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Opportunities for a STEM-Focused Retention and Success Program in Times of Fiscal Constraint: Case Study of the Houston-Louis Stokes Alliance for Minority Participation (H-LSAMP) Program

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Abstract

This study explores Houston-LSAMP's efforts in retaining and supporting underrepresented minority (URM) students in STEM fields. Established by NSF in 1998, H-LSAMP is a regional alliance of five universities that provides retention programs aimed at increasing URM student graduation rates. However, many of these efforts have now been halted or severely underfunded during the second Trump administration. Recognizing the vital role of such efforts and the ongoing need to support URM STEM students, this study aims to assist existing programs that now operate with little or no funding, or with significantly reduced budgets, by analyzing key components of H-LSAMP that effectively promote student success. This study reveals that while H-LSAMP partner institutions vary in their programmatic approaches, all support minority students through academic development, financial aid, community-building, and professional development opportunities, among other initiatives. Student financial support emerges as the most vital component in promoting success, as it removes financial burdens and enables students to focus on their academics, which increases retention. Building on these insights and the

shrinking availability of financial support, this paper suggests several cost-effective strategies to improve URM student success in STEM amidst financial challenges.

Keywords: STEM retention program, college retention, minority student retention, collaborative learning community

Recommended Citation

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Retaining and graduating students in science, technology, engineering, and mathematics (STEM) programs has been a challenge for universities, especially for underrepresented minority (URM) students[1] (Chen, 2013; Foltz et al., 2014). To support increased STEM student success, many universities have successfully implemented retention and persistence programming for academic support, mentoring, research opportunities, and scholarships specific to the STEM fields (Bonsangue et al., 2018; Drew, 2011; Maton et al., 2012). Many of these programs aimed at improving URM student STEM success have been funded through the Louis Stokes Alliances for Minority Participation (LSAMP) Program, established in 1991 by the National Science Foundation (NSF). The LSAMP program has allowed for the creation of regional alliances across the nation that have demonstrated improved URM student success in STEM degree completion (Ghazzawi et al., 2022; Hicks, 2007; Maton et al., 2012).

Despite this success, federal funds for these programs have been halted or substantially reduced by the second Trump administration (Olesko et al., 2025), as was the case with the reduction of funds awarded to the H-LSAMP regional alliance. While the academic literature base has provided a rich literature understanding the ways in which programming across programs has thrived and aided students, research exploring the most cost-effective strategies to implement in times of fiscal constraint is missing. In an attempt to contribute to the academic literature and to aid the many programs that now must exist on no budget or a substantially reduced budget, this qualitative case study analysis of the Houston-LSAMP (H-LSAMP) regional alliance aims to highlight the most efficient, low-cost strategies for improving URM student success in STEM. Our research is guided by the question: What are the integral components within the H-LSAMP that aid in student success? After examination of the integral program components from the perspective of program staff, program directors, faculty, and students, this study culminates in recommendations that could be employed by both LSAMP alliances and other collegiate STEM retention and success programs facing defunding or severe budget reductions.

Conceptual Framework

Generally, college student success is influenced by myriad interacting factors including individual, familial, school, and community characteristics (Perna & Titus, 2005). Perna (2006a) introduces a multilevel model that combines various college-choice theories, placing college success in a broader context. In her model, she argues that the social environment, particularly the community where students live, influences how students and their families obtain and use information about college costs, financial aid, and other related topics, which ultimately impacts students' academic performance (Perna, 2006b). This model incorporates research documenting how the characteristics of the high school that students attend, such as teacher quality, school culture, school engagement, college preparation programs, and rigorous curriculum are also well documented to influence college student success (Boyd et al., 2011; Chase et al., 2014; Kuh et al., 2008).

[1] URM students are defined as students who are Black, Hispanic, Native American, and/or Alaskan Natives (National Science Foundation, 2019).

Literature Review

Across the United States, URM students attending Historically Black Colleges and Universities (HBCUs), Minority Serving Institutions (MSIs), and Hispanic-Serving Institutions (HSIs) have higher retention rates and graduation rates than their peers attending predominantly White institutions (American Council on Education, 2015; Excelencia in Education, 2019; Flores et al., 2017; Gasman et al., 2017; Williams et al., 2005). These institutions create a supportive environment for URM students with diverse faculty and staff, culturally relevant curricula and support systems specifically focused on breaking down barriers URM students commonly experience in higher education (Palmer et al., 2010; Salazar et al., 2010; Williams et al., 2005). Specifically to support the underrepresentation of minority students in the STEM fields, institutions have adopted intervention programs targeted at improving URM student outcomes.

STEM majors present specific challenges to college success. Students who are less well prepared in foundational math and science concepts struggle in first-year courses, and students without high levels of personal autonomy and well-developed communication skills struggle to transition from high school into the heavy class loads of higher education (Casanova et al., 2023). To best support STEM students specifically, university-based programs often include financial support, tutoring services, scholar academies, collaborative learning communities (CLCs), summer bridge programs, mentoring, workshops/seminars, research experiences, advising (academic and career), support with gatekeeper/gateway courses, potential curriculum reform, etc. (Estrada et al., 2016; Harper & Quaye, 2009; Laursen et al., 2010; Thiry et al., 2012). Additionally, retaining and graduating students in STEM programs has been a challenge for universities, especially among URM students (Foltz, Gannon & Krischmann, 2014; Chen, 2013). While STEM retention and intervention programs vary by institution and aim (LaCourse et al., 2017), the most effective STEM programs for URM students are those that aim to assist students with overcoming a range of barriers at both institutional and personal levels and have resulted in increasing student retention rates, helping students achieve higher grades, increasing the number of students graduating with STEM degrees, and increasing the number of students who pursue STEM graduate degrees (Clewell et al., 2005; Maton et al., 2012; Treisman, 1985). By engaging directly with high schools, teaching from culturally relevant curriculum, offering specialized academic and financial support systems, as well as providing mentoring and counseling from a diverse staff and faculty, these institutions offer programs and services which focus on issues common among minority students (Palmer et al., 2010; Salazar et al., 2010; Williams et al., 2005).

