campuses as well as at [independent colleges and universities]. We [had a budget] to meet with each other a couple times of year at least...you'd have all these STEM directors in a room together, which was wonderful in terms of discussing issues and strategies...

She reasoned that because there was more discretion [to advocate for URM students] at the graduate level, having a network of peers to collaborate with was “just so vital to the success of recruiting URM students.” There was also a national counterpart to this statewide organization.

Angela also spoke of the power of the national peer organization for STEM administrators to which she belonged. Similar to the concept of safe spaces for students, in Angela's own words, statewide and national networking organizations were like “safe houses.”

According to her:

[It] was also really powerful to have [these peer networks]... in terms of graduate students [because] if I knew someone at [a university on the East Coast] and my student wanted to go there [for graduate school], I ha[d] a direct person to put them in touch with.

Just as students needed safe spaces to vent, apparently so did the administrators.

Intra-Campus Collaboration for Funding Opportunities

There were other collaborative relationships among administrators that were detailed in my interview with Berkeley administrators. For example, there were STEM programs across UC Berkeley for students contemplating graduate studies in engineering, the basic sciences, and health sciences. Administrators and faculty from these departments collaborated with one

another for the purposes of seeking federal funding for REUs (Research Experiences for Undergraduates). These national programs were precursors to UC-LEADS and continue today.

UC-LEADS was another gateway to graduate school for URM students in STEM. Founded in 2000, UC LEADS was a system-wide initiative run by the University of California Office of the President (UCOP). The acronym stood for The University of California Leadership Excellence through Advance DegreeS and provided two summers of research and leadership development for promising STEM undergraduate students interested in pursuing doctoral studies in STEM. The UC LEADS was geared towards preparing underrepresented minority students for graduate study.

Limited resources are an issue in maintaining funding of STEM initiatives and programs like those Nicole outlined and the ones offered in the “STEM College” that was the focus of this case study. Key takeaways from interviews and analyses of documents were that two strategic approaches principally drove Berkeley’s outreach to URM students throughout the stages of the STEM pipeline: opportunities for research and academic and social support services. Both of these approaches as described in interviews with stakeholders relied upon collaboration, and more importantly funding resources, for their success.

At a central level, the Berkeley STEM Equity & Inclusion Initiative was a campus-wide effort to assess STEM initiatives. The report’s authors noted that all STEM programs across campus have different funding mechanisms from multiple sources (see Table 6).

Table 6. UC Berkeley Funding Sources

<i>Public Funding</i>	<i>Private Funding</i>
<ul style="list-style-type: none"> • Internal Berkeley Fund • UC Office of the President (UCOP) • Federal (e.g., NSF), State or District Funds 	<ul style="list-style-type: none"> • Public and Private Donations • Foundation Grants • Client-based fees for services • Industry and corporations

This funding mix shown in Table 6 has been called “unstable” and the report suggested that program collaboration was one way to bring stability. Nicole’s comments about how students’ ability to access information on STEM programs and initiatives was limited by available funding during my interview with her appeared to confirm what was contained in the report. Nicole remarked, “As far as outreach, we have programs that kind of come and go, [be]cause funding [is] such an issue and access to information here on campus can be a challenge.” Also, the report did note that undergraduate programs receive the majority of funding. In discussing funding specific to the “STEM College” I studied, Will gave a pretty lengthy explanation during his interview with me. Will was very familiar with how funding worked for graduate study. Will had been on campus for over 25 years and was known for advocating for women and underrepresented minority students. Will had a reputation for going out of his way to make everyone feel welcome in the department and to know each student, making sure that no one was overlooked.

Will described the graduate student-funding model as “one student, one faculty member.” Essentially, faculty were empowered to decide who got funded and who did not for graduate school. According to Will, “So it's much more dependent on individual sponsorship and because the funding situation has changed for them, faculty are much more risk-averse,” when admitting students. Angela made a related observation about discretion at the graduate

school level. Unlike undergraduate STEM studies, at the graduate level, there was some leeway to still practice advocacy. She commented, “[There were] still scholarships that were targeted at minority graduate students in [STEM].”

Furthermore, Will gave details of how the “STEM College” worked with NSF, NIH and other government partners to fund research for URM undergraduate students interested in pursuing graduate degrees in STEM. The federal government had three levels of funding: pre-college, undergraduate, and graduate. Funding fell into two categories: planning grants and implementation grants. Collaboration occurred because campus like Berkeley had to coordinate with other entities, universities or agencies. Will’s remarks indicated that NSF funding was a critical resource for recruiting graduate students, especially URM students, in STEM.

Sharing of Resources and Information

Just as stakeholders described that funding was a resource, information was a resource too. When it came to accessing information, the outreach director, Nicole, reflected upon how many of the problems in recruiting URM students – especially in STEM – happened because some administrators lacked an understanding of what was and was not allowed in terms of recruitment and outreach under Prop 209. From Nicole’s point of view:

I guess there was some confusion around how [Proposition] 209 affected recruitment and outreach... [Proposition] 209 is about admissions and had nothing to do with recruitment, outreach, or yield... I think we have really got to a place where we understand it's okay to reach out to the student because they are of a certain ethnic group. So we have a lot more opportunities for that but I think it's still a work in progress, especially around STEM.

It appeared that this misunderstanding of Proposition 209 affected how resources were allocated to support recruitment and retention of URM students pursuing STEM degrees throughout college and graduate school.

Angela, who also worked as a student affairs administrator, agreed that Proposition 209 (Prop 209) had a “really toxic” effect on many of the successful programs that UC Berkeley had. For Angela, running support services programs for students was challenging because of the political atmosphere on campus during her time as a STEM Director. According to Angela, “Prop 209 spread a lot of fear and hesitancy.” Will, too, related how since “graduate admissions are totally owned by the departments,” and “[there are many] ways of interpreting [Prop 209],” rather than risk being challenged, departments would avoid any collaborative programs that could be misinterpreted.

Politics aside, talking to STEM directors about the pipeline of URM students prepared for graduate STEM study always returned to how prepared they were for pursuing undergraduate STEM degrees. Programs and events like summer bridge, boot camps, and diversity weekends were common approaches to building social capital among URM students right from the start of their educational journeys as undergraduates in college. Whether or not the student was an undergraduate or graduate student, once a student was admitted to campus, creating ties to bond URM STEM students with one another was important.

Within the “STEM College” I investigated for this study, students at the undergraduate level were provided with academic and social support services by the STEM Center. The STEM Center was a shared resource across several academic units on-campus. The program was created by the Academic Senate to serve “underprivileged students” and had served URM students since 1974. According to the Center’s website, the STEM Center provides academic support to high school students, undergraduate STEM majors, and graduate students with a goal of preparing them to be “outstanding STEM professionals.” This program was particularly notable given its origin of 1974. As mentioned in Chapter Two, during the 1970s there was an

increase in enrollment in higher education of African Americans and Latinx students (Hurtado, 1994).

Angela gave yet another example from her experience as a student services administrator in the “STEM College.” She described how to build academic support and social systems for URM students by working with many different campus partners:

On-campus we [had a collaborative program] called the *Coalition for Excellence and Diversity in Math, Science and Engineering*. [The program was a handful of academic support programs that] were sort of unofficially affiliated. What we did was offer extended sections for gateway courses like introductory calculus, chemistry, and biology. Students would receive extra units for taking these sections and the benefit was that other URM STEM students would be clustered in these sections.

Angela was proud of the resulting empowerment students’ gained who were clustered into her academic support program:

They all went marching into freshman chemistry class [on the first day of class] – you know 20 of them – that knew each other and they [the students] said everybody else was looking at them like, “You already know each other?” Wow. So, yeah, the social capital [that comes from working together] is important.

Angela could relate to what these students were experiencing as URM students majoring in STEM fields. She was a STEM alumna from Berkeley. She also oversaw the very program that she participated in as a student. This firsthand knowledge also “really did help” her to win the financial support for her program from the Dean of this particular “STEM College.”

Boundary Spanning Across the Sectors

For this study, I also interviewed three nonprofit leaders, Isaiah, Sasha, and Sandy, all of whom represented statewide and national organizations that worked on STEM pipeline issues. Interviews with each nonprofit stakeholder uncovered linkages with the campuses and to each other as nonprofit influencers and advocates. Additionally, because of their statewide and national vantage points, all of the nonprofit stakeholders expertly discussed the STEM pipeline

development from “K to Gray.” Their breadth of advocacy and influence spanned pre-K to PhD programs. With their focus on equity and representation, their voices as a group – and as individuals – contextualized college readiness and access for African American and Latinx students across the entire 10-campus UC system. Coincidentally, two of the three (67%) of the nonprofit leaders interviewed for this UC Berkeley case study were also UC alumni, although none of them had degrees from UC Berkeley.

