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The Institutionalization of An Innovative Curricular Component in a Federally Funded Program to Increase Minorities in STEM Fields. A Case Study of a Small and Large University

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THE INSTITUTIONALIZATION OF AN INNOVATIVE CURRICULAR COMPONENT IN A FEDERALLY FUNDED PROGRAM TO INCREASE MINORITIES IN STEM FIELDS. A CASE STUDY OF A SMALL AND LARGE UNIVERSITY.

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APPROVAL FOR SUCCESSFUL DEFENSE

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Abstract

The study focused on the Houston-Louis Stokes Alliance Minority Participation Program. Its mission is to increase the number of under-represented students in STEM majors. The National Science Foundation has been funding this program for the past 20 years. Studies were conducted about its success, however, little has been said about HOW the program was formed and prospects for its future amid changes in leadership due to retirement and turnover of staff members. This study looked at the sustainability of LSAMP, specifically how one central academic program component—the academic excellence workshops were institutionalized/integrated by funding it into the organizational life of each of the two lead institutions of the Houston alliance. So, this study examined how over time, the Houston-LSAMP achieved sustainability through institutionalization of the pipeline program. Rogers' Diffusion of Innovation Theory was the conceptual framework employed to frame this case study and formulate the research questions and sub-questions. The institutionalization of the workshops at the University of Houston and Texas Southern university were studied since they are the past and current leaders of the Houston-LSAMP alliance, respectively.

Keywords: *Houston-LSAMP, URMS in STEM, institutionalization, diffusion of innovation theory, LSAMP workshops*

Dedication

This dissertation is dedicated to my four amazing daughters:

Kristin Victoria, Danielle Olivia, Nia Angelica, and Candace Elizabeth Hardy.

I pray this serves as an inspiration to all of you as pursue your own academic endeavors.

To Randall D. Hardy for showing me that victory does not always mean I stop the storms of life from coming. True victory is when I do not let the storms of life stop me!

I also dedicate this work to my mother, Jacqueline Tull, and my entire family and all of my friends for their unwavering support throughout the years.

In Memory Of

Frederick, Paulina, Carlton John Tull, Thelma Dundas, Sylvia Walcott, H. Herbert Busby, and Cyril C. Ollivierre

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Chapter 1: Introduction

To remain globally competitive and increase the number of traditional college students completing two- and four-year college degrees, America needs to expand access to higher education and focus attention on the success of those who enroll. Expertise in science, technology, engineering, and mathematics (STEM) will be particularly important for maintaining a thriving economy and developing innovative solutions to global challenges. However, only 6% of 24-year-olds in the United States hold first degrees in these fields, placing the country 20th in a comparison group of 24 industrialized countries. Many American students initially interested in STEM areas select other fields after they begin college; only 33% of White students, 42% of Asian American students, and about 20% of Black, Latino, and Native American students who aspire to complete a STEM major succeed (Hrabowski, 2014).

Demographers predict that Black, Latino and Native American students will soon comprise 40% of the college age population (National Science Board, 2010).

Technological and economic strength of the U.S. depends on the success of minorities in STEM fields (National Academy of Sciences, 2010). This is a problem because if a significant percentage of the American college population (40%) has a low STEM college graduation rate, then this can contribute to a shortage of minorities in STEM jobs. This can be a hindrance to the United States' ability to compete globally.

In seeking to account for the underrepresentation of minorities among college graduates in STEM majors, financial difficulty and poor pre-college academic preparation contribute to slow minority persistence rates in STEM (Anderson & Kim, 2006; Chang, Sharkness, Newman, & Hurtado, 2010). Women, first-generation students, and those from low-income backgrounds also attrite at higher rates than their counterparts after declaring themselves STEM majors (Griffith, 2010; Hill, Corbett, & Rose, 2010; Huang, Taddese, & Walter, 2000; Kokkelenberg &

Sinha, 2010; Shaw & Barbuti, 2010). Far too often, students of color who start college with the intention of having a career in science do not survive introductory calculus, physics, and chemistry courses. Traditional remedial and counseling approaches have had little impact on assisting these students through the first year of college or on increasing the number of those who complete a math/science-based curriculum such as engineering (Treisman, 1985).

