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Houston-Louis Stokes Alliance for Minority Participation: Findings from 17 years of a Multi-institutional Consortium Focused on Building Minority Student Success in STEM

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ABSTRACT

This rich, longitudinally descriptive study provides an examination of program outcomes, student characteristics, and workforce outcomes of the Houston-Louis Stokes Alliance for Minority Participation (H-LSAMP) program. Utilizing data from the University of Houston's Education Research Center, this study offers a detailed analysis of the long-term effects of participation in the H-LSAMP program, from high school to university and into the workforce. Findings from this study revealed that only 25% of the high school campuses attended by H-LSAMP students had a high proportion of economically disadvantaged students. In addition, nearly 75% of undergraduate students enrolled in the program graduated within the timeframe of the study, half of which were from Black and Latinx backgrounds.

Keywords: science education, student success, achievement gap, underrepresented racial minorities

Introduction

Wide disparities in science, technology, engineering, and mathematics (STEM) degree attainment across race and ethnicity remain a persistent concern across the nation (Dika & D'Amico, 2016; Hurtado et al., 2010; National Board of Sciences, 2010; Riegle-Crumb et al., 2019). Despite the nation's shifting demographics, student achievement in STEM fields fail to reflect the diverse backgrounds of the population (Allen-Ramdial & Campbell, 2014; James & Singer, 2016).

Under-represented minority (URM) students in the United States are formally defined as those students from Black, Mexican American, American Indian, Hawaiian Native, Alaskan Native, or Mainland Puerto Rican backgrounds (Association of American Medical Colleges, 2003; Page et al., 2013). Although they enter STEM majors with the same degree of interest as their peers, attrition rates among under-represented minority students are much higher (Chang et al., 2014; Chen, 2013; National Academies of Sciences, Engineering and Medicine, 2016). For Black and Latinx Students, 6-year STEM undergraduate degree completion rates are 22% and 29%, respectively, compared to 43% for White students (National Academies of Sciences, Engineering and Medicine, 2016). According to a recent report by the U.S. Bureau of Labor Statistics (2021), employment in STEM occupations is projected to increase by approximately 8% by 2029, demanding an approximate increase of 80,000 jobs in the STEM workforce. National data project that by the year 2060, almost two-thirds of the U.S. population's youth will be of color (U.S. Census Bureau, 2019). Despite advances in efforts directed towards increasing diversity among the nation's STEM workforce, there still remains wide disparities in the diversity of the STEM workforce compared to that of the general population (National Center for Science and Engineering Statistics (NCSES), 2021. Although Latinx and Black students making up 18.5% and 13.4% of population demographics, respectively, only 15% and 9% of STEM undergraduate degrees were awarded to Latinx and Black students in the 2018/2019 academic year (NCSES, 2021). As the U.S. is rapidly transitioning into a non-White majority nation, these findings clearly portray the importance of URM students' educational outcomes and success in STEM to the nation's economic vitality and global prominence (National Academies of Sciences, Engineering and Medicine, 2016).

URM students face a multitude of challenges and barriers in their journey toward STEM degree completion (Chen et al., 2014). Lack of academic pre-college preparation, lack of support from faculty and peers, as well as alienation and racism have been identified as some of the barriers faced by minority students in STEM (Strayhorn, 2013). In addition, research studies suggest URM students, particularly first-generation, low-income students, are more likely to experience financial burdens as a result of the high cost of pursuing a STEM degree (Hurtado et al., 2010; Stephens et al., 2012). Consequently, economically disadvantaged URM students are more likely to take on debt and work in order to afford their living and tuition expenses compared to their peers (Stephens et al., 2012). Such pressures play a significant role in STEM attrition rates among URM students, as well as their adjustment and sense of belonging to their campus culture (Hurtado et al., 2010).

Another major barrier faced by URM student populations is the inadequate academic preparation they may receive in high school, particularly in the areas of mathematics, lowering their odds of persisting through their STEM degree (Chang et al., 2014; Lisberg & Woods, 2018; Riegle-Crumb et al., 2019). The wide disparities in academic preparation contribute not only to the significantly higher attrition rates among URM populations, but also create an unequal playing field among students even prior to their admission into college (Lisberg & Woods, 2018; Riegle-Crumb et al., 2019). A significant body of research highlights the vital role of student's precollege academic background on their success in STEM fields (Crisp et al., 2009; Saw et al., 2018; Shaw & Barbuti, 2010). Rigorous course-taking in math, particularly in the first year of study, can have a significant effect on a student's likelihood of persisting in a STEM degree (Chen, 2013; Whalen & Shelley, 2010).