Nonprofit executive Sasha ran a California affiliate of a national nonprofit that focuses on the STEM pipeline at the K-12 level. Sasha was aware that her organization needed to work collaboratively across the education segments in order to make progress on getting more URM students into STEM in college and graduate school. Sasha remarked, “We’ve started to deepen our post-secondary work [on the STEM pipeline] as well.” As one might expect from a grass tops leader like her, nonprofit leader Sasha’s map of relationships within the STEM pipeline included “a large group of organizations...that aren’t necessarily [on college campuses] that could be really helpful [to increasing representation of minority students in STEM]. [These organizations include] non-profit organizations, civil rights groups, and others who are committed to social change...” Sasha’s map was an obvious example of boundary spanning (i.e., engaging different partners across boundaries to see this complex social problem from different points of view).

Among the other influencers and advocates interviewed, nonprofit executive Isaiah was more frank in explaining the realities of organizations like his coordinating their work across the field. According to Isaiah, “I think what you will find is a number of these organizations do their own independent [work]. So, there’s many of us [working on] different aspects of the [pipeline].” Such a broad array of organizations attempting to address the shortages in the STEM pipeline

meant that collaboration was not easy. In Isaiah's opinion, "It is not insignificant to ask organizations to collaborate, because quite frankly, funders don't pay for collaborations." He continued sharing his thoughts on collaboration by asserting:

Collaboration is not a technical path. It's a relational path. One reason funders don't pay for it is [that] it's hard to measure whether or not organizations have good, genuine, authentic relationships that are allowing them to do work [that flows together].

Furthermore, the fact that "If you're making an investment in a collaboration, you're making a multi-year significant investment for those organizations to really get to know one another."

Summary

Altogether, responses from the administrators, a business leader, and nonprofit leaders illustrated relevant collaborative relationships needed to increase the numbers of URM students in graduate STEM programs. The themes that emerged from interviews with UC Berkeley stakeholders were that in order to create systems change, stakeholders needed to work across all of the segments and to encompass the entire education pipeline. Moreover, community-based organizations had key relationships within the African American community that gave administrators access to African American students, in particular. Furthermore, like intersectoral collaboration, intra-campus collaboration to provide physical spaces for students to cope with their environment is important, as well as partnering across campus for funding opportunities, information-sharing, and resource-sharing was a vital strategy. Once again, spanning boundaries created networks locally and nationally that assist with recruitment. By working together with other campus and community partners, the administrators and other key stakeholders in this study demonstrated the power of collaboration.

Case Study: UC Davis

Overview

Introduction

Described as the agricultural heart of the state, California's Central Valley produces everything from rice to tomatoes to almonds.¹⁵ Two things are responsible for California's superior food production: environmental conditions and soil. Like the automobile industry has been for Michigan or the energy industry for Texas, the agricultural industry has much to do with California's economic evolution since the state leads the nation in food production. Moreover, UC Davis has fortified California's dominance in this arena for over 100 years. Today, the farmlands surrounding the Central Valley are juxtaposed with technological innovations on UC Davis's campus, melding together images of California's agricultural past with its technology future. California's agricultural ascendancy stems largely from UC Davis' relationships with industry, its research achievements, and increasingly its production of STEM graduates. Perhaps just like the early leaders before them realized about agriculture, campus leaders today recognize that UC Davis' future growth runs through the heart of producing STEM graduate students, especially URM graduate students.

On a quick tour of the UC Davis campus, one is likely to feel the campus' palpable connection between its roots and its future. The 7000-acre campus first opened its doors as a research and science extension of UC Berkeley in 1908 and grew from an agricultural farm to a full campus in 1959. Graduate degrees were awarded beginning in 1949 and UC Davis' Chemistry Division was the first to receive patents of all the UC campuses. Now, one is as likely

¹⁵ Retrieved from <http://cityofdavis.org/about-davis/location-and-topography>

to see cows, as one is to see solar panels dotting the vast expanse of land within the university's borders.

In turning to the prior lessons learned from its agricultural roots, leaders now tend to a solid foundation and positive climate as part of UC Davis' strategy for increasing the number of URM students in STEM graduate programs. The campus has 90 graduate programs and throughout the years, UC Davis has enjoyed many top honors including first in the world for veterinary science and first in the world for agricultural science, along with first in the nation for launching women into STEM professions. Moreover, UC Davis ranks sixth in the nation as a public university and ninth in the nation for institutions granting undergraduate degrees to students of color. Recent accolades for UC Davis include: ranked first among the 13 most important STEM colleges for women by Forbes and second among the top colleges doing the most for low-income students by the NY Times.

Background

To investigate collaborative relationships at UC Davis in a "STEM College," interviews were conducted with three STEM administrators and two business leaders (one vice president and one general manager) who were alumni with STEM degrees. Of the three STEM administrators, two had full-time student affairs roles and one had a part-time academic affairs role that involved graduate student admissions. As with UC Berkeley and UCLA, the nonprofit leaders interviewed had broader perspectives gained from years of experience working on the STEM pipeline nationally and locally. Even still, they were intimately familiar with UC policies and programs to increase URM participation in STEM degree programs at the undergraduate and graduate level. The average experience of this cohort was nearly 23 years.

Pseudonyms used to protect anonymity for each interview participant are summarized in

Table 7.

Table 7. UC Davis Case Pseudonyms

Name	Role	Responsibilities
“Mario”	STEM Administrator, outreach	His responsibilities include increasing the pool of URM graduate students and providing workshops and academic support to graduate students.
“Donna”	STEM Administrator, outreach and student services	Her responsibilities included recruitment, retention, development, and graduation of underrepresented students in STEM.
“April”	STEM Administrator, part-time academic appointment	She was an instructor and administrator with responsibility for improving the diversity of graduate in the “STEM College.”
“Sydney”	Business Leader (Vice President, Customer Services)	Her responsibilities included overseeing customer services at a Fortune 500 company based in California.
“Marcia”	Business Leader (General Manager)	Her responsibilities included university relations. She developed on-campus recruitment strategies for engineers and scientists at the bachelor’s, master’s, and PhD levels.
“Lori”	Nonprofit Advocate	Her responsibilities include leading her organization’s research agenda, overseeing strategic media and communications, and building coalitions.

In addition to the interviews, documents and artifacts were also analyzed. For example, UC Davis had a comprehensive, online STEM portal with links to resources for students, parents, teachers, counselors, and industry. The portal’s home page dubbed itself “the go-to resource for all things science, technology, engineering, and mathematics related at UC Davis.” This website was a one-stop shop for students of all levels, parents, teachers, counselors, and

industry partners who want to learn about the STEM resources available to UC Davis students. It is not surprising that such a portal existed when according to statistics found on the site, over 56 percent of UC Davis undergraduates major in STEM, over 100 majors in STEM are offered, and STEM faculty comprise over 60 percent of total faculty at the University. This large number of STEM faculty was significant because, as the interviews revealed, faculty-student relationships and faculty's role in creating an inclusive culture were critical to student success in STEM at UC Davis.

Shaping Strategy, Addressing Challenges and Barriers, and Building Relationships

Key themes that arose from my interviews with UC Davis stakeholders were the roles that organizational culture, leadership commitment to diversity, boundary spanning across the sectors, a multi-faceted strategy, and mentoring played in increasing the underrepresented student populations in the STEM pipeline. The following sections cover each of these themes in more detail.

Organizational Culture

All but one of the administrators and business leaders interviewed at UC Davis highlighted the importance of establishing an inclusive culture for increasing the numbers of URM students in this "STEM College." In theory, an inclusive culture seems logical; however, it is much harder in practice to implement. The culture at UC Davis had been shaped by administrators' efforts aimed at achieving HSI (Hispanic Serving Institution) designation. A university initiative highlighted UC Davis's goal to reach this designation by 2018-2019. Doing so meant that UC Davis would be eligible for federal funding for diversity and related programs.

Prior to launching this HSI initiative, UC Davis had undertaken a similar initiative to increase representation of women as faculty and students.

One of the interviewees, April, was an administrator with an academic appointment and over 20 years of experience on campus. She provided a representational diversity example of how men and women in the department had worked together to increase gender diversity at the faculty level:

It was [just as] important to men in the [STEM College] to address diversity. And so, they actively recruited women into faculty positions at the assistant level. Then, those women then played an active role in recruiting more women to the [STEM College].

The entire faculty – men and women – embraced the pursuit of gender diversity.