Some specific examples of especially successful programs include:

1. The Mathematics Workshop Program (MWP) at UC Berkeley, aimed to help minority students succeed in math courses through a peer-led program where undergraduate students facilitate discussion sections for lower-division math courses (Treisman, 1985). The success of this program has spurred similar programs such as the Merit Workshop Calculus program at the University of Illinois at Urbana-Champaign, that focus on an alternative teaching style of calculus geared to students who are underrepresented in STEM (University of Illinois Urbana-Champagne, n.d.).
2. The Minority Engineering Program (MEP) is a college-level expansion of the MESA (Mathematics, Engineering, and Science Achievement) program that operates in some high schools across the US. The MEP was established at the University of California with

an aim of increasing the number of minority students who pursue engineering degrees. The program includes components such as academic advising, professional development, and tutoring, and has been touted as increasing the number of URM students graduating with engineering degrees (MESA, n.d.).

3. The Howard Hughes Medical Institute (HHMI) Success in Science program provides funding for undergraduate research experiences for students pursuing STEM degrees (HHMI, (n.d.). The HHMI has supported early career scientists in advancing their careers through these research experiences. Research indicates that undergraduate research experiences is positively correlated with students' persistence in STEM fields (Lopatto, 2010).
4. The Meyerhoff Program, at the University of Maryland Baltimore County (UMBC) is a more comprehensive intervention program that aims to address four critical areas based on their association with hindering minority student success in the sciences: (1) Knowledge and skills; (2) Motivation and support; (3) Monitoring and advising, and (4) Academic and social integration (Maton et al., 2012). The Meyerhoff program includes a myriad of components, such as a summer bridge program, mentoring, research opportunities, and community building.

While evidence of the success of URM STEM programming is clear, these programs are typically well-resourced through philanthropic and governmental grants supplementing institutional funding. Currently missing from the literature base is exploration programming from a lens of efficiency that institutions need to make budget decisions least likely to impact student outcomes in times of fiscal constraint. This study seeks to extend the literature and support institutions during times of fiscal constraint by documenting the components of programming students, faculty, and staff associate most closely to URM STEM success. The findings of this study can support institutions in making decisions to offer the most cost-efficient and effective programming for URM STEM students.

H-LSAMP

The H-LSAMP is a regional alliance first funded by the NSF in 1998 and includes five universities: University of Houston, Texas Southern University, Texas State University, University of Houston Downtown, and University of Houston-Clearlake. The H-LSAMP is centered around collaborative learning communities (CLC) that aid in increased academic achievement and student sense of belonging (Treisman, 1992), and has been demonstrated to support URM academic achievement and STEM persistence specifically (Bonsangue et al., 2018; Drew, 2011). The CLCs created by H-LSAMP involve informal and formal learning opportunities that focus on combating inadequate preparation for STEM subjects through summer preparatory/bridge programs, tutoring and study groups, faculty and peer mentorship, supplemental course workshops, engagement in research activities, and community building. Between 2004 and 2019, the H-LSAMP program graduated more than 2,000 URM students with baccalaureate degrees, and over half were URM students. Beyond the traditional LSAMP focus on undergraduate success, H-LSAMP has extended its reach to increase retention of STEM students through graduate school. As of the 2020 academic year, 319 H-LSAMP graduates had gone on to complete graduate degrees in Texas and were comprised of primarily Black (35% of

Master's degree graduates and 48% of PhD graduates) and Hispanic graduates (22% of Master's degree) (Ghazzawi et al., 2022).

For this study, student participants, staff, and faculty of the H-LSAMP regional alliance provided insight into the most integral components of the regional alliance via interviews and focus groups. The details of the sample, data, methods, and results of this study are provided in the following sections.

Sample and Data

Participants for this study were sampled from all five H-LSAMP university campuses, which included interviews with H-LSAMP program staff, program directors, faculty, and students. To sample student participants, program staff for each H-LSAMP campus advertised the student focus group opportunity with various dates and times to all participating LSAMP students who then indicated their availability for focus groups. One focus group was conducted at each of the five participating institutions based upon the date and time offering that allowed for the greatest number of participants. Note that the participants of focus groups and interviews were volunteers and were not randomly selected, and thus potentially contributed self-selection bias in the viewpoints expressed in this study. Table 1 shows the number of interviewees and focus group participants by university.

Table 1

H-LSAMP Universities: Interviews and Focus Groups

University	Type of Institution	Faculty/ Staff Interviews	Number of Students in Focus Group(s)
Texas Southern University	Historically Black College/University (HBCU)	3	29
Texas State University	Hispanic Serving Institution (HSI)	3	8
University of Houston	Hispanic Serving Institution (HSI) & Asian American and Native American Pacific Islander-Serving Institution (AANAPISI)	7	7
University of Houston – Clear Lake	Hispanic Serving Institution (HSI)	1	2
University of Houston - Downtown	Hispanic Serving Institution (HSI)	3	4

Note. 1 additional interview was conducted with the Alliance Executive Director

The 18 members of the staff and faculty sample included Associate and Instructional Professors across subjects such as mathematics, chemistry, physics, biology, biochemistry, occupational safety and research, as well as full-time LSAMP program staff, scholar academy staff, and other enrichment staff. Several professors who were interviewed also held additional

roles on campus such as Assistant Dean positions. There were a total of 51 students who participated in the focus groups. The student participants ranged from second-semester freshman students to graduating seniors and were pursuing a variety of STEM majors.