The nation's economic prominence and position as a leader in STEM fields, along with innovation and technology, is inextricably linked to the quality, skill and diversity of its workforce. Improving the nation's STEM workforce has transcended merely increasing quantity and skill. In the current technological landscape, advances and discoveries in science thrive on teamwork and diverse skills and perspectives (National Board of Sciences, 2010). Approximately 99% of jobs in the STEM workforce require a post-secondary degree (Fayer et al., 2017). To meet this increasing demand, significant efforts must be made to recruit, retain, and assist students from URM backgrounds to successfully complete college and enter the STEM workforce (Holden et al., 2010).

Over the past decade, STEM intervention programs around the nation have embarked upon substantive efforts to increase the enrollment and collegiate success of under-represented minority students in STEM majors (Gilmer, 2007; LaCourse et al., 2017). The Houston-Louis Stokes Alliance for Minority Participation (H-LSAMP) represents a multi-institution alliance designed primarily to improve URM student persistence and graduation in STEM. Supporting research highlights the importance of STEM intervention programs at increasing the academic preparation, retention, and student success of URM students in STEM fields (Carpi et al., 2017; Jackson & Winfield, 2014). Furthermore, research emphasizes the value of certain intervention experiences in successful career outcomes of graduates (e.g., Griffith, 2010; Pascarella & Terenzini, 2005; Xu, 2013). For instance, extant literature on features of successful STEM intervention programs highlights their ability to foster minority students' sense of science identity and self-efficacy (Carlone & Johnson, 2007; Espinosa, 2011; Robinson et al., 2019). Xu (2013) found that science identity values among minority students were a significant predictor of STEM career retention. In addition, the academic support provided through STEM intervention programs, in the form of mentorship, advising, and academic preparation in math, play an integral role in STEM career pathway retention, particularly among under-represented student populations (Jelks & Crain, 2020; Stipanovic & Woo, 2017; Xu, 2013). With this evidence in mind, this study aims to demonstrate program achievements of the H-LSAMP in terms of bachelor, graduate degree attainment, and workforce outcomes across various socio-demographic and pre-college characteristics.

H-LSAMP

About the Alliance

The H-LSAMP program was established with the goal of increasing the number of qualified URM students who earn a baccalaureate degree in the STEM fields. As a partnership, H-LSAMP particularly strives to prepare minority students with the academic and career skill-sets to successfully pursue a graduate degree and/or career in a STEM field by working towards eliminating the two well-documented causes of attrition in STEM fields at the University level: financial need and academic support. To increase diversity among the STEM workforce, and bring its numbers in line with population demographics, the consortium relies on empirical research on student retention, academic integration, and collaborative research to guide program initiatives and components most beneficial to minority students' academic achievement.

At its core, H-LSAMP was founded with the goal of providing academic support to increase student retention. To achieve this enrichment core, program components reflect the principles of Treisman (1992), centered on collaborative learning communities (CLC), that promote academic integration and sense of belonging among URM students. Research highlights the tendency of URM students to self-isolate from peers, depending on themselves to succeed through their academic journey (Treisman, 1992). The CLC model emphasizes the added value of peer group learning techniques, faculty mentorship, and academic supplementary support on URM academic achievement and persistence in STEM. The success of the CLC model in promoting the academic integration, sense of belonging, and academic achievement of URM students is well-documented and has been widely implemented in various institutions across the nation (Bonsangue et al., 2018; Chinn et al., 2007; Drew, 2011; Duncan & Dick, 2000). Guided by the CLC model, partner institutions dedicate significant resources to provide H-LSAMP scholars with the right academic success skills that enable them to succeed in their respective STEM major, and withstand the various pressures associated with pursuing a degree in STEM. At every partner institution, a dedicated space is provided for H-LSAMP students to gather, study and attend workshops. In addition, partner institutions provide student skills training, which assists students in building better study habits and time management skills, goal setting capabilities, and communication skills. Personal and professional development workshops are also offered to provide support in areas such as student commitment to their major and career, as well as work ethics, behaviors, and attitudes.