Correspondingly, this rise in women faculty resulted in a rise in women students in the “STEM College.” April also noted how more women faculty translated into more female role models. Most importantly, she and other leaders had felt that improving the climate for women made increases possible in the representation of women students and faculty in STEM. From her point of view, “On the faculty side, a lot of it [increasing diversity] had to do with culture.” Campus leaders were now sowing the seeds for similar strategies aimed at producing more URM student and faculty representation.

In different interview, a business leader and alumna, Sydney, also pointed out how the inclusive culture at UC Davis had led to increases in the diversity of administrators, as well as faculty and staff. Sydney believed that diverse faculty and STEM directors were an integral part of the strategy for recruiting diverse students. In Sydney’s own words, “Diversity [is important for] finding people who can foster and mentor diverse and underrepresented students when they do come to UC Davis.” Creating the foundation and climate for industry was necessary if UC Davis was to achieve its HSI designation. Sydney’s comments were reflected in marketing

materials that promoted the “STEM College” at UC Davis as “an exceptionally collaborative, cross-disciplinary culture.” Both Sydney and April had observed how culture influenced strategy at UC Davis.

Leadership Commitment to Diversity

Sydney was in a unique place to observe these changes to UC Davis’ culture and leadership. In addition to earning B.S. degree from “STEM College,” Sydney had spent many years volunteering board and committees at her alma mater throughout the course of her professional career. Thus, her relationships with a variety of alumni and other campus stakeholders factored prominently into her contributions to the corporate advisory council chaired by the Dean of “STEM College.” Importantly, achieving diversity within “STEM College” also coincided with the arrival of a new Chancellor, who was himself African American with a STEM PhD. His appointment served as a powerful symbol of the university’s commitment to achieving excellence and advancing diversity.

Like Sydney, Marcia was another alumna who felt that leadership in “STEM College” had an impact on increasing the numbers of URM students applying to graduate school in STEM at UC Davis. Marcia, who herself was a first-generation college student, was the campus contact for her corporation and had also volunteered as an alumna for years on campus. Sydney and Marcia perceived that Deans had the power in the STEM Colleges on campus and that the Deans were in the best position to get the buy-in from the faculty in order to recruit more URM students at the graduate school level.

Furthermore, being engaged volunteer corporate advisory board members provided Sydney and Marcia access to top university officials. This access allowed each of them to strategize and see the big picture for increasing STEM graduates from these underrepresented

groups. Sydney reflected, “[By networking with] other university leaders...I think I have a greater understanding of what the goals are at the university.” Partnering with leaders on diversity and inclusion initiatives meant Sydney and Marcia could offer their companies’ points of view on workforce needs, especially for STEM graduates. For example, Sydney explained, “And I think [as a business leader] collaboration is really the only way you can get a real feel in the universities for what benefit [students are] getting out of certain training and certain kinds of skill sets [upon graduating from] the universities.” As discussed earlier in the UC Berkeley case study, nonprofit stakeholders like Sandy also favored this systems approach to increasing representational diversity in STEM. This “big picture” ability is one of Senge et al.’s (2015) core components of systems performance.

Marcia described in more detail how her access to leadership drove her company’s on-campus strategy: “[To increase] the number of African American students or [Latinx] students that we hire, we [look] at the front end [of the pipeline].” According to Marcia, the front-end of the STEM pipeline was the undergraduate level, well before a student applied to graduate school. Marcia leveraged her relationships with campus leadership, her role on the corporate advisory council of “STEM College” and her alumni leadership to ask, “What are you going to do at [UC Davis] to make changes?” If she was not satisfied with the response, she would then say, “Hey, you know what? Then you don’t have the diversity that we’re looking for to replicate within our company [and] we’re going to go somewhere else.” For her, work on the front-end meant “talking to the dean, talking to the chancellor, and talking to the [associate chancellor of equity].”

Boundary Spanning Across the Sectors

Another strategy for URM recruitment and expansion of the pipeline was to span boundaries across multiple sectors. All of the UC Davis stakeholders interviewed discussed

relationships they regularly engaged in for the purpose of building the pipeline. Some of the key partners were: other campus departments, community-based organizations, other higher education institutions, the UC Office of the President (UCOP), and government grant funders like the National Science Foundation (NSF) and National Institutes of Health (NIH). For example, even though her company did not recruit as many graduate students as they did undergraduates, Marcia, explained the hiring process. Graduate students hired often resulted from partnering with faculty on “[research] projects that are similar to the kind of work that we're doing here at [her company].” Here again, was another research example that showed how beyond hiring, companies like Marcia’s aligned strategy with cross-sector collaboration.

Yet another strategy to find more graduate students was to build relationships with faculty at other schools, particularly at the California State Universities (CSUs) and California Community Colleges. Recognizing that the pipeline is thin for graduate student prospects in STEM, these institutions have large untapped pools of URM undergraduate students. In particular, April stressed how important it was for “STEM College” to build relationships across these institutions in order to increase the numbers of potential graduate students. She explained, “It’s the one-on-one contact with faculty at other schools who have academically talented, often first-generation undergraduates [that helps us to identify talent].”

In addition to the sizeable African American and Latinx student populations, April also acknowledged how preparation received at the CSUs was key in attracting students for graduate school in STEM. She shared:

The California State University System prepares students who are first in their families to go to college...The faculty know this and so, the faculty will actively recruit at CSU's as a way of improving the diversity of the applicant pool.

As an administrator responsible for growing the number of graduate students in “STEM College,” April employed a strategy of going where the students were. In this case they were at CSUs.

Like the CSUs, community colleges were important places from which to recruit potential students too. Here again, April confirmed that faculty actively recruited underrepresented minority students at the community colleges for summer research opportunities because faculty “saw it [community college recruitment] as a bridge to Davis.” According to April, “once these students have had an undergraduate research experience at Davis, and then they became a full-time student here, they [can] continue research in the lab.” The strategy here was to convert these transfer students into graduate students by establishing a relationship with them even before they (students) became undergraduates.

In addition to student benefits, collaborating with other institutions had benefits for stakeholders, too. Here is how Marcia, as a corporate advisory council member, described the value in serving on similar boards across the country:

When I sit on a board at [University A] ...I listen and I pick up little nuggets of information. Then I go, “You know, I was talking to [University B] about that last month. I’m going to share that” ... Or... “Hey, I heard this at the board meeting. You guys might want to consider looking into this or trying this....”

This type of best practices sharing was part of the collaborative process when engaging with schools to fill the STEM pipeline.

Furthermore, according to Marcia and Sydney, business leaders who looked to diversify the graduate student pipeline for STEM often “[found] common areas and common ground to work on” as well as “[found] organizations that [the company] want[s] to have a particular strategic relationship with [in terms of philanthropy].” Marcia, further explained:

We try to see what are we looking for in the relationship, what is the university or association looking for their relationship and then how do we find sort of common areas and common ground to work on. Sometimes it involves funding but not always.

Finding common ground via boundary spanning was important to nonprofit influencers and advocates too. In the words of nonprofit executive Isaiah, “we're very small-staffed, and so we try to work at the level of, what's the bigger picture that needs to be addressed, statewide?”

In addition to culture, leadership commitment, and boundary spanning across the sectors, their own experiences in college informed the business leaders interviewed. As a former STEM major and first-generation college student, Marcia reflected:

When I think back to my own experiences pursuing undergrad and graduate degrees, there was a lot of support at the right times and the right people being involved in my life. There were influencers [that allowed] me to get through [college] and graduate in the top of my class, get into [graduate school] and [earn an advanced degree in STEM].” There's a lot that happened. At the time there were people that were very influential and really pulling for me...I would've not been able to afford college if I [didn't have their support].

Furthermore, Marcia's insights about how collaboration with peers informs her today as a professional were particularly insightful. She shared personal stories from her own experiences of being a URM student in STEM, both as an undergraduate and graduate student.

The experience I had [as a minority] was very important, [because] you can't create diversity in a vacuum. As a business leader today, [I] can strive to increase the number of URM students and maybe even be successful at that, but [there's value in examining] what relationships are like between the students [regardless of racial or ethnic background]?...You still have students that can see the value in working together and knowing that it's important to have someone that doesn't look like you, or have someone that doesn't have the same experience as you [in school with you].

These two examples demonstrated how Marcia relied upon her own experiences as a URM student to drive decisions regarding her company's relationship with UC Davis.

Multi-Faceted Strategy

In describing her company's approach to attracting talent, Marcia referred to trying a lot of things as a "multi-faceted strategy":

You have to work with your partners to decide what is the most effective way to reach the talent including underrepresented minorities that you're looking for. It's really a lot of dialogue with the partners and how best [our company] can help support the students. Ultimately we want people at the end of the pipeline [graduates] but we're helping the broader audience, knowing that only X amount of those students ultimately are going to be interested [in] and hired by [our company].