Interviews were conducted in person or via Microsoft Teams and were recorded. Four of the five focus groups were held in person and one was through Microsoft Teams. The interview and focus group protocols (See Appendices A-D) were adapted from the protocols developed for a national LSAMP study prepared for the NSF (Clewell et al., 2005). Interviews and focus groups were conducted over a three-month period, with each lasting approximately 25-75 minutes. When conducting interviews and focus groups, we adhered to the approved questions to ensure topic areas were discussed but adjusted the ordering if topic areas came up organically. Additionally, if responses reflected answers to other questions, we ensured those questions were not redundantly asked. Discussions were typically guided by what we interpreted to be meaningful to the participants in order to further explore those prevailing themes. To ensure the anonymity of the students/staff and their comments, no specific linkages between university and commentary have been made in this study.

The student focus group protocol included questions about student experience throughout the LSAMP program. In addition to asking about student experiences in and the impactful components of programming of the LSAMP program, questions were asked about how students learned about the LSAMP program, the application process, and perceived benefits prior to entry. Students were also asked if they would recommend the program to others, how they might improve the program, and their plans after graduation. Interviews conducted with staff and faculty were guided by questions about their involvement with the LSAMP program, outcomes of the program, and their perceptions of the most impactful components of the programming. Staff and faculty were also asked about challenges faced within the program and how they might improve the program for future students.

Methods

A reflexive thematic analysis (RTA) was used to code responses based on pre-identified themes and to facilitate the development of several new themes from the coding process. RTA is an interpretive qualitative approach that aids in the identification and analysis of themes and patterns within a descriptive-based data set (Braun & Clarke, 2006). Themes are built based on summaries of participants responses to each interview or focus group question and represent the researchers' interpretation of patterns across the data (Braun & Clarke, 2019). RTA is seen as the triangulated interpretation of the dataset, informed by the theoretical assumptions and shaped by the analytical skills of the researcher (Braun & Clarke, 2019). From the conceptual framework guiding this study, the multilevel model of individual, familial, school, and community characteristics (Perna, 2006a) grounds the researcher in a set of theoretical assumptions and themes for the analysis. Familiar with the specific components of the model, researchers will generate initial codes and themes aligned with the various levels of the model.

RTA involves a six-phase process including (1) Familiarization with the data; (2) Generating initial codes; (3) Generating themes; (4) Reviewing potential themes; (5) Defining and naming themes; and (6) Producing the report (Braun & Clarke, 2006). In order to ensure trustworthiness in the analytic process, notes, codes, and themes were recorded at each phase of the analysis and maintained in an audit trail, and member checking was conducted after each phase of the analysis. During phases 1-2, interviews and focus group notes were re-read to

ensure the notetaking was viable for interpretation and generated general themes to begin coding through a spreadsheet. Notes were pulled from each interview, which aligned with themes in the spreadsheet. This process resulted in the emergence of new themes (phase 3) and revisions to these initial themes (phase 4). The themes were then reviewed broadly, resulting in the consolidation of some and the separation of others based on the variation within the theme (phase 5). The spreadsheet was then transcribed to best pull the segments out into the final report structure (phase 6), which is presented in the next section (Findings).

Findings

The purpose of this study was to identify the components of the H-LSAMP critical to URM student success and to identify low-cost, effective strategies to support student success in STEM when budgets are reduced or eliminated. As such, this study did not go into detail to describe the financial support provided to students, one of the main features of the H-LSAMP. All five institutions in the alliance offered financial support and assistance to H-LSAMP students, in varying amounts. Interviewees indicated that financial support ranged from $2,000 to $15,000, depending on several factors, including the number of students in the program each semester. Interviewees mentioned that student financial support made up the majority of their budget, and all other program components were very "light" to maximize the per-student award amount. H-LSAMP institutions prioritize financial support for students, as financial burdens for URM students being retained in college are prevalent across the literature (Pascarella et al., 2004; Strayhorn, 2018).

Though students, staff, and faculty found value in financial assistance and the impact of financial support should not be deemphasized, this study focuses on the components of the H-LSAMP that could be provided at little or no cost in times of fiscal constraint. Analysis of interviews and focus groups from H-LSAMP students, faculty, and staff yielded three themes described in detail in the following sections: academic development, community, and professional development.

Academic Development

H-LSAMP students, faculty, and staff highlighted how academic development was a crucial component within each institution in the alliance. Each partner in the alliance required or supported one or several of the following academic services for undergraduate H-LSAMP students: tutoring, supplemental instruction opportunities, peer study groups, pre-college development, workshops to build academic grit and skills, academic advising, and collaborative learning community and spaces.

An H-LSAMP program staff member described the academic development in their program:

> We have a learning community, which is a dedicated space in the library, the students see this as their home away from home. We have academic workshops, supplemental workshops for freshman and sophomore math and science courses. All the supplemental instructors are students. We have the tutoring center, which our students use and work in for their math and science courses. We have collaborative learning groups that start at the freshman level, and a summers scholar academy to help students get into their first choice major. Mentorship is also a big part of the program, from mentors to peer facilitators.