In terms of core academic development, collaborative learning experiences are promoted through both formal and informal group learning practices, peer-facilitated workshops, both peer and faculty mentors, and tutors. Peer and faculty mentorship is a crucial component of the H-LSAMP program, particularly in its benefit for URM student success, academic integration, and sense of belonging (Holland et al., 2012; Kendricks et al., 2013). Collective research findings emphasize the importance of faculty mentorship in predicting minority student academic performance in STEM (Kendricks et al., 2013, Wilson et al, 2010). In addition, informal peer mentors can also ease the transition of students into their STEM field of study, and increase the sense of camaraderie among students, which ultimately builds URM students' socio-academic integration and sense of belonging to their academic community (Carlone & Johnson, 2007; Holland et al., 2012).

Program Components

Components of the program are carefully designed to recruit, prepare and support high school students and incoming freshmen from disadvantaged, under-represented backgrounds.

1) **High School Recruitment:** the alliance focuses on active recruitment efforts directed towards high schools with a high percentage of minority enrollment. These include recruitment efforts targeted towards high school counselors and events such as College Night Out, that attract students from across the state. In addition, the alliance connects with schools on a yearly basis to participate in STEM competitions that motivate students' interests in STEM fields.
2) **Summer Camps:** each year, the alliance conducts engineering camps that introduce both middle and high school students to different engineering fields and careers through hands-on experience and conversations with industry leaders and professors.
3) **Pre-freshman Enrichment Program (PREP):** to combat inadequate pre-college academic preparation, particularly in the areas of mathematics, the alliance runs a yearly, academic intensive, seven-week program for high school students aiming to enter a STEM college major. The program includes SAT preparation and science workshops, collaborative learning environments, and STEM career awareness talks to introduce and prepare potential students for a successful career in their chosen STEM field.
4) **Summer Bridge Program:** focused on increasing the first-year success of at-risk students enrolled in STEM fields, the summer bridge program provides an intensive month-long calculus preparation, followed by four more weeks of course work that stimulates their readiness for university courses. Through the use of self-guided studying, collaborative learning environments, mentorship, and additional faculty support and guidance, the summer bridge program provides at-risk students with invaluable preparation and skills to persist through their STEM degree.
5) **Financial Support and Assistantships:** Students participating in the H-LSAMP are awarded stipends based on their academic credentials and financial need. Despite the strong academic support offered through the H-LSAMP program, research strongly suggests that socio-economic difficulties are the main force behind student attrition rates in STEM fields (Barton, 2003; Malcom & Dowd, 2008). Stipends are awarded annually, for up to five years, and are contingent upon students' active participation in the H-LSAMP program activities. In

addition, and in line with the collaborative learning model which encourages social integration among students, level one students funded through stipends are encouraged to offer three hours each week to the learning community. Such support could be in the form of a workshop facilitator, tutor, or computer lab assistant.

Collectively, the different elements within the H-LSAMP program work in tandem to equip high school graduates and freshmen students with the foundational tools, as well as the academic and financial support to prepare them for success in their respective STEM majors and a seamless transition into the STEM workforce.

Purpose of the Study

This study provides a rich descriptive longitudinal study of the graduation and workforce outcomes of students enrolled in the H-LSAMP program from the first graduating cohort in the 2004/2005 academic year until 2019/2020. As part of a broader set of on-going longitudinal studies that examine program participation effects on student success outcomes, this study provides essential foundational understanding of H-LSAMP program components, initiatives, and outcomes related to student achievement, retention, and graduation. This study will provide the foundational descriptive basis for which future, more detailed analyses of the impact of math and financial support, among other variables, could potentially impact student success. Despite the program being in effect for over 20 years, few studies have explored overall, multi-institutional program impacts in terms of degree completion, and matriculation to graduate school and workforce outcomes. This study uniquely adds to the existing body of literature on STEM intervention outcomes by tracking students' progress, graduation outcomes, and mobility across an extended period of time and across multiple participating institutions in a single urban area. Such expansive data availability lends the study the ability to follow H-LSAMP scholars from high school and into the workforce, offering a broad yet detailed description of program outcomes over time. In particular, our study addresses the following research questions:

1) Descriptively, to what extent do H-LSAMP graduates come from economically disadvantaged high-school backgrounds?
2) What are the H-LSAMP undergraduate and graduate degree outcomes, particularly across race, field of study, and gender?
3) To what extent do intervention efforts lead to careers in STEM fields as identified by the Standard Industrial Classification (SIC) codes?