Similarly, part-time administrator and faculty member April expressed that finding what works to recruit underrepresented minority students for graduate study in STEM meant "trying a lot of things...based on what's worked at the undergraduate level [even if] the solutions might not be the same."

Make no mistake about it, a large number of students completing undergraduate STEM degrees make decisions based on family. As Marcia points out, "They could come from supportive family backgrounds, or from families who are not supportive." According to her, for these underrepresented students, many of whom are also the first in their families to go to college, continuing on from undergraduate studies to earn a graduate degree is unfamiliar. Therefore, students often opt not to pursue graduate degrees.

Moreover, the choice of major sometimes depends upon whether or not their families wanted them to leave home or go to college in the first place. From Marcia's point of view as a business leader, "I think there's this misperception that [for] all first-generation [students]...families wanted them to go to college. [Some of their families] wanted the student to stay home working for the family business or to not go so far away from home." Similarly, April echoed Marcia's comment from her perspective of an administrator in the "STEM

College” researched at UC Davis. She said, “I think the other challenge that we encounter is that the students that we're trying to recruit are first in their families to even get an undergraduate degree.” This underlying issue is why some collaborators put an extra emphasis on explaining to families the value of their child earning a master’s degree.

Just as family is part of the multi-faceted strategy, exposure to research is yet another way that universities attempt to influence students. Donna, a career UC Davis employee as well as alumna and person of color, elaborated on why exposure to research and life as a professor is critical to persuading young undergraduates to pursue graduate degrees. She spoke of a recent panel that her STEM program hosted with faculty members, “Faculty members were invited to share their experiences of earning PhDs in STEM. Students learned that day that each of them [faculty members] had their different reasons for pursuing research, for pursuing becoming a professor.” According to her, “The students just felt [connected to the faculty] at that moment.” Hearing from faculty gave students an opportunity to learn what faculty members were doing in their labs. From that event, Donna reported that one student even asked, "Could I work in your lab?" Like Donna, Marcia also emphasized how first-generation and underrepresented minority students need repeated exposure to role models and access to information, especially when it came to graduate school. URM students benefited from repeated exposure to faculty members.

In addition, according to April, “The other area that's worked really well for UC Davis was in making improvement in our underrepresented population in [STEM College] is that we can recruit our own [students for graduate study].” Early exposure in undergraduate studies to research opportunities has played a role in that improvement effort. Still another administrator, Mario, added, “[Getting] students to appreciate research and having an undergraduate research experience is critical for [improving competitiveness for graduate admissions].” Mario was in a

central campus role as an administrator. He worked directly with students across many “STEM Colleges.” He focused on developing skills for these students that went beyond what they were learning in the classroom or research labs.

Another facet of building relationships and collaborating with campus partners to increase output from the STEM pipeline was how business leaders used their financial resources. Marcia shared how “[There are] only a few of us that do this [university relations] for the whole company, and so we're good at building relationships and partnerships...” Furthermore, in response to questions about supporting student organizations, on-campus recruiting, and graduate school outreach, Marcia maintained, “You [need] to have all of these different strategies while also balancing [the strategies] with the available time and the funding that you have. You have to kind of be smart with your time and your money.” Because there are many more organizations than companies have resources to sponsor, representatives like Marcia are careful to spend the time figuring out which ones have the greatest opportunities to build the STEM pipeline for graduate school and career opportunities. Overall, stakeholders interviewed gave many examples of trying different things to support the broader mission of helping URM students in the STEM pipeline reach graduate school.

The Importance of Mentors

Regardless of the stakeholder group, mentoring as a theme was evident in each of the interviews I conducted. When I asked about the important relationships that inform STEM pipeline work, I heard things like “the mentor/mentee relationship is so important” But what was it about these mentoring relationships that made them so essential? April felt because research is central to graduate study in STEM, encouraging students to proactively manage their mentoring relationships with faculty was important. Also, according to April, to combat students’ feeling

isolated, UC Davis offered support mechanisms like peer-mentoring programs and connected students with graduate student identity clubs.

Administrators, business leaders, and nonprofit leaders all agreed that faculty also bore responsibility for nurturing the mentor/mentee relationship. Mario, a STEM Director with experience at private universities across the country before arriving at UC Davis, felt that faculty mentors were successful in their relationships with students when they balanced giving formal information about research and career opportunities with information about how they (faculty) made personal decisions about where to attend graduate school, etc. In the same spirit, Donna, another campus administrator who had spent her entire career in student services at UC Davis, had made the same point when she talked about exposure to faculty at an event her “STEM College” hosted. Likewise, Sydney, the alumna business leader, had drawn a similar conclusion in talking about committed leadership. As mentioned in the discussion of strategy at the beginning of this case study, Sydney shared that the Dean of the STEM College acknowledged “how successful they've been and recruiting professors who are women or underrepresented minorities and the impact that has had on the campus' ability to attract a diverse student population.”

Donna thought it was important to point out the impact of peer relationships for URM students majoring in STEM, “When you're working [together as students], [you are] going to impact other students as well... let's say [or STEM College] is providing [information] to a student. That student will sometimes share with other students who are not in [this STEM College], and on and on.” In a sense, the network effect caused by these relationships benefitted students by reducing the complexity differential (i.e., the difference between the complexity of the system and the complexity of its environment). Donna even reported that she “sometimes

even think[s] that when [she's] talking to students, [whatever information she shares] will likely be shared with someone who's not in [STEM program], just because they think that this advice is really helpful.” Both faculty-to-student and student-to-student mentoring were important in getting students, especially URM students, to and through STEM graduate programs.

Summary

In summary, strategies, challenges and barriers, and relationships were discussed at length with six stakeholders connected to UC Davis and four findings emerged. First, an organizational culture rooted in diversity, equity, and inclusion is integral to the recruitment strategy for URM graduate students in “STEM College.” Second, leadership commitment to diversity starts at the top of the organization, so that there is alignment in “STEM College” with the institution’s goal of increasing student diversity in STEM. Third, boundary spanning across the sectors by cultivating relationships with CSUs and community colleges offer opportunities to grow the pipeline of URM students pursuing graduate school. Fourth, stakeholders at UC Davis agreed that trying different things like placing students in close contact with faculty who may have been the first in their families to go to college, providing physical spaces for students to cope with their environment, or engaging family members in graduate school decisions supported the broader mission of helping to recruit students. Lastly, mentoring relationships reduced complexity differentials that existed between the lives of these URM students, as minorities on campus who are many times are the first in their families to attend college and their lives as STEM students.

Cross-Case Analysis

Overview

This investigation of cross-sector collaboration aimed at expanding the representation of students pursuing graduate study in STEM highlighted a range of possibilities for getting African American and Latinx students to college and moving them through the pipeline at three different UC campuses. Unpacking strategy compelled me to take a closer look at African American and Latinx students' challenges and barriers in applying for graduate school in STEM. Within these challenges and barriers were exceptional stories. There were stories of how leaders from each sector navigated the mix of organizational capabilities, information, and resources at the three campuses. There were stories of how these leaders built bridges with research and fellowship programs to connect URM students to graduate school opportunities; and there were stories of how these leaders cultivated bonds among students, faculty, and staff who served as peer support and role models. What is more, the interconnected nature of the STEM pipeline (“from K to Gray”) called into question a “one-size-fits-all” approach or looking at one campus in isolation.

Each of the three campuses, UCLA, UC Berkeley, and UC Davis, offered distinctive collaborative approaches for improving the prospects of African American and Latinx students seeking admission to graduate school in STEM. Through the experiences of 17 people interviewed and analyses of documents and artifacts, I constructed a composite view of some key collaborative relationships found when building support and inclusive climates for URM students looking to advance through the STEM pipeline to graduate school. The following four findings emerged from the cross-case analysis of the three campuses.

Stakeholders Intentionally Collaborate Around Shared Goals

First of all, the road to graduate school began as early as K-12. Having relationships with nonprofit leaders like Dee, Ebony, Isaiah, Sasha, and Sandy informed administrators and business leaders at all three campuses about what was happening at earlier stages of the pipeline. Alternatively, the nonprofit leaders gained leverage in their efforts to advocate on behalf of marginalized groups and to influence public policy locally and nationally by having relationships with campus administrators and business leaders.