Undergraduate students across the alliance have various opportunities for academic development. One H-LSAMP program director depicted how students have autonomy to decide how they want to engage in the program academically:

> Each student has a semester project, and they choose how to fulfill this requirement, this can be research with faculty, a STEM internship, serving as a teaching assistant, a supplemental instructor, learning assistant, or if they are an engineering major they can use their senior design class as their project, which is a project to design a solution in the real world.

The benefits of student academic development through tutoring and workshops are well documented in research literature. Tutoring is shown to improve students' academic success, retention, and perceptions (Batz et al., 2015; Hidayat & Saad, 2025), and it is especially beneficial for URM students (Reinheimer & McKenzie, 2011). Studies also indicate that tutoring and facilitating supplemental instruction benefit both the students receiving support and the tutors themselves (Skoglund et al., 2018). Peer tutoring exemplifies this, as it serves as a support system for new student adjustment and is associated with improved academic performance, which is expected given the mutual benefits for both tutors and tutees (Arco-Tirado et al., 2019). Much like tutoring, workshops have been shown to enhance students' general STEM knowledge and help them develop important life skills, such as setting long-term goals and making major career decisions, among other benefits. (Casey et al., 2019).

Beyond academic development for undergraduate students, institutions also supported graduate students' academic development. One institution provided H-LSAMP students access to the Hispanic Educational Technology Services (HETS) to take practice graduate entrance exams such as the GRE, MCAT, and PCAT. Prior to obtaining a HETS license, this institution offered a GRE preparation program for H-LSAMP students which included a three-day in person course. Some institutions found it financially feasible to obtain a comprehensive portal that covered a wide span of resources, such as interactive interviewing, and scholarship listservs, that were available year-round for all students within their LSAMP. One interviewee described how their institution took advantage of vouchers for graduate testing provided by the Educational Testing Service for LSAMP students. Additionally, a student focus group participant described that their H-LSAMP program director bought study guides for students preparing for the Fundamentals of Engineering exam which is commonly undertaken by many engineering students upon graduation.

Community

Each member of the H-LSAMP alliance made attempts to foster community with approaches varying depending on staffing capacity. Mentoring, community-building activities, social events, and student professional development opportunities were all mentioned as examples of ways that each program created or promoted organically. Mentorships were referenced numerous times as being with both faculty and peers. One student focus-group participant reflected, "The peer mentorship program is really great, you are around people and students who want to succeed and have similar goals, being around them rubs off on you, you ask questions and become more confident."

Another student reflected on her transition in mentoring through H-LSAMP by saying, "I was a peer mentor, senior peer mentor, now I'm a peer mentor again – I want to help the

incoming LSAMP students the same ways I was impacted." Another example of fostering student professional development within the alliance is a "Women in STEM" series hosted by one institution for their H-LSAMP students, not exclusive to women. In this series they have invited former H-LSAMP women who are still in the STEM field to share their experiences on navigating the space, issues they encountered, and lessons they wish they had learned sooner. A H-LSAMP program manager described the formation of this series and the way it is benefiting both women and men involved in their program:

> We got another grant to help with faculty women to mentor our female students and then have also started a women in STEM series, where we bring back alumni that have made it to their Ph.D., opened a business, or are working in high level STEM positions…..We hosted it online to avoid more expenses, and that way we can have even more alumni participate. Our male students even come to hear what these women are saying – they have similar questions.

An example of a community-building activity is a STEM book and film club that one institution hosts each semester, where students engage in in person discussions and build community:

> We have a book and film club, in the spring I send them a list of books which the students rank – whichever is highest ranked, I purchase these books for each student and we have a semester long book club. In the fall we do a film, in the past we have done 'Inception', 'Klara and the Sun', things that are futuristic or on artificial intelligence, that sort of thing. Students don't have to be part of the club, they have the option to do two STEM or career related workshops instead.

These experiences allow students from different fields to come together and discuss issues from an interdisciplinary lens. In some cases, alliance partners hosted social events but did not require students to attend, and in other cases, partners believe these social interactions should happen organically through the communal spaces provided and connections formed.

One program staff member shared:

> These students quickly understand that being part of this group helps with their self-esteem. I had a student in my class [calculus], and I told him to apply. He was a first gen student and he got in and said this was the first time he felt like he belonged to something, He did so well in the program and he was so grateful – he developed friendships and he went on to grad school, finished his Ph.D. and now he is somewhere in the medical field but reaches back out to us often. The summer he did research, it really changed his life. This is one story of many, for a lot of students who didn't think they would go to grad school at all.

The strength of community, particularly for URM students in college, supports students in forming collaborative and educational support networks which helps build academic confidence (Chang et al., 2011). These sentiments depict the connection between community and self in terms of students' academic trajectory and growth. Mentorship from more senior students was also identified as a critical part of building this community. Students mentioned that had they not been part of H-LSAMP, then they would not have gotten to meet some of their best friends, would not have travelled to conferences, or built confidence, among other positive facets.

Professional Development

Across the alliance, students, staff, and faculty iterated the importance of professional development opportunities for students, including undergraduate research, internships, and skill building.

Undergraduate Research

Participation in undergraduate research led by a faculty member was highlighted as an integral professional development opportunity for H-LSAMP students. One institution requires student research participation and hosts a student research conference, while the remaining institutions support students in obtaining faculty-led research opportunities. One H-LSAMP program manager indicated that this would be the primary activity to keep, as it provides students a great advantage. They stated, "If I could keep one activity, beyond mentoring and tutoring, the best bang for our buck is Ph.D. mentored research on campus. This gives students confidence they can apply externally through the mentored research."