Theoretical Framework

The development of the H-LSAMP was empirically supported by Treisman's (1992) Mathematics Workshop Model. The model centralizes around characterizing and promoting minority students' academic skills in both mathematics and science courses, through the establishment of a collaborative learning environment with a strong and supportive peer network. Treisman's model is founded upon concepts of sense of belonging and academic integration, enabling minority students to learn science and mathematics in a more effective manner through implementing various support resources for these students, including advising support, peer led team learning, and faculty mentorship. The model was initially implemented at the University of California, Berkeley, and led to successful academic outcomes among participants of the program. Subsequently the program, along with the collaborative learning techniques, have been successfully implemented in various other STEM intervention programs across the nation (Chin et al., 2006; Duncan & Dick, 2000). To that end, the concepts of Treisman's model, along with the supporting evidence of the success of undergraduate STEM intervention programs on the retention and graduation of minority students, provide a conceptual lens from which to assess the success of the program at supporting minority student success in STEM.

Data Source & Methods

Data for this rich, longitudinally descriptive study were obtained through the University of Houston's Education Research Center, which contains key longitudinal student-level information obtained from the state education agencies, higher education agencies as well as the state workforce commission. The data sample used for this analysis contained graduates from the H-LSAMP program beginning from the first undergraduate graduating class in 2004/2005 until 2019/2020 (n=2,044). Participant data analyzed in this study was limited to level-one H-LSAMP students, who were funded by the H-LSAMP program across the consortium's partner institutions. Using data from the University of Houston's Education Research Center, this study allowed for the tracking of students over time using longitudinal data beginning from high school, to higher education, and into the workforce.

Data Analysis

Given that the scope of this study is to provide a rich descriptive analysis of H-LSAMP student characteristics and graduation outcomes, data analysis involved the process of descriptive statistics in the form of cross-tabulations and frequency tables to assess the proportion of H-LSAMP graduating students across major, race, and similarly across workforce occupation. To assess the percentage of H-LSAMP students from disadvantaged backgrounds, school accountability ratings were merged with graduation data in order to match H-LSAMP students with their respective high school campus and rating. Finally, H-LSAMP graduation files were merged with workforce data, where SIC codes were identified to describe the workforce occupation of students following their completion of the program.

Limitations

Although this study presents data indicative of students' postsecondary and workforce outcomes, results of this analysis only provide data for students who remained in the state after graduation. For this reason, students who pursued graduate degrees in other states would not be captured in this analysis. Therefore, graduate degree outcomes presented in this study may not be an accurate representation of program results outside of the state. In addition, though a key indicator of students' socio-economic status, pell eligibility of H-LSAMP scholars could not be captured in this analysis due to the abundance of missing data in this field. Several research studies posit that this is due to the reduced likelihood of students, particularly those from socio-economically disadvantaged backgrounds, to file the Free Application for Federal Student Aid (De La Rosa, 2006; Feeney & Heroff, 2013). For this reason, the lack of inclusion of pell eligibility status limits the results of this analysis. However, other indicators of socio-economic status were included such as high school accountability ratings, and the proportion of economically disadvantaged students at high school campuses. One of the main objectives of the program, and similar STEM intervention programs across the nation, is to equip students with the financial and academic support needed to access and successfully complete a STEM undergraduate degree (Lisberg & Woods, 2018). Recruitment initiatives for the H-LSAMP undertaken by program administrators focus on targeting students from economically disadvantaged backgrounds (Ghazzawi et al., 2021). Despite the unavailability of precise data on student socio-economic status, this study uses the increased probability of consortium students being from socio-economically disadvantaged backgrounds as a proxy for financial need.

Results

Findings from this study found that the majority of high school campuses (67%) attended by H-LSAMP students had a favorable accountability rating. In addition, only 25% of high school campuses attended by H-LSAMP scholars had a high proportion of economically disadvantaged students. Under-graduate degree outcomes portrayed that approximately half of all H-LSAMP graduates were from Black and Latino backgrounds. Results also showed that nearly half of all under-graduate degrees obtained were in the field of Natural Science and Mathematics (NSM), and 34.5% of under-graduate degrees were obtained in Engineering fields. In terms of graduate degree outcomes, our findings indicate that 319 H-LSAMP undergraduates went on to pursue graduate degrees, 56% of which were in STEM fields of study. Finally, analysis of workforce outcomes demonstrated that 38% of H-LSAMP graduates were employed in STEM or STEM-related occupations, while 62% were not.