Besides having valuable relationships to inform stages of the pipeline, in UC Davis's case, an intentional strategy to recruit URM students at the undergraduate level positioned them to advance these students into graduate programs in "STEM College" for a number of reasons. First, the decision at the university level to pursue HSI status was a vision shared by academic units like "STEM College." Intentionally growing the numbers of undergraduate students from traditionally underrepresented groups increased chances of them either pursuing graduate school in general or staying on to earn their graduate degree from the "STEM College" at UC Davis. Second, external stakeholders like the alumni business leaders and nonprofit leaders interviewed had a systems view and embraced the changes that were being articulated by the Chancellor as well as the Dean of the "STEM College." The external points of view informed decisions being made inside "STEM College" and allowed for business leaders like Sydney and Marcia to learn from one another and to align their company's limited financial resources for research and hiring to the diversity strategies at UC Davis.

Organizational capabilities differed at UC Berkeley and UCLA. In a post-Proposition 209 environment, these two campuses had in some ways become risk averse when it came to outreach and programming that served these underrepresented groups. This risk aversion led to

dismantling academic support programs within “STEM College” at UC Berkeley that were largely focused on URMs. Instead, the UC Berkeley now relied upon centralized approaches to serve minority groups receiving academic support. Another consequence of dismantling funding for programs within “STEM College” at UC Berkeley was that academic units with STEM majors across campus now worked more closely with one another to identify federal funding to support research opportunities for students. This situation required administrators like Nicole, Angela, and Will to adopt an entrepreneurial spirit in working to increase the numbers of URM students applying to graduate school in STEM.

At all three campuses boundary spanning serves as a way to cultivate relationships other public higher education institutions and public and private sources for funding student research opportunities. Since research was a gateway to graduate school, for example, UC Davis faculty members engaged in relationship building with California Community Colleges and CSUs to reach back much earlier in the STEM pipeline for future graduate students. Recognizing that large numbers of African American and Latinx students attended California Community Colleges and CSUs shaped UC Davis’ strategy for increasing the numbers of URM students in the graduate school pipeline included outreach to these segments for participation in REU (Research Experiences for Undergraduates) collaboratives. Moreover, as part of its STEM pipeline strategy, UCLA, too, was growing its own URM graduate students by finding research funding from industry partners to support faculty members willing to engage with students as early as freshman year. Without question, opportunities for undergraduate research was a common theme discussed among all of the campuses studied.

Having relationships with other public higher education segments provided other benefits for UC Davis, UCLA, and UC Berkeley. The CSUs, in particular, were beneficial partners for

growing the numbers of URM student in graduate school because of their preparation of first-generation college students. The theme of sharing of resources and information came up in seven (41%) of the interviews with stakeholders at all three campuses. Many of these first-generation college students were also underrepresented minorities. Being first-generation in some cases meant not having access to information or financial resources regarding graduate school at home.

Moreover, as first-generation college students, they were often times strongly encouraged by their families to work once they finished their undergraduate studies. In a nod to the pluralistic value of diversity, business leaders like Vaughn, Raquel, Sydney, and Marcia felt that exposure and information were critical to making students successful as leaders on campus and in pursuing graduate students for jobs at their respective companies. As Vaughn put it, “The key for [my company] is to build these relationships with these universities at a level of not only recruiting but also developing these [URM] students into leaders.”

Stakeholders collaborate to identify and provide research and job opportunities

By the time a student reaches graduate school, a case can be made that the “pipeline” no longer resembles a network and instead resembles “a pyramid.” The narrowing occurs because of the distinctive feature of graduate study: the one-on-one nature of a student’s relationship with a faculty member. According to April, an administrator at UC Davis, “Graduate students are admitted in a very decentralized way [and] faculty make that decision of whether a graduate student joins the program or not.” Similarly, Will at UC Berkeley stated, “In general [when it comes to recruitment], the faculty member can be the most powerful, most persuasive, particularly if they're offering funding.” This is due, in part, to the heavy reliance on prior research experience as a prerequisite for graduate school. Faculty hold the keys to those research

opportunities; professors as mentors unlock STEM opportunities for most students. The primacy of a student's relationship with a faculty member at this juncture is the reason why the pipeline now looks more like a pyramid.

Financial resources give business leaders leverage to shape strategy

Business partners could affect strategies on campus because of the unstable funding environment that dogged California's public research universities. But these partners were not free from their own funding constraints. As Marcia, the general manager who oversaw campus relations with UC Berkeley and UC Davis explained, "You [need] to have all of these different strategies while also balancing [the strategies] with the available time and the funding that you have." Companies like hers and the ones represented by other business leaders interviewed in this study used a portfolio approach in working with campuses to grow the STEM pipeline.

Support services mitigate social isolation and shape strategies

In interviewing administrators at the three campuses, the role of "safe spaces" for students – as well as administrators – featured prominently into shaping strategies and allocating resources and information within the STEM pipeline. I found that physical spaces and ways of formally gathering served as channels to communicate information about fellowship and research opportunities and for students (and administrators) to vent their frustrations. With single digit percentages in representation in the "STEM Colleges" studied at UC Davis, UC Berkeley, and UCLA, it is no wonder that students felt isolated. Administrators used financial capital provided by business partners to fund these social networks within their "STEM Colleges." In doing so, they strengthened bonds among these underrepresented students with the hopes of retaining them through college and into graduate school. In particular, STEM

administrators were facilitating connections with stakeholders across the network even though they were not the ones directly responsible for admitting graduate students.

Still another group of stakeholders who were investing in long-term collaborative approaches were the nonprofit leaders. Their capital was earned in the community and in the political arena by advocating on behalf of URM students in order to equitably grow the STEM pipeline. Strategically, nonprofit leaders engaged with public education system across all segments (K-12, Community College, California State Universities, and the University of California). They also engaged with state and national government entities. These leaders added a voice calling for systems change, which was in keeping with what Senge et al. (2015) described as “seeing the big picture.” Systems change cannot happen without the ability to see the big picture.

Concluding Remarks

When it came to URM students at UCLA, UC Berkeley, and UC Davis contemplating graduate school, the university’s role, namely the role of professors, was most critical in shaping a STEM student’s path post-college. Even still, university, business, and nonprofit stakeholders who maintain the STEM pipeline understood how collaborating with one another could open up professional and educational pathways for graduate study. These collaborative efforts looked different across the three campuses. Some were at a central campus level. Others were at an academic unit level. Still others were at a departmental level within an academic unit.

Collaboration occurred over time and was inversely proportional to the number of URM students applying to graduate school, i.e., collaboration increased even as the number of eligible students shrank. Throughout the stages of the STEM pipeline, the pipeline changes shape from a pipeline to a network to a pyramid. Even before they make it to the point of applying to graduate

school, many of these students often lack the know-how of prioritizing on-campus and off-campus relationships to secure research opportunities and work experience early in their undergraduate careers. For this reason, what is commonly described as a pipeline, can look and feel like a pyramid, especially to African American and Latinx students.

Well before getting to the point of applying to graduate school, undergraduate URM STEM students navigated a network (system) of pipelines – much of which was held together by a myriad of collaborative relationships among various stakeholders. Within the network, administrators were the bridge builders between what schools espoused on their websites and in their diversity plans, and what the reality was on the ground for URM students. Many of these students were the first in their families to attend undergraduate college. If that were the case, then these same students were the first in their families to attend graduate school.

Lastly, calling this complex social system a pipeline simplified complexities enmeshed within this vast human effort. Reducing the complexity differential within the “STEM Colleges” at UCLA, UC Berkeley, and UC Davis often times happened through sharing of information and resources. STEM directors interviewed in these “STEM Colleges” acted as bridge builders for other sectors interested in developing and sustaining the pipeline. Moreover, business leaders having direct links to the campus influenced resource allocation in ways that STEM administrators could not.

Chapter Five: DISCUSSION AND CONCLUSION

Introduction

My research explored collaborative interpersonal and organizational relationships among university administrators, business leaders, and nonprofit stakeholders at three University of California campuses (UCLA, UC Berkeley, and UC Davis). These stakeholders engaged in efforts to expand African American and Latinx representation in STEM graduate programs. I asked members of these three organizational sectors questions about collaborative relationships in order to understand how different forms of social capital benefit underrepresented minority (URM) students likely to pursue graduate study in “STEM Colleges.” I also asked each of these stakeholders questions about how they employed collaborative relationships to allocate information and resources among URM students interested in pursuing graduate school in STEM. Finally, I asked these stakeholders what role these collaborative relationships play in developing strategies to reduce the complexity differential URM students experience. The complexity differential arises from the difference between the lives of these URM students, as minorities on campus who are many times are the first in their families to attend college and their lives as graduate students. Data collected and analyzed revealed a number of ways stakeholders across the three sectors collaborate in order to provide outreach and support services for minoritized¹⁶ students in higher education stages of the K-to-career STEM pipeline.