The undergraduate research experience for STEM students supports retention efforts and aids in students eventually publishing more research upon graduation (Hunter et al., 2007; Thiry et al., 2012). The authentic and practical exposure to the scientific process can also enhance students' understanding of scientific concepts (Linn et al., 2015; Russell et al., 2007). In addition to participating in the research process, involving students in the academic publication process was meaningful to both students and faculty. One interviewee reflected on what he felt was the most valuable part of the research process:

> Publications – they don't come in with that expectation that they will get their name and research out there. I have students publishing 3 papers before they graduate so it's very exciting – they see that they can do it before graduate students and that becomes a leverage point and really good for their career. Students do not come in with the expectation that they will be able to partake in such activities.

Internships

Several interviewees shared how gratifying it was to hear of students interning with businesses and organizations where H-LSAMP graduates were employed and companies reaching out regarding students and job prospects. One H-LSAMP program staff member touted the internships as being one of the key successes of the program:

> One of the major successes has been the number of internships our students get in the summer – their achievement makes them competitive, and these are life changing experiences. For some of them it might be their first time on a plane and out of Texas just for an internship which helps them be more confident and competitive.

Another program director commented on the rigor and quality of the internships students have obtained:

> Most of our students get internships in their freshman year and end up all over, we have had students go to Harvard, Michigan, a lot of great places to do research or work for the

> summer. In most years the students altogether might get more than $100,000 in money from their internships. They are very heavily recruited and same for grad programs even.

Participants' narratives about internship benefits align with research showing positive effects of internships on students across disciplines and backgrounds. Internships affect academic outcomes for both advantaged and disadvantaged students (Binder et al., 2015). Beyond improving academic outcomes, technical and research internships have been found to build professional networks, boost success expectations, improve STEM skills, and develop identity and confidence (Coté et al., 2025; Stofer et al., 2021). Research found that these skills are typically developed through activities such as preparing posters and manuscripts, collaborating with teams, working independently, and engaging in program activities for URM students (Elkihider et al., 2025). Research also indicates that paid internships can influence career choices, such as increasing STEM students' interest in STEM teaching careers (Cook et al., 2022).

Skill Building

In addition to participating in undergraduate research and internships, many interviewees and focus-group participants identified several skills they found useful in life and the workforce that were developed through participation in the H-LSAMP program. These skill-building opportunities ranged from conference support to workshops that are geared toward H-LSAMP students. Skills developed through H-LSAMP participation included networking skills in formal and academic settings, as well as leadership and communication skills gained by leading tutoring or presentations. Communication skills were also referenced numerous times by interviewees as a crucial component regardless of the career field. H-LSAMP students develop these critical skills when they are awarded opportunities to engage with faculty and participate in conferences. Research indicates that skills developed through these professional-development activities support student persistence, assist students in making future career decisions, and foster a sense of belonging in STEM programs (Bruthers et al., 2021). Additionally, skill development tailored specifically for URM students, which provides them with a range of valuable skills for life and the workforce, has been shown to enhance academic preparedness, retention, and overall success in STEM. Skill building also boosts self-efficacy, career aspirations, and a sense of science identity among URM students in STEM (Carpi et al., 2016; Jackson & Winfield, 2014; Robinson et al., 2019).

Confidence Building

The need to increase student confidence levels in providing tutoring services, leading workshops, and presenting research was a theme across interviews and focus groups. Tutoring, supplemental instruction, and peer study groups were where many H-LSAMP students provide services to fellow students. In cases where students were leading workshops and/or tutoring, they spoke of their feelings of apprehension that turned into confidence. One student reflected:

> At the beginning of leading the workshops I was nervous but now I feel more secure. The first time I was facilitating, I was thinking there was no way I could lead but I was paired up with someone great in the matching program that made it a great experience.

The four themes that emerged from our qualitative interviews and focus groups echo the extant literature on retaining and supporting URM students in STEM fields. Previous research consistently indicates that institutional factors, including programs, practices, resources, and structural components, play a critical role in enhancing the learning and retention of URM students (Xu, 2018). Research has also identified several conditions that are effective in enhancing URM students' persistence in STEM, including providing opportunities for experiential learning experiences, such as undergraduate research, internships (Carpi et al., 2016; Hurtado et al., 2010), tutoring and peer mentoring (Casey et al., 2019; Hidayat & Saad, 2025; Rockinson-Szapkiw et al., 2021), and many others. However, in times of financial constraints when funding is significantly reduced, questions remain about how best to support URM students. In the next section, based on our analysis of current data, we provide several recommendations for low-cost, effective programming to support URM students in the STEM field.

Low-Cost, Effective Programming for Times of Fiscal Constraint

Understanding the most critical components of STEM student support programming in times of fiscal constraint, we then highlight several recommendations for low-cost, effective programming. Some recommendations were specifically articulated by interviewees and focus group members, while others were inferred based on the synthesis of academic literature. We present these recommendations to be employed within LSAMP alliances and in institutions without formally designated programs.

Faculty Research Champion Cultivation

A major component of the H-LSAMP is student research experience, which is evidenced to support retention among STEM students (Hunter et al., 2007; Thiry et al., 2012) and can also enhance students' understanding of scientific concepts (Linn et al., 2015; Russell et al., 2007). We found that having a dedicated/invested person, deemed as a faculty champion, is vital to not only scale research programs but also safeguard continuous opportunities. Faculty champions within the alliance can recruit faculty participants for student research. Faculty champions can encourage other faculty to participate in student research by sharing positive experiences, circulating and communicating student research projects, and serving as a resource for participants.