Research Question 1: High School Background, Accountability Ratings and Socio-economic Status

Given supporting evidence of the association between high-school academic experiences and collegiate success of minority students, an important component of this descriptive study involved the overview of high school accountability ratings as well as the percentage of economically disadvantaged students enrolled at those campuses attended by H-LSAMP scholars. Minority students are more likely to attend schools with a lower socio-economic status (Goldsmith, 2011), inevitably leading to a lack of resources and less instruction in advanced courses such as mathematics and science (Martinez & Guzman, 2013). As one of the major recruitment objectives of the alliance is to reach minority students from economically disadvantaged, low-performing high schools, descriptive data concerning the high school background of H-LSAMP scholars offers key indicators on the extent to which recruitment tactics are targeting the intended student population.

State campus accountability ratings were collected for the 2018/2019 academic year. These ratings evaluate school performance based on student achievement, school progress, and closing gaps across racial ethnic groups. Children at Risk (n.d.) ranks campuses according to student achievement, with a particular attention to student performance comparisons across campuses with similar low-SES levels, as well as student growth and college readiness. Campuses also receive an overall rating ranging from A to D, and an F rating is assigned to those campuses that did not meet performance criteria to earn at least a D rating (Texas Education Agency, 2021). High school campus ratings of H-LSAMP scholars are presented in Table 1. In addition to campus accountability ratings, descriptive data concerning the percentage of economically disadvantaged students at each campus were collected. Results are presented in Table 2. A total of 265 high school campuses were rated, including 18 campuses with ratings unavailable during 2019. Approximately 25% of high school campuses received a rating of C or below, while 67% of campuses received a rating of B- or higher.

Table 2 represents the proportion of campuses with above 75% of students from socio-economically disadvantaged backgrounds. The cut-off rate of 75% was chosen for the purpose of this study in accordance with the National Center for Education Statistics (2021) as a proxy to identify high-poverty schools. Results demonstrate that nearly 25% of high school campuses attended by H-LSAMP graduates had a high percentage of economically disadvantaged students, while the majority of high school campuses (75.5%), had a low percentage of economically disadvantaged students.

Table 1

H-LSAMP Scholars High School Campus Ratings

Accountability Rating	N	%
A	46	17.4
A-	21	7.9
B	64	24.2
B-	46	17.4
C	21	7.8
C-	30	11.3
D	13	4.9
D-	*	*
F	*	*
N/A	18	6.8
Total	265	

Note. *Data value was masked due to small sample size

Table 2

Proportion of Economically Disadvantaged Students – High School Campuses Attended by H-LSAMP