Despite efforts at the national level, the percentage of underrepresented minority (URM) students graduating in STEM continues to be significantly less than that of their non-URM counterparts (Change the Equation, 2014; James & Carlson, 2012; National Science Board, 2014). STEM Improvement Programs (SIPs) have been dogged by questions about their efficiency and their continued existence is being questioned. These programs have been in existence for decades and have grown over the last 20 years (Dyer-Barr, 2014). Yet, one of the most common criticisms of SIPs is that their design and implementation are not guided by research. Instead, they are implemented in a piecemeal style that relies on small doses of information and the intuition of individuals with a particular interest in increasing the numbers of URMS in STEM (DePass & Chubin, 2008). The conclusion that research is not conducted to inform the design, implementation, and improvement practices of SIPs is a problem because it is unknown what effects, if any, these interventions actually have. Yet, these programs continue to be funded, developed, and implemented despite this lack of critical evidence (DePass & Chubin, 2008; Fleming, 2012; Leggon & Pearson, 2006; Ream, Lewis, Echeverria, & Page, 2014; Tinto, 2012).

Many colleges and universities, however, address this problem with underrepresented minority persistence by using the Tinto model to integrate these students into the higher educational organization academically and socially. Workshops and science-related field trips

have been established, as well as peer group projects, and faculty often serve as mentors to help recruit and retain Black and Latino students in STEM (Gafney, 2010). There are several programs that share this objective—one of them is in its 29th year of existence.

The Louis Stokes Minority Alliance Participation Program (LSAMP) was founded in 1991 by the late former Ohio congressman Louis Stokes to increase the number of underrepresented minority graduates in science, technology, engineering, and math. The LSAMP program places emphasis on transforming STEM education through innovative recruitment and retention strategies and experiences for groups that are historically underrepresented in the STEM disciplines. Those specific groups are African American, Alaskan Natives, Native Americans, Hispanic Americans, Native Hawaiians, and Native Pacific Islanders. The LSAMP program's goal is to increase participation at the baccalaureate level. Alliances are formed among multiple higher educational institutions to work together to accomplish this. The LSAMP program started with six alliances and has grown to 46, with over 600 institutions included as partners. Over 40,000 LSAMP participants have completed bachelor's degrees in STEM disciplines, and a significant number of these students have pursued graduate study in STEM (NSF, LSAMP, 2011).

Problem Statement

The National Science Foundation has funded the Houston-LSAMP since 1999. Studies were conducted on the alliance's effectiveness since that time. It remains to be seen, however, what happens to this program when there is a change in leadership at the participating colleges and universities. This problem begs the question of what happens to the program when the pioneers and trailblazers who enacted it retire. Dr. A. James Hicks, senior program director of LSAMP at the National Science Foundation, (NSF), has called on university program administrators to create *sustainability plans* so that LSAMP can continue to thrive at their own

institutions when the federal funding stops due to the shifting of funds because of ongoing fiscal crises in American higher education. “They understand that the federal government didn’t intend to support such programs forever” (Abdul-Alim, 2012). We look at sustainability *specifically* in terms of how one central academic program component—the academic excellence workshops —were institutionalized/integrated by funding them into the organizational life of each of the two lead institutions of the Houston alliance.

The purpose of the study is to examine how over time the Houston-LSAMP achieved sustainability via institutionalization of its academic workshops.

In addressing this broad proposal, we have employed one major conceptual framework within which to formulate specific research questions and subquestions. The diffusion of innovation (DOI) theory (Rogers, 2003) is explained below, to guide this study.

Diffusion of Innovation Theory

The four overarching elements of the DOI theory serve as a lead-in to the research questions: 1) innovation, 2) communication channels/dissemination, 3) time/adoption, and 4) social systems/implementation and maintenance. Each of these four elements were applied to the Houston-LSAMP alliance. Rogers (2003) defined diffusion of innovation as “the process by which an innovation (such as LSAMP) is communicated through certain channels over time among the members of a social system” [the participating institutions in the Houston alliance represent the social systems]. Within these four elements of the framework, there are growing numbers of subtheories and concepts as DOI theory is applied and continues to evolve (Scott & McGuire, 2017).