Staff and Faculty Support

A theme that prevailed among the interviewees was related to lessons and ideas gleaned through experience leading a program like H-LSAMP. This is centered around two primary sub-themes: (1) Hiring people that care and (2) making sure leaders understand and are committed to LSAMP. Hiring people who care is particularly important when a strong facet of LSAMP is in building community such that students have more of a stake in their learning. Hiring individuals who not only want to advance H-LSAMP but also be a support system for students navigating this space is essential. In the second sub-theme, specific leaders identified were upper university administration and congresspeople. This wide range of leadership ensures nationally funded programs are being touted and celebrated in a variety of audiences.

Workshop, Tutoring, and Course Alignment

One challenge frequently mentioned in student, staff, and faculty interviews and focus groups was misalignment of timing and content among workshops, tutoring, and courses. Workshops and tutoring were brought up as common challenges as they are not typically integrated but supplemental to courses which creates a lack of uniformity and may potentially impact quality. Students who had served as facilitators for supplemental instruction workshops indicated their efforts in supporting students from different course instructors, but that created its own set of challenges as there was variation even in relation to the same course and how materials were taught. Interviewees also mentioned that despite college success courses and study skills seminars, there was a challenge for students in making the connection between these lessons to their actual classes. Another interviewee shared that when they ask students how they study for exams, students indicated they read the notes, rather than working with the material and practicing problems.

Reviewing the workshop, tutoring, and course schedule and content across the alliance would provide opportunity to correct the alignment issues. Formally reserving time and space for faculty and those leading tutoring and workshops to plan for the semester and academic year, such as a workshop and course materials planning summit, would create opportunities for collaboration and community building to align syllabi and schedules, share materials and resources, discuss topics that have been most difficult for students, and share best practices. Whether formal or informal, this type of pre-semester planning initiative among faculty, supplemental instruction leaders, and students has been shown to aid in the quality of tutoring and academic workshops (Bouwma-Gerhart et al., 2014; Derting et al., 2016).

Networking

Allowing for students across H-LSAMP to broaden their networking and collaboration circles should have a positive impact on student exposures and experiences, as literature has suggested that networking can benefit students through industry knowledge, job opportunities, mentorship, community, and collaboration (De Janasz & Forret, 2008). Sharing and engaging the H-LSAMP connections across the alliance may also strengthen the within-alliance connections, particularly for H-LSAMP programs that may not have the bandwidth to host more community and social events. Establishing more connections early across the alliance can allow for more organic relationships and community building to occur (Shah, 2014; Yukselturk & Bulut, 2007).

Establishing community groups on social platforms like LinkedIn, for H-LSAMP students and graduates is a low-maintenance way to share opportunities, connect current students with former students within similar backgrounds and fields, and solicit support from alumni on events and/or employment prospects. This platform can also be leveraged to form mentorship and internship opportunities for students with graduates at varying levels. This will allow for broader exposure of careers and broaden students' understanding of a given field. A STEM alumni community can help current students in terms of guidance, networking, navigating professional and academic pathways, and can help address diversity and inclusion issues within STEM as current students can see how they are represented in the field (Brown, 2016; Kahn & Ginther, 2017). Additionally, alumni networks can be a powerful engine for fundraising to help cover additional program costs, program expansion, opportunities for students or increased

scholarship support to help defray the ever-increasing costs of living and tuition which significantly impact the most disadvantaged students.

Confidence Building

Beyond additional and more refined training for students in these positions, allowing for gradually increasing levels of responsibility may be beneficial to increase confidence, such that workshop facilitators are partnered with peer-mentors who have previously led workshops. The peer mentors would lead the first few weeks of a workshop as the newer facilitator becomes more confident in the space and then takes more ownership. This peer-mentor relationship can also include shadowing opportunities with regard to preparation for workshop facilitation, which is highlighted in the literature as a positive component in increasing student confidence (Ruiz de Velasco et al., 2016).

To help increase student confidence with regard to presenting research, we recommend creating H-LSAMP research interest groups as an optional experience for students to participate in and creating workshops to help the broader STEM student population address common presentation anxieties. Research indicates that common anxieties regarding presenting research include fear of judgment and self-doubt (Linn et al., 2015), therefore providing seminars that address these issues can support students in learning new strategies to mitigate their presentation reservations. Creating small peer groups based on similar research interests could facilitate organic discussions on those topics, which, in turn, will build greater confidence in the content area. These research cohorts can meet and have opportunities to discuss research based on a prompt and present for a few minutes each to their group, similar to a program titled "Toastmasters International - Speechcraft for Scientists and Engineers" which is structured to build skills related to presenting research (Toastmasters International, 2026). Not all students will have the opportunity to conduct research, but they can still participate in practicing presenting research and information in a journal club format. This can be scaled such that research cohorts can present across groups to practice articulating information to students with limited knowledge on their specific research topics.

Conclusion

Across the H-LSAMP alliance, students, staff, and faculty described how fostering academic development, fostering community and student professional development supported students along their college journey. While student financial support was an integral component to student success, this study focused on programming aspects that could be offered during times of fiscal constraint. As the opportunities to provide student financial support diminish, the recommendations within this study aim to provide low-cost, effective programming to support fellow LSAMP programs around the nation and/or university colleges hoping to expand learning opportunities for STEM students to increase student success.