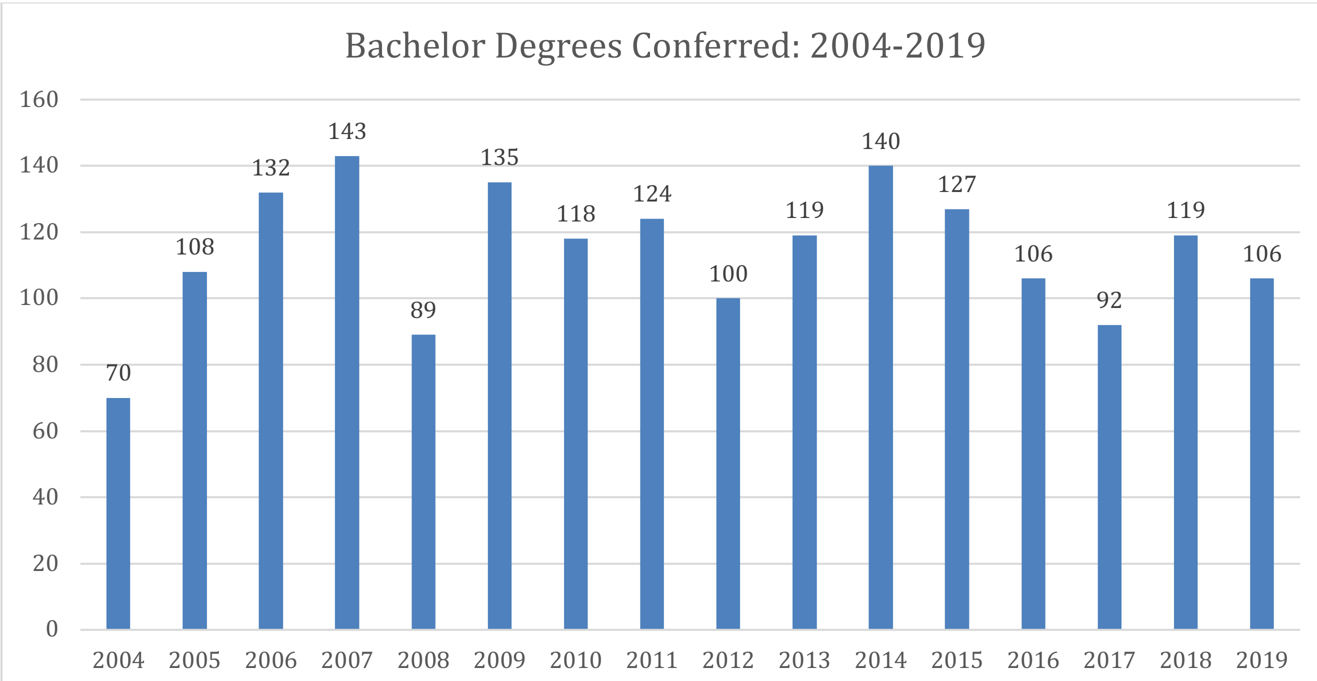
Percentage of Economically Disadvantaged Students at High School Campus	N	%
Below 75%	200	75.5
Above 75%	65	24.5
Total	265	

Research Question 2: Undergraduate and Graduate Degree Outcomes

As of the 2019/2020 academic year, there was a total of 2,839 students enrolled in the program. Approximately 74% of students graduated over the course of the timeframe of this study (2004-2020). The H-LSAMP has graduated 2,044 level one students with bachelor's degrees. Approximately 46% of graduates were female and 54% were male. Nearly 50% of bachelor's degree recipients were from Black and Latino backgrounds. Figure 1 presents the number and percentage of bachelor degrees conferred each year from 2004-2019. Table 3 presents the percentage of graduates from each racial/ethnic category. The percentage of graduates varied over time, likely due to a number of factors such as changes in level of financial support between entities such as the National Science Foundation, corporate sponsorship, donor and institutional financial support, which has a subsequent effect on cohort sizes each year.

Figure 1

Bachelor Degrees Conferred by the H-LSAMP*: 2004 -2019*



Note. Bachelor degrees conferred (all degrees) includes H-LSAMP students. Copyright 2020 by the Urban Education Research Center.

The largest proportion of H-LSAMP scholars were Black students, accounting for approximately 27% of total enrollment in the program, followed by Latino students (23%). Asian students made up 18% of total enrollment, followed by White students (9%). Degree completion mirrored program participation. See Table 3 for this information.

Table 3

Bachelor Degree Recipients by Race

Race	**N**	**%**
White	182	8.9
Black	551	26.9
Latinx	478	23.4
Asian	370	18.1
Other	463	22.7

Over 50% of bachelor degree recipients graduated in the field of NSM, and approximately 34.5% of recipients graduated with a major in Engineering. Only 8.5% of degrees awarded were in non-STEM fields of study. Bachelor's degree recipients by major/field of study are displayed in Table 4.

Table 4

Bachelor Degree Recipients by Major/Field of Study

	Frequency	%
NSM	1,042	51.0
Engineering	706	34.5
Computer/Technology	123	6.0
Other/non-STEM	173	8.5

Table 5a presents the proportion of students enrolled by major/field of study according to ethnicity. As shown in the table, approximately 55% of Black students and 40% of Latinx students were enrolled as NSM majors. Nearly 46% of Latinx students were enrolled in engineering degrees, while 24% of Black students chose engineering as a major. Table 5b displays bachelor's degree recipients by field of study and gender. In total, 54% of H-LSAMP undergraduate scholars were male and 46% were female. A larger proportion of bachelor degree recipients in NSM were female (56.8%), while 43% were male. A higher percentage of males received Engineering undergraduate degrees (69.5%), compared to females (30.5%).