1) Innovation—An idea, practice, or object that is perceived as new. Innovations may include, for example, anything from a new form of technology to educational policies to emerging medical practices (Rogers, 2003; Scott & McGuire, 2017)
2) Communication channels—Disseminating information about an innovation such as the Houston-LSAMP can be seen as a social and dynamic process in the diffusion of innovation theory. The National Science Foundation disseminated information about the alliance in 1999 when it agreed to fund the program. Mass media channels such as television, newspapers, radio, books, magazines, and now the internet and social media are instrumental in promoting the Houston-LSAMP to adopters such as participating institutions and students. They reach a large audience inside and outside of the Houston area. Mass media are most effectively used to increase broad awareness and general knowledge of the innovation (Houston-LSAMP). On the other hand, interpersonal communication involves face-to-face interaction with two or more individuals including outreach in such venues such as classes, professional workshops, and conferences to persuade individual adopters such as URM students to embrace this Houston-LSAMP innovation.
3) Time—There are several aspects that involve the consideration of time when adopting an innovation (Houston-LSAMP). Three relevant subtheories are described by Rogers (2003) and Scott and McGuire, (2017).

   3A) The Innovation Decision Process. This is when adopters (staff at lead and participating institutions) must first learn about the innovation of LSAMP and decide to adopt it. The length of time required in the innovation decision process can vary widely depending on individuals and circumstances (Scott & McGuire, 2017).

3B) Individual Innovativeness. Some individuals are more open to new ideas than others. Adopter categories range from 1) innovators—the small number of risk takers who are the first to adopt Houston-LSAMP and its —to 2) early adopters who follow the lead of innovators (particularly when the former retire and these early adopters become the new leaders) by expanding knowledge and awareness to their peers in their local Houston network. This group is often seen as *opinion leaders* to whom others look for advice. 3) The early majority adopt new ideas in the Houston-LSAMP, but are not considered opinion leaders and 4) the late majority or laggards are the small number who are the last to adopt an innovation (Houston-LSAMP) or never adopt the innovation at all. This group approaches this innovation with skepticism and caution. They wait until most of their peers have adopted new components in the Houston-LSAMP and there is significant proof of its worthiness (Rogers, 2003).

3C) Rate of Adoption. Numbers of participants in Houston-LSAMP will increase rapidly as the influence of early adopters and the early majority persuades the later majority. The attributes of the Houston-LSAMP, the innovativeness of the individual adopters, and the sources and channels of communication all play a role in how quickly the Houston-LSAMP and its new components are diffused over time.

4) **Social Systems.** Diffusion of an innovation such as LSAMP occurs within social systems such as universities and colleges comprised of members who share a common objective. This is where the Houston-LSAMP is institutionalized as early adopters can promote the new components of the program and start implementing them. Changes and modifications are made (Scott & McGuire, 2017). However, after

a program and its components are implemented, they are maintained, sustained, or preserved when leaders decide to either continue or discontinue a program. This describes maintenance, which is the final stage of the DOI theory.

Within the context of diffusion of innovation theory, the following research questions were examined.

Research Questions

1) How did the University of Houston and Texas Southern University institutionalize the central academic component of their LSAMP program—the Academic Excellence workshops—between 1992 and 2019?
2) How did past and current leaders (such as the Deans of the Colleges of Sciences at the University of Houston and Texas Southern University) become aware of this LSAMP program component and how was the program disseminated to their respective institutions (DOI-dissemination)?
3) In terms of adoption, what prompted these leaders to actually initiate these workshop programs? When did they take action and how did they get the program started (DOI-adoption)?
4) In terms of implementation, how did leaders re-modify the program over the years? What were the specific changes (DOI-implementation)?
5) Finally, in terms of maintenance, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of their respective institutions as reflected in staff job descriptions, budgetary lines, space allocation, curricula, and mission?

Significance of the Study

The Houston-LSAMP alliance is a worthy case study based on its success rate and its similarities to the original six LSAMP alliances and other national consortiums. Houston is in its 20th year as an LSAMP participant; it is not one of the original alliances. However, this consortium is just as successful as the other LSAMP alliances and implements the same activities as the original alliances which have participated in this program since 1991. Those consortiums are Alabama, Arizona State University, University of California, Mississippi, Puerto Rico, and Texas A & M University alliances. The Houston alliance has more similarities than differences from the original six, as it offers the following:

- A summer bridge program for incoming freshmen interested in STEM who are transitioning from high school to college. The summer bridge program enrolls recent high school graduates into their STEM program to prepare them to start a rigorous schedule in the fall semester.
- Research experiences for undergraduates.
- International research activities (just started) for its students.
- A bridge to the doctorate program for undergraduates awarded a STEM degree.

The historical overview of these six alliances as well as Houston are addressed in Chapter 2. The limitations of this study are acknowledged as follows.