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Appendix A:

Interview Protocol – Program Director

1. How long have you been manager/director of this project?
2. What are your main functions as project manager/director? (Probe: Ask interviewee to differentiate between role as manager of the lead institution's own activities and role as coordinator of Alliance activities)
3. Do you hold any other position within the institution and to whom do you report?
4. Where within the institutional structure is your project located? How and why was the decision made to locate the project there?
5. Is there an advisory committee to your project?
6. If yes, please describe its composition. (Probe: What constituencies are involved?) Has its membership changed over time? How?)
7. Please describe how your advisory committee functions. (Probe: How often do you meet? What is the role of the committee? What type of input does it provide [for example, does it provide input into policy and practice relating to project components?])
8. Are there any other committees that are part of your project? If so, please describe their membership and role vis a vis the project.
9. Please list your staff by title and describe the role of each.
10. Who is responsible for the day-to-day operation of your project? What does this responsibility entail?
11. What would you say are your Alliance's main goals? Have these goals changed over time? How do these goals relate to the institution's overall goals?
12. Why did your institution wish to establish an LSAMP project? Can you give me a brief history of what led to the establishment of an LSAMP project? (Probe: Is there a history of activities to increase the number of underrepresented minority students in S&E?)
13. How and why were your partner institutions in the Alliance chosen?
14. How and why were your approaches and strategies determined from project goals?
15. How are participants recruited for your project? What would you say is your project's most effective recruitment strategy?
16. Is there an application/selection process? If so, what is it?
17. What are the main ways in which partners in your Alliance interact? (Probe: Do they share resources? Hold regular decision-making meetings? Are there activities designed to bring together students and/or faculties from different institutions?)
18. What, in your opinion, have been the most effective strategies employed to promote collaboration among the various partners in your Alliance? (Probe: Between four-year and feeder schools [two-year colleges, tribal colleges, HBCUs]? Between your Alliance and high schools? Between your Alliance and graduate institutions?)

19. What role has the lead institution played in fostering linkages among Alliance partners?

20. Have Alliance partners changed over time? How? What were some of the reasons for these changes?

21. In general, how has your Alliance evolved since its inception? What have been the major changes it has experienced? What were reasons for these changes? (Probe: Changes in focus? Target population? Strategies and activities?)

22. What would you say have been the major outcomes of your LSAMP project? (Probe: Increase in STEM BS degrees awarded? Increase in the diversity of STEM enrollment? Changes in institutional infrastructure, curriculum, instruction, faculty attitudes?)

23. What has been the impact of your project on the infrastructure of Alliance institutions in terms of promoting diversity in STEM? (Probe: Has lasting change been effected? In what policies or practices has change taken place that promotes diversity? Possible answers: Course revision or development, faculty training, recruitment practices, articulation agreements with community colleges? Student support activities?)

24. Have there been any scholarly publications that have emerged from your project? Has your project contributed to any efforts at dissemination or replication of practices developed by LSAMP?

25. What factors have accelerated the attainment of project goals?

26. What have been the biggest challenges that your project has had to overcome?

27. Does your Alliance have current contact information of project graduates? If so, how is this information currently used?

Appendix B:

Interview Protocol – Program Staff

1. How long have you been site coordinator?
2. What do you see as your main functions a site coordinator?
3. Do you hold any other positions within the institution?
4. To whom do you report?
5. Where within the institutional structure is the LSAMP project located? [Probe: Why was the decision made to locate it there?]
6. Is there an advisory committee to the project? If so, please describe its composition and role. [Probe: Does it provide input on policy? Assist with project functions such as recruitment and selection of participants?]
7. Please list your project staff and describe their roles.
8. Who is responsible for the day-to-day operation of your project?
9. What does that responsibility entail?
10. How did the LSAMP project come about on your campus? [Probe: for history and background of project. Why did the institution decide to join the Alliance? Who were the major players in establishing the project on your campus?]
11. What are the primary components of your program? [Probe: tutoring, research, career development, workshops, mentoring, etc. Please describe each project feature implemented by your LSAMP project.]
12. How would you describe the project's goals as it applies to your campus? As far as you know, have these goals changed over time?
13. How is student progress monitored? Who gets monitored? How often? By whom? What kind of information is used to monitor student progress?
14. Do students receive systematic feedback on their progress (Probe: How often? Through what mechanism?)?
15. How were your approaches and strategies in implementing the LSAMP project determined from your project goals? [Probe: We are interested in how and why you chose your targeted population and how and why you identified the specific approaches/strategies you now use to meet project goals.] Have these approaches and strategies changed over time?
16. If you were to draw a profile of your typical participant, what would he or she look like?
17. How effective do you think the strategies and approaches used by the project have been in meeting the needs of your target population?
18. On average, what would you say is the percentage of underrepresented minority STEM majors who switch out of STEM institution wide? Among LSAMP Level I participants?
19. On average, what would you say is the percentage of underrepresented minority STEM majors who leave your institution altogether? Among LSAMP Level I participants?

20. Do you follow up LSAMP graduates once they leave the institution? If so, how do you use this information?

21. What are the main institutions in the Alliance with whom you collaborate? Please describe this collaboration. [Probe: Partnerships between two-year and four-year institutions; partnerships between four-year colleges and graduate institutions.]

22. What mechanisms have been established by the Alliance to facilitate decision-making among partners? Do you feel that it is effective?

23. What, in your opinion, has been the role of the lead institution in the Alliance? Do you feel that this is the appropriate role for a lead institution? If not, what should it be?