Table 5a

Bachelor Degree Recipients by Major/Field of Study and Race

Race	NSM	Engineering	Computer Science	Other/Non-STEM	Total
	N %	N %	N %	N %	N %
White	84 46.2	80 43.9	9 4.9	9 4.9	182 100
Black	303 54.9	131 23.8	53 9.6	64 11.6	551 100
Latinx	187 39.1	219 45.8	22 4.6	50 10.5	478 100
Asian	225 60.8	114 30.8	12 3.2	19 5.1	370 100
Other	243 52.5	162 34.9	27 5.8	31 6.7	463 100

Table 5b

Bachelor Degree Recipients by Major/Field of Study and Gender

Gender	NSM	Engineering	Computer Science	Other/non-STEM	Total
	N %	N %	N %	N %	N %
Female	592 56.8	215 30.5	37 30.1	96 55.5	940 45.9
Male	450 43.0	491 69.5	86 69.9	77 44.5	1,104 54.0

Graduate Degree Outcomes

As of the 2019/2020 academic year, 319 graduates from the H-LSAMP have successfully gone on to complete advanced degrees from state institutions, including 290 Master's degrees and 29 PhD degrees. In addition, 49 students received advanced graduate degrees in Pharmacy, Optometry, and Medicine. Approximately 56% of Masters degrees obtained were in STEM fields of study, including 32% of Masters degrees obtained in majors from NSM, 23% Engineering, and nearly 4% in Computer Science. Over half of PhD degrees awarded (55%) were in NSM fields. Among graduate degree recipients, nearly 35% of master's degree graduates and 48% of PhD graduates were Black, while 22% of master's degree recipients were Latinx students. Table 6 presents graduate degree outcomes by race.

Table 6

Graduate Degree Outcomes by Race

Degree Conferred	White N %	Black N %	Latinx N %	Asian N %	Other N %	Total
Masters	19 6.6	103 35.3	65 22.4	31 10.7	72 24.8	290
PhD	* *	14 48.3	* 3.5	7 24.1	* *	29
Pharmacy/Optometry/Medical Degrees	* *	16 32.7	* *	23 47.0	6 12.2	49

Note. *Data value was masked due to small sample size

Research Question 3: Workforce Outcomes

To examine the workforce outcomes of H-LSAMP STEM scholars after matriculation from college, graduation files were merged with data from the Workforce Commission enabling this study to track data on the industry that students were working in based on their corresponding SIC code. Although this data provides the study with a wealth of information on career trajectories, a limitation to the results of this study is that the precise occupation of each student is not available. Consequently, our findings present workforce outcomes by industry level which may or may not accurately represent STEM-related careers within these industries. For instance, while education may not traditionally be defined as a STEM field of study, teachers of advanced biology, chemistry, or mathematics high school courses could potentially be categorized as working in a STEM field. With the inability to accurately account for these differences in mind, this section provides an overview of the industry outcomes of scholars after their entry into the state workforce. Table 7 presents the percentages of H-LSAMP graduates, who graduated in a STEM field of study, employed in both STEM and non-STEM related industries. As a whole, 25% of H-LSAMP STEM graduates in the state's workforce were employed in STEM occupations, while 75% of the graduates were not.

Table 7

H-LSAMP Graduates- Workforce Occupation Industries

Industry	N	%
Farming[1]	*	*
Oil/Natural Gas & Liquid Extraction[1]	23	1.44
Construction[1]	36	2.25
Transport and Product Manufacturing[1]	122	7.62
Wholesale, Retail & Entertainment[2]	703	43.88
Banking and Business Services[2]	168	10.49
Computer Related Services[1]	114	7.12
Medical Related Services[1]	112	6.99
Education & Public Service[2]	287	17.92
Engineering[1]	*	*
Unknown/Other[2]	35	2.18
Total	1,602	100

Note. *Data value was masked due to small sample size
[1] STEM industry
[2] non-STEM industry