This chapter begins with a discussion of four key findings from my research and relates these findings to existing literature reviewed in Chapter Two. Following the discussion, I

¹⁶ According to Gillborn (as reported in Bensimon and Dowd, 2015), some groups acquire minority status through the beliefs and social processes placed upon them by other groups rather than by their numerical representation. *Minoritized* symbolizes lack of power and more limited access to economic and social assets.

examine implications for practice and educational leadership. Finally, I offer thoughts and reflections about my research and plans for future dissemination of these findings. Once again, this study showed how stakeholders from three different sectors used collaboration to bond, bridge, and link students in STEM to people and programs to address the complex social problem of underrepresentation of African American and Latinx students in STEM graduate programs.

Discussion

There were four key findings from my research with “STEM Colleges”¹⁷ at three UC campuses. First of all, stakeholders intentionally collaborated to achieve shared goals in conducting outreach to prospective underrepresented minority (URM) graduate students. In addition, stakeholders collaborated to identify and provide research and job opportunities for URM students enrolled in STEM graduate programs. Thirdly, the financial resources and power dynamics of business leaders’ relationships as alumni and with school leadership, gave them additional leverage to influence diversity strategies at the three campuses studied. Lastly, stakeholders collaborated in designing support services to mitigate social isolation many of the URM students encountered on the campuses studied. These four findings will be explored in more detail throughout the remainder of this section.

To begin with, administrators and business leaders studied built relationships intentionally with one another and with faculty to enable outreach strategy. Moreover, working together revealed different levels of personal versus positional power among the stakeholder groups. Administrators in this study had been higher education administrators for more than 22

¹⁷ “STEM College” is a pseudonym for an academic unit on each of the campuses.

years. Many were employed within their campus' "STEM College" at the time that Proposition 209¹⁸ passed in 1996. Because of their professional experiences pre- and post-passage of the proposition, they (administrators) were keenly aware of the challenges in interpreting how to recruit and retain underrepresented minority students. They used their personal power to build relationships with business leaders and faculty members, two other stakeholder groups within a university that have enormous positional power. Moreover, these administrators and business leaders used their positional power to affect opportunities for URM students in STEM well before these students even applied to graduate school.

In particular, relationships between business leaders and faculty members led to financial sponsorship of research activities, research exposure for students, and the sharing of information about graduate education and job opportunities. More importantly, administrators and business leaders each made use of the linking form of social capital¹⁹ to familiarize students with potential faculty mentors and faculty with potential graduate students – sometimes as early as freshman year. This linking social capital was analogous to faculty engagement and student support noted in Thompson and Campbell (2012). Linking students to faculty as undergraduates in STEM programs was critical for building a pool of potential graduate students.

Furthermore, this exposure to faculty as mentors was indispensable for URM students. Many of them were the first in their families to attend college. If they were the first to attend college, then they were also the first to attend graduate school. As discussed earlier in Chapter Two, approximately half of American Indian/Alaska Native and African American, and more

¹⁸ The passage of this proposition banned race-based affirmative action programs in admissions, financial aid, and hiring throughout the public sector in California (Biegel et al., 2016; Douglass, 1998; Lipson, 2011; Santos, Cabrera, & Fosnacht, 2010)

¹⁹ Linking social capital encompasses relationships that span power relations (Woolcock & Narayan, 2000).

than 40 percent of Hispanic or Latinx, doctorate recipients belong to families in which neither parent has been awarded a college degree (NSF, 2016), whereas 50 percent of Asian and White doctorate recipients have at least one parent with an advanced degree. From this data, it was assumed that the series of firsts described above meant that URM students had less familiarity with graduate school than their Asian or White peers. Moreover, the NSF reported that African American and Latinx students had lower expectations about attending graduate school. More than half of the administrators interviewed for this study noted that having faculty mentors was essential for URM students considering graduate school in STEM.

Beyond faculty and student relationships, administrators and business leaders attended to relationships in the STEM pipeline, using bridging social capital,²⁰ that were beneficial to URM students seeking graduate study. In the competition for what some professors perceive are the best students, relationship building for advancing equity and racial/ethnic diversity goals may seem counterintuitive. Moreover, admissions committees within the “STEM Colleges” in this study over-rely on a broader definition of diversity to achieve their interactional and educational diversity goals in recruiting students. This over-reliance is perhaps a by-product of market influences (e.g., globalization, shifting demographics, and scarce financial resources) on higher education. On the other hand, this over-reliance can be a way to limit risks and exposure. As a result, the overall culture of recruitment becomes a barrier that restricts access for African American and Latinx graduate students (Anderson et al., 2007; Thompson & Campbell, 2013; NSF, 2016). In response, intentionally collaborating with external stakeholders on outreach can

²⁰ “Informal personal networks, formal associations, and other connections among socially dissimilar groups” (as cited in Weisinger & Salipante, 2005, p. 33).

remove traditional boundaries that restrict access to higher education for African American and Latinx students (Holley, 2009; Siegel, 2007; Siegel, 2010).

Furthermore, a broad definition of diversity that encompasses qualifications and characteristics beyond race and ethnicity (Garces, 2014) concerns STEM administrators in this study who want to increase the numbers of African American and Latinx students at the graduate school level. As Posselt (2016) argues, to increase the numbers of African American and Latinx students, collaborators like the ones in this study need to know how admissions officers construct applicant desirability to make decisions. I found that collaborative relationships among administrators, business leaders, and nonprofit leaders employed bridging social capital to close the gap between diversity rationale and historic affirmative action goals among stakeholder groups. In this way, bridging social capital buffered against what organizational experts Bolman and Deal (2008) describe as over-relying on rationale instead of committing to building relationships in organizations.

Furthermore, some STEM professors rationalize selection of graduate students by privileging a student's academic profile from their undergraduate studies over how they will fit into the characteristics and climate of the school. Johnson (2007) contends that this rationalization emanates from "a narrow focus on decontextualized science and the construction of science as a gender-, ethnicity-, and race-neutral meritocracy." Further, Johnson's study argues that "large, competitive, fast-paced classes, poor teaching, and an unsupportive culture" are indicators of characteristics and climate in undergraduate STEM programs. Therefore, from a systems perspective, prioritizing rationale over relationships starts early in a URM's STEM experience and enlarges underrepresentation of minorities in STEM by the time they reach graduate school eligibility.

A third form of social capital, bonding social capital,²¹ attempts to compensate for over-reliance on the rationale discussed above. Similar to Johnson’s study, Hurtado (1994) explains that faculty expectations and attitudes and quality of interaction are paramount for student success in graduate studies. Some of the ways bonding social capital addresses how URM students will fit into the characteristics and climate of the school are: having opportunities to deeply engage STEM course content with peers; participating in research; and joining affinity networks (Griffin & Muniz, 2015; Griffin, Muniz, & Smith, 2016). Evidence from my interviews with each of the administrators in my study confirmed that these sorts of tactics helped them to build relationships between students, as well as with professors. Therefore, employing tactics that embrace bonding social capital to achieve racial and ethnic diversity in “STEM Colleges” at UCLA, UC Berkeley, and UC Davis is important given the social isolation many URM students feel.

On another note, the nonprofit leaders in my study demonstrated other ways to leverage bonding social capital for the purpose of achieving diversity in STEM graduate programs. Although I did not expect to find explicit ties between the nonprofit leaders that I interviewed and faculty members within “STEM Colleges,” the nonprofit leaders did have access to other campus leaders in the study. Their access as a group stemmed from racial/ethnic bonds or from their alumni connections with the campuses in this study. Also, their access as a stakeholder group was critical for advocating and influencing for social justice. For this reason, nonprofit leaders added legitimacy to the work that administrators were doing to increase racial and ethnic

²¹ The kind of social capital associated with group membership (as cited in Weisinger & Salipante, 2005).

representation in STEM. Legitimacy leads to rewards such as resources and other critical support when social norms guide organizations (Siegel, 2010).

Moreover, these nonprofit leaders saw themselves as holding universities accountable for espoused representational diversity goals. This was an area where tense relations could surface among stakeholder groups because, as one nonprofit leader expressed, “Holding others accountable for their outcome[s] doesn't often lead to close collaboration.” Senge, Hamilton, and Kania (2015) said it best though, “We know of no examples where effective system leaders achieved broad-scale success without partners” (p. 33). Bonding together for social justice, the nonprofit advocates and influencers in my study legitimated the universities’ work to increase racial and ethnic representation in STEM.