24. Do institutions within the Alliance share resources? How? Please describe?

25. What do you feel have been the main benefits of your collaboration with other institutions within the Alliance? [Probe: To your institution? To your students?]

26. What, if any, main problems have you encountered in collaborating with other partners?

27. Overall, do you think that the collaborative relationship among partners within the Alliance works well? Why?

28. What institutional resources are used to support the LSAMP project? [Probe: university space, support staff, materials, computer time, other in-kind contributions, money]

29. How supportive has your institution been vis a vis your LSAMP project?

30. Has your institution (or departments within the institution) made any changes in policy or practice as a result of the LSAMP project? If so, what have these been? [Probe: Have recruitment practices changed? Courses? Instructional practices? Advisement procedures? Etc. Has the institution made changes to facilitate project implementation?]

31. What would you say have been some effects of LSAMP that will last beyond the life of the project? Are there plans for continuing LSAMP activities?

32. How might the project or elements of the project be funded if NSF funding ends?

33. What are some of the main factors facilitating implementation of your project?

34. What, in your opinion, have been the biggest challenges you've encountered in implementing your project? How have you addressed these?

35. What are some of the lessons learned in implementing your project?

36. What changes would you like to make to the project?

37. What, in your opinion, have been the major successes so far of your LSAMP project?

38. What, in your opinion, are the most important features of your project? Why?

Appendix C:

Interview Protocol – Associated Faculty

1. In which department do you teach?
2. What specific subject(s) do you teach?
3. How long have you been involved with LSAMP?
4. Are you a faculty mentor?
    - 4.1. How did you become a mentor?
    - 4.2. How many participants have you mentored?
    - 4.3. How many are you currently mentoring?
    - 4.4. Please describe your role as a mentor with LSAMP [Probe: How many times a month do you have contact with a mentee? What are typical types of interaction you have with mentees?]
    - 4.5. What, in your opinion, is the most valuable service you provide as a mentor?
    - 4.6. Did you receive training to be a mentor? Please describe.
    - 4.7. What effects do you think the mentorship program has had on participants? [Probe: In terms of helping them graduate? Go on to graduate school in STEM?]
    - 4.8. What recommendations do you have for improving the mentorship program?
5. Please describe your main involvement with LSAMP? [Probe: for different ways the respondent may be involved: as an instructor, advisory board member, member of curriculum revision committee, participant in professional development workshops for faculty, research supervisor, faculty mentor, etc.]
6. What do you see as the project's goals?
7. Have you taught LSAMP students in your classes?
    - 7.1. How would you describe the typical LSAMP participant?
    - 7.2. How well prepared are they to do the required work in a course?
    - 7.3. Do they appear to be appropriately placed?
    - 7.4. What do you see as the main problems encountered by LSAMP participants in your classes? How has the project helped to address these problems?
8. What do you see as LSAMP participants main strengths?
9. Have you derived any benefits from your involvement with LSAMP? What have these been? [Probe: Has your involvement with LSAMP affected your teaching? The way you interact with students?]
10. What are the main challenges that you've faced in working with the H-LSAMP program?
11. From your perspective, does the program run smoothly?

12. Do faculty involved with LSAMP interact or collaborate across partner institutions within the Alliance? If so, please describe.
13. What effects has the LSAMP project had on student participants? [Probe: Are student participants more likely to do better in their coursework?]
14. Do you think student participants are more likely to graduate with a STEM degree?
15. Do you feel that student participants are better prepared to attend graduate/professional school in a STEM field because of their LSAMP experience? Why?
16. Do you feel that student participants are more likely to attend graduate/professional school in a STEM field because of their LSAMP experience? Why or why not?
17. What recommendations do you have for improving the overall LSAMP program?

Appendix D:

Focus Group Protocol – Students

1. How did you come to be an LSAMP participant?
    1.1. How did you find out about LSAMP?
    1.2. Why did you apply?
    1.3. How did you expect to benefit from being in LSAMP? Have your expectations been met?
    1.4. If you came from a community college, were you involved in LSAMP at your two-year college?
2. How effective are the services provided by LSAMP to meet your needs?
    2.1. What kinds of services are provided by LSAMP at your institution? Of these, which would you say are the most helpful? Why? Which would you say are not really helpful? Why not?
    2.2. What role have LSAMP services played in helping you complete your STEM degree so far? Do you think additional services are needed? What are they?
    2.3. If you have any peers that have left the STEM pathway or college generally, what were the primary reasons?
    2.4. If you came from a two year college, what role have LSAMP services played in helping you to make the transition to a four-year college? Which would have been most helpful in this regard?
3. What do you think about the math and science courses you've taken in your program?
    3.1. What courses have you found particularly helpful? Have you enjoyed them?
    3.2. What courses have you had the most difficulty with? Why?
    3.3. What are your perceptions about the quality of the instruction that you receive from faculty in your program?
4. How well does LSAMP run at your institution?
    4.1. How efficiently does the LSAMP project run? What difficulties have you encountered in accessing services provided by LSAMP? Why do you think you have had these difficulties? Have you experienced difficulties as a STEM major at your institution? How has LSAMP helped you to overcome these difficulties?
5. What changes would you recommend to improve LSAMP?
6. If you are nearing graduation, what are your plans for the future?
    6.1. What do you plan to do immediately after graduation? If your plans include graduate school, do you plan to continue in STEM? If your plans include graduate school, what was the role of LSAMP in helping you make the decision to go to graduate school? In preparing you for graduate work in a STEM program?