Limitations of Study

The purpose of this study was to see how the Houston-LSAMP institutionalized its academic workshops over the past 20 years. Limitations of the study included several factors. Some LSAMP components were enacted since 1992—seven years before the actual Houston chapter was launched in 1999. Some of the innovators from 1992 are no longer available to help answer the research questions mentioned above. The LSAMP program also consists of 46

alliances and over 600 individual institutional participants. It is impossible to study the impact of that many cases in one study. The Houston alliance itself has eight current participating members and several academic components to it. It is more realistic to focus on one central academic component and the current and former lead institutions. Now that some limitations are identified, an explanation of the definition of terms follows.

Definition of Terms

Some key words extracted from the research questions defined in this study are innovation, institutionalization, dissemination, adoption, implementation, and maintenance.

Innovation. A new practice, method, idea, or product. Examples include educational policies, new forms of technologies, and medical practices (Rogers, 2003; Scott & McGuire, 2017).

Institutionalization. Learned behaviors (or practices and programs such as the Houston-LSAMP and its academic excellence workshops) are embedded into the routines of an organization (Crossan et al., 1999).

Maintenance. An innovation moves from implementation to institutionalization. At this phase, administrators and practitioners make a commitment to continue or discontinue use of the program (Dingfelder & Mandell, 2011).

Dissemination. Administrators are made aware of such innovative programs and are encouraged to adopt them (Rohrbach, 1993).

Adoption. Administrators form attitudes toward an intervention (recruitment and retention strategies to increase URMS in STEM majors), and commit to initiate the program (LSAMP).

Implementation. Practitioners begin to use an innovation. Re-invention (changing or modifying an innovation) is especially likely at this stage.

The specifications of these variables that are involved in addressing the research questions are applied in Chapter 3. Following is a brief summary of this chapter.

Summary

Chapter 1 introduced the problem of underrepresented minority (Black and Latino) STEM college graduates and an answer to this problem. The Louis Stokes Alliance for Minority Participation Program, named after the late congressman from Ohio, was launched in 1991. Its mission is to increase the number of URM STEM graduates and it has proven to be successful with now approximately 46 alliances and over 600 participating institutions. Funded by the National Science Foundation, LSAMP in Houston, Texas is a younger alliance launched in 1999 and has not only significantly increased the number of URMS in STEM, but also gone through many stages. The program is complex in this one alliance alone, but its components are similar to those of the original LSAMP alliances launched in 1991.

It is important to note, however, that the federal government does not intend to support such programs forever due to ongoing fiscal crises in American higher education (Abdul-Alim, 2012). This, coupled with leadership succession, makes it difficult to maintain the goals of LSAMP. The purpose of this study was to examine how the Houston-LSAMP has balanced the institutionalization and innovation of one federally funded program component over its 20-year existence. The framework is the diffusion of innovation theory (Rogers, 2003), from which the research questions being used to guide this study were generated. This chapter explained the four elements of DOI as well as the significance of the study, its limitations, and definitions of key words including variables involved in addressing the research questions.

Preview of Chapters 2 and 3

Chapter 2 consists of a review of literature with regard to the presence (or lack thereof) of Black and Latino students in STEM majors, an explanation of policies and programs that have

addressed URMS in STEM, and a historical overview of the Houston-LSAMP alliance in comparison to the six original LSAMP alliances launched in 1991. Chapter 2 also includes examples of programs that follow elements of the diffusion of innovation theory explained in Chapter 1 and ends with studies about leadership succession.

Chapter 3 restates the research questions and describes specifications of the variables involved in addressing the research questions as well as methodology detailing a design of the case study. Key variables are identified as well as an explanation of how the data was collected and analyzed.

Chapter 2: Literature Review

Overview of Chapter 2

This chapter consists of the following categories:

1) Studies about the underrepresentation of Black and Latino students in STEM majors
2) Studies about policies and programs implemented to address the shortage of Black and Latino students in STEM majors
3) Research on the history of the Houston alliance and its success
4) Previous studies on the diffusion of innovation theory
5) Previous studies about leadership succession

Underrepresentation of Black and Latino Students in STEM Majors

This section discusses statistics and studies of the presence (or lack thereof) of Black and Latino undergraduate STEM majors. According to the President's Council of Advisors on Science and Technology (PCAST, 2012), six-year degree completion rates in STEM are less than 40% nationwide. This shortage raises concerns about the United States' ability to remain competitive in science and technology fields (Hira, 2010). Women and URM students account for nearly 70% of college enrollment, but they are underrepresented among