Another finding from my study supported education researchers’ claim that collaboration assists organizations in building organizational capabilities through resource sharing, the creation of joint educational programs, technology enhancement, and workforce preparation (Di Domenico et al., 2009; Amey, 2010). In my study, I found that collaborative relationships between business leaders, campus administrators and faculty supported research and job opportunities for students. This close connection to economic and private industry goals was a key feature of collaboration with the “STEM Colleges” on the campuses of UCLA, UC Berkeley, and UC Davis. More importantly, I found that business stakeholders who held the purse strings were able to creatively problem solve by linking their company’s philanthropic resources to activities on campus. Collaborative relationships between universities and industry exemplify two things: resource dependence theory, which Siegel (2010) discusses in his article on why universities join cross-sector social partnerships, and the Triple Helix model of the knowledge economy. Also, university, business, and nonprofit leaders recognized the value in

possessing shared stakeholder goals to facilitate outreach for prospective underrepresented minority (URM) graduate students. In an era of declining public resources for higher education in California, having shared goals aligns scarce human, financial, and information resources. Bolman and Deal's (2008) political frame underscores this point by theorizing that we compete on the basis of our values for scarce resources. Unlike competition, when values are aligned through collaboration, optimal allocation of scarce resources to occur.

Moreover, the stakeholders interviewed throughout my study extolled institutional culture as a driver of diversity. Their responses matched the findings from a quantitative study conducted by Thompson and Campbell (2012). In that study, researchers examined systemic practices aimed at diversity and institutional culture in graduate school using a collaborative model that emphasized shared goals and relationships. In a resource-constrained environment like that of California's public research universities, the value of relationships between business leaders and campus leaders is so important. Specifically, the relationship between deans of "STEM Colleges" and business leaders can support representational diversity goals. For instance, when financial resources from industry align with a dean's actions and espoused views about the benefits of diversity on campus, the entire campus community gets onboard. Business leaders feel as if they are making a difference in the community and that their companies' limited resources are being used wisely. Faculty members are able to advance knowledge, inquiry, and innovation. Nonprofit influencers and advocates feel that their policy prescriptions to hold universities accountable are working. Most importantly, students feel valued and that the campus climate is healthy for them to succeed.

The fourth finding in my study was that in addition to relationships and institutional capabilities, collaboration increased the numbers of URM students in STEM graduate programs by reducing

the complexity differential.²² Said another way, collaboration on student support initiatives was in response to environmental complexity (Schneider, Wickert, & Marti, 2017). At UCLA, 40 percent of URM undergraduate students enrolled in the “STEM College” went on to graduate school in STEM, and 47 percent of those students going on to graduate school from the “STEM College” chose UCLA. This is an example of how collaboration functioned as a safety net for underrepresented minority students by reducing the complexity between being a graduate student, in general, at a large, predominantly white public research university and a graduate student in STEM, in particular.

Taking a closer look at environmental complexity, Anderson et al. (2007) used a comprehensive framework methodology and found that when conducting African American and Latinx recruitment, the community or the larger environment in which the school is located, characteristics of the school itself, and the nature of community-based STEM education within the [STEM School] mattered. Additionally, underrepresented minority students face racial challenges and cultural dissonance that stem from disconnects between the cultures of their families and that of the university (as reported in Figueroa and Hurtado, 2013). To mitigate these challenges, Stanton-Salazar’s research (Bensimon & Dowd, 2015; Stanton-Salazar, 2011) on faculty, administrators, and student affairs professionals acting as “empowerment agents” offers insight into using positional authority, resources, and networks to advance diverse, equitable, and inclusive institutional policies and practices. Administrators and business leaders alike were successful in using both positional and personal power to advance diversity goals.

²² All social systems are defined by a complexity differential, i.e., the difference between the complexity of the system and the complexity of its environment (Schneider et al., 2017)

Most importantly, according to African American and Latinx students, the presence of other African American and Latinx students remains important in attracting African American and Latinx students to choose certain schools for graduate study (Anderson et al., 2007). Thus, providing a safe space for URM students within the “STEM Colleges” afforded students the familial environment that URM students in particular need to thrive culturally. In my study, at least three of the administrators and three of the four business leaders, acting as empowerment agents, collaborated with other campus partners to provide physical spaces for students who felt socially isolated to cope with their environment.

Implications for Practice and Education Leadership

As Siegel (2005) asserts, “One of the single lessons to be drawn from the diversity movement of the last decade is that colleges and universities do not pursue their diversity-related interests in a vacuum” (p. 519). Increasing racial and ethnic diversity in graduate STEM programs involves multiple stakeholder relationships, vast financial and human capital investment, and coordinated strategies across the education pipeline. Thus, one implication for practice is heightening awareness of the value and variety of relationships required among the sectors to produce more representation. Evidence from this study showed how university, business, and community leaders leverage bonding, bridging, and linking social capital to advance diversity goals by collaborating across each of their stakeholder groups.

Furthermore, data analyzed revealed how some campuses intentionally built long-term relationships among businesses and nonprofit stakeholders while other campuses focused on relationships with government partners. For example, members of the stakeholder groups studied committed to building sustainable relationships with one another in order to support the goal of outreach to underrepresented minority students. Other institutions that want to improve

their representational numbers should engage regularly with a variety of stakeholders on outreach initiatives and strategies. Formal organizational structures such as advisory and alumni boards catalyze opportunities for URM students seeking fellowships, research experiences, and summer internships.

Another implication for practice is that cultivating relationships can lead to financial and human capital investment in particular from business leaders. Even though continuing declines in state funding for public universities like UC exacerbate the need for additional sources of revenue, these funding gaps open new doors to relationship building. For instance, development officers regularly interact with prominent alumni and can quickly assess their interest in making corporate gifts to support URM outreach and/or participating on corporate advisory boards and committees. Therefore, administrators who are tasked with outreach to underrepresented minority groups should consider building relationships with their development counterparts on campus in order to align outreach goals with development strategies.

Beyond outreach and financial and human capital investment, another implication for practice and education leadership is coordinating strategies across the education pipeline. To work as a university administrator, business leader, or nonprofit influencer/advocate tasked with expanding the representation of African American and Latinx students pursuing graduate study in “STEM Colleges” is to be a systems leader. Keeping the STEM pipeline full for graduate study, while simultaneously addressing social justice concerns, requires leaders from each of these stakeholder groups to work across all the education segments.

In particular, stakeholders tasked with increasing URM enrollment in graduate STEM programs cannot view the problem through a single lens of representation. Beyond getting URM students to a graduate STEM program, a key finding from this study was how business

leaders and administrators looked for ways to emotionally support students in these programs to get them through their programs as well. Moreover, with initiatives such as summer research experiences, college and graduate school preview days, and faculty-student mentoring, universities, two-year colleges, and high schools can span boundaries to build partnerships that facilitate URM students' journeys from college to career.

Furthermore, the years of service for many of the campus administrators interviewed in this particular arena matter. Long histories of accumulated knowledge and relationships, which are tacit within administrators' work experiences, impact succession planning. How is knowledge transferred when these administrators leave these roles or retire? Anticipating the growing focus on diversity and changing demographics many universities face, education leaders should develop the pipeline for administrators to specifically serve this STEM population.

In summary, there are relationship, strategy, and leadership development implications for practice gleaned from findings in this study. Universities should look to collaboration with alumni, businesses, and community-based organizations as a way to create outreach capacity beyond the financial and staffing constraints of current organizational structures. Moreover, the complex nature of pipeline development suggests that cultivating graduate students begins as early as in the K-12 segment of the pipeline. Lastly, developing a cadre of administrators who are immersed in the nuances of this work is important in order to increase the number of URM students in graduate STEM programs.

Future Research

From a systems perspective, more research studying outreach to underrepresented minority students applying to graduate school in STEM is needed. First, UC officials have expressed how population growth, increasing ethnic diversity, and long-range demographics are

major trends shaping students and faculty populations (All University Faculty Conference on Graduate Student and Faculty Affirmative Action, 1990). Added to this, key Supreme Court decisions (*The Regents of the University of California v. Bakke* (1978), *Grutter v. Bollinger* (2003), and *Fisher v. UT Austin* (2013)) have stirred up much discussion on the purpose of diversity in higher education at public universities. Often the rationale has espoused the educational benefits of diversity, benefits that extend to the marketplace and society-at-large. Furthermore, only a handful of empirical studies exist on what is important to admissions decision makers at the graduate level and why (Posselt, 2016). In each of these instances, collaboration has a role to play.