Discussion

Program Successes

Results from this descriptive study provide a broad overview of the goals of the H-LSAMP since the first graduating cohort of scholars in 2004. Given that the goals of the consortium are centered around increasing the academic preparedness and number of URM students in STEM fields, the results of this study demonstrate that out of the 2,044 undergraduate degrees obtained, approximately 27% were awarded to Black students and 24% to Latinx students. These findings provide clear evidence of program participation effects on the graduation, retention, and academic success of URM students in STEM fields and support previous studies that have demonstrated successful program outcomes (e.g., Duncan & Dick, 2000; Jiang et al., 2005; Lisberg & Woods, 2018). Findings also provide evidence of the success of the alliance at assisting students to successfully matriculate into Masters and PhD programs in STEM fields of study. From a national perspective, the results of this study indicate the consortium supports the current imperative to produce a STEM workforce that truly mirrors the nations demographics (Stacy-Ann et al.; 2014; National Science Foundation, 2015). Given that part of the broader goals of the program, in line with national efforts, focus on creating a more level playing field for students from under-represented backgrounds, the results from this study, particularly as they pertain to the high proportion of students of color successfully completing their degree, support the notion of expanding access to and completion of undergraduate and graduate degrees in STEM. A substantive body of literature highlights the wide racial disparities that exist in STEM degree enrollment and completion (McGee, 2020; National Academics of Sciences, Engineering, and Medicine, 2019). In addition, the general atmosphere of STEM degrees and professions are widely known to have a biased, strict, and highly competitive culture that negatively impacts minority students in particular (Leath & Chavous, 2018). To that end, the results of this study indicate that institutional and program components, along with the academic support and financial aid provided to students, play a significant role in degree completion and successful matriculation of URM students into a STEM graduate degree and eventually into the workforce.

Recruitment Efforts

In terms of high school accountability ratings, results portray that a significant proportion of high school campuses from which H-LSAMP scholars graduated from were not classified as economically disadvantaged campuses. This does not necessarily mean individual students attending these schools were not themselves from low-income families, but it does raise the question of whether the participants being recruited are the ones most in need of the programming. Given that one of the major recruitment strategies of the alliance is to target students from primarily disadvantaged high schools, such findings highlight the need for further intentional recruitment efforts to reach students most in need of the financial assistance offered through the H-LSAMP program.

From an economic perspective, this study offers a preliminary understanding of intervention outcomes that could contribute to the upward economic mobility of disadvantaged and under-represented students (Xie & Killewald, 2012). Through learning mechanisms that focus on strong academic preparation in mathematics, financial and academic support in the form of peer and faculty mentorship, intervention programs such as the H-LSAMP are able to tackle the most significant elements that attribute to racial gaps in URM STEM degree attainment (Adelman, 2006; Chen, 2013; Lichtenberger & George-Jackson, 2013).

Implications

Findings from this study provide evidence of the effectiveness of STEM intervention efforts in diversifying and increasing the proportion of URM students successfully enrolling and graduating from STEM fields of study. However, these results do not show the success of such programs at increasing the percentage of STEM graduates employed in STEM fields of study. To that end, in support of national efforts to diversify the STEM workforce in a way that reflects today's population demographics, intervention programs are advised to further strengthen program content and components to bolster career preparedness and job training opportunities that could help create stronger networking skills and connections otherwise unavailable to this sub-population of students (Jelks & Crain, 2020; Stipanovic & Woo, 2017).

Directions for Future Research

Given the descriptive nature of this study, an ongoing set of studies are being conducted that utilize inferential inquiry to investigate program participation effects over time. Such analyses include the use of propensity score matching to match H-LSAMP scholars with similar non-participants of the program based on a series of baseline characteristics, and subsequently measure program participation effects after matching on covariates (Ghazzawi et al., 2021). The advantage to using techniques such as propensity score matching is the reduction of selection bias, increasing the robustness of our analyses (Winship & Morgan, 1999). Additionally, further studies being conducted include examining the impact of program participation on the wage differentials of H-LSAMP scholars over time. These studies aim to contribute to the existing literature by offering empirically proven results that support continuous calls for intervention efforts across the nation. In addition, through the use of longitudinal data that follows students through their educational trajectory and into the workforce, these studies will uniquely contribute to the extant literature by highlighting pre-college, academic, and workforce characteristics most significant to successful student and labor outcomes.

Conclusion

This study provides an essential foundational understanding of the outcomes of a multi-institutional consortium that strives to increase the academic achievement and completion rates of URM students enrolled in STEM fields. Through demonstrating both the outcomes and limitations of such programs, this study offers legitimacy to further increase efforts, both state and nationwide, in implementing STEM intervention programs that center around providing academic and faculty support, along with peer mentorship, to increase the representation of minority students in STEM.

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