According to Holoien (2013), collaboration is a way for groups to engage in enacting social change. Moreover, Amey et al. (2007) contend that it is critical for stakeholders to consider the process involved in establishing collaborations, how they function, and the factors that allow them to exist over time. However, currently available research does not explore the dynamics of collaboration within stakeholder relationships embedded within STEM outreach at all stages of the educational pipeline. Studying collaboration in outreach programs can inform existing and future outreach programs. Future research may also fill in the gaps left open by my study. For example, incorporating the voices of students and faculty, incorporating outcome data for students persisting in and graduating from STEM graduate programs, and analyzing climate data for URM students in STEM graduate programs at California public research universities are not included in this study.

Concluding Remarks

A friend recently shared with me that when she was working on her PhD, her mentor said to her, “Every dissertation is fundamentally a personal story.” She was right. This dissertation

has been my story. I am a stakeholder in this process of increasing the numbers of African American and Latinx students in STEM graduate programs for several reasons. First, I am a proud Californian of African American descent and a graduate of two of the campuses studied. Second, I worked for almost 25 years at a Fortune 500 company headquartered in California that recruited STEM interns and professionals from all of the universities studied. Throughout my business career, I witnessed what happens when business and education leaders span boundaries to collaboratively address future workforce needs. Third, and perhaps most importantly, I am a civic leader who cares about the California public higher education system delivering on its promise to serve all of its citizens. In order to do so, the outreach must begin at an earlier stage of the educational pipeline. The health of our economy is depending on it.

Minoritized students trapped in low-performing K-12 public school systems, many of whom may never even have an opportunity to study STEM at UC campuses, need advocates for them. On campus, these advocates are the administrators who function as empowerment agents. In the community, these advocates are the nonprofit leaders who leverage their relationships with key decision makers in policy and institutional arenas to impact systemic change. In industry, these advocates are the business leaders that link vital resources between the private and public sectors. No matter which stakeholder category, all of these leaders truly are the storytellers for what is happening across our state in advancing URM students through the STEM pipeline and how that impacts our economy and all Californians' quality of life. Together, their collective efforts provide the voices to the voiceless and the momentum for change.

From kindergarten to career (or as one interviewee described it, "from K to Gray"), enormous human effort is required to navigate African American and Latinx students through the complex social system referred to as "the STEM pipeline." As a student advances through the

pipeline towards graduate school, the collaborative human effort becomes more salient in comparison to earlier stages of the pipeline. Relationships within and among institutions at this stage can make or break a student's chances of earning an advanced degree. Case studies of three UC campuses allowed me to conduct in-depth examinations of people, processes, and programs benefitting URM students applying to graduate school in STEM. As a result of this study, campus administrators, business leaders, and nonprofit influencers and advocates now have information about multi-faceted, collaborative approaches designed to increase enrollment of African American and Latinx candidates in STEM graduate programs at UC campuses. In closing, "Change often starts with conditions that are undesirable, but artful system leaders help people move beyond just reacting to these problems to build positive visions for the future" (Senge, Hamilton, & Kania, p. 29).

Appendix A

Interview Questions: STEM Administrator

Suggested Opening Questions

- 1) How long have you worked at your university?
- 2) Tell me about your work. Or tell me how you became involved with [insert collaborative URM outreach program].

I. What roles do collaborative relationships play among higher education STEM directors, business leaders, and nonprofits, in their efforts to bolster strategies for expanding representation of African American and Latinx graduate students in STEM?

- 3) What is your vision for recruitment of URM graduate student candidates?
- 4) In what ways does your department support you in fulfilling that vision?

Follow-up: In what ways does the university support your department in conducting URM outreach?

- 5) Describe the planning process your department conducts in order to decide how to reach URM students interested in graduate school in your program.

- 6) How do you use collaboration/depend on other to do your work in conducting URM outreach?

- 7) How are goals for collaborative URM recruitment set?

- 8) How do decisions about URM recruitment get made in your department?

Follow-up: Think back to the last decision on URM recruitment in your department. How was that decision made?

II. From their own experiences, how do they as stakeholders say working together helps to address key challenges and barriers URM students face in persisting to graduate school in STEM?

9) Are there major challenges regarding collaborative URM recruitment programs?

Follow-up: If yes, please discuss.

10) What are some organizational problems you might expect to address at the onset of collaboration with others related to URM candidate recruitment?

III. In their own words, how do these stakeholders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

11) Whom do you work with most often (on-campus and off-campus business and nonprofit partners) to collaborate on URM recruitment?

Follow-up: Please describe frequency and duration.

12) Tell me about current interactions with other stakeholders within the collaboration?

Follow-up: Who would do the most talking at the table?

Follow-up: Is there anyone not at the table that should be?

13) How do you build relationships with business and nonprofit partners for the purpose of recruiting URM candidates?

14) Besides you, if I wanted to have a face-to-face meeting in your organization with the people most directly involved in creating and implementing diversity recruitment and retention policies, who would be at that table?

Closing questions:

15) What else would you like to share about collaboration?

16) Whom should I turn to learn more about this topic?

17) Is there anything else that you would like to share?

Interview Questions: Business Leader

Suggested Opening Questions

- 1) How long have worked at your organization?
- 2) Tell me about your work. - Or - Tell me how you became involved with [insert collaborative URM outreach program].

I. What roles do collaborative relationships play among higher education STEM directors, business leaders, and nonprofits, in their efforts to bolster strategies for expanding representation of African American and Latinx graduate students in STEM?

- 3) Describe the strategic planning process within your organization with respect to collaborative URM outreach programs/initiatives?
- 4) How are goals for collaborative URM recruitment set?
- 5) How do you use collaboration/how you depend on others to do your work to advance in conducting URM outreach?

II. From their own experiences, how do they as stakeholders say working together helps to addresses key challenges and barriers URM students face in persisting to graduate school in STEM?

- 6) What are some organizational problems you might expect to address at the onset of collaboration with others related to URM candidate recruitment?
- 7) Are there major challenges regarding collaborative URM recruitment programs?

Follow-up: If yes, please discuss.

- 8) What will happen if your organization “does nothing” (i.e., maintain status quo) about URM enrollment in graduate study?

III. In their own words, how do these stakeholders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

9) How do you build relationships with university and nonprofit partners for the purpose of recruiting URM candidates?

10) Whom do you work with most often (on-campus) to collaborate on URM recruitment?

Follow-up: Please describe frequency and duration.

11) Tell me about current interactions with other stakeholders within the collaboration?

Follow-up: Who would do the most talking at the table?

Follow-up: Is there anyone not at the table that should be?

12) Do you work with professors on outreach?

Follow-up: If yes, please describe how you work with these professors to conduct URM outreach.

13) Besides you, if I wanted to have a face-to-face meeting in your organization with the people most directly involved in creating and implementing diversity recruitment and retention policies, who would be at that table?

Closing questions:

14) What else would you like to share about collaboration?

15) Whom should I turn to learn more about this topic?

16) Is there anything else that you would like to share?

Interview Questions: Nonprofit Leader

Suggested Opening Questions

- 1) How long have you been at your organization?
- 2) Tell me about your work. Or tell me how you became involved with [insert collaborative URM outreach program].

I. What roles do collaborative relationships play among higher education STEM directors, business leaders, and nonprofits, in their efforts to bolster strategies for expanding representation of African American and Latinx graduate students in STEM?

- 3) What is your vision for recruitment of URM graduate student candidates?
- 4) Describe the planning process your department conducts in order to decide how to reach URM students interested in graduate school in your program.
- 5) How do you use collaboration/depend on other to do your work in conducting URM outreach?
- 6) How are goals for collaborative URM recruitment set?

II. From their own experiences, how do they as stakeholders say working together helps to address key challenges and barriers URM students face in persisting to graduate school in STEM?

- 7) Are there major challenges regarding collaborative URM recruitment programs?

Follow-up: If yes, please discuss.

- 8) What are some organizational problems you might expect to address at the onset of collaboration with others related to URM candidate recruitment?
- 9) What will happen if your organization “does nothing” (i.e., maintain status quo) about URM enrollment in graduate study?

III. In their own words, how do these stakeholders identify others in the STEM network to partner with on collaborative approaches to increase representation of African American and Latinx graduate students in STEM?

10) Whom do you work with most often (on-campus) to collaborate on URM recruitment?

Follow-up: Please describe frequency and duration.

11) Tell me about current interactions with other stakeholders within the collaboration?

Follow-up: Who would do the most talking at the table?

Follow-up: Is there anyone not at the table that should be?

12) Do you work with professors on outreach?

Follow-up: If yes, please describe how you work with these professors to conduct URM outreach.

13) Please give an example of how you depend on others to do your work to advance the goal of recruiting URM students for graduate study.

Closing questions:

14) What else would you like to share about collaboration?

15) Whom should I turn to learn more about this topic?

16) Is there anything else that you would like to share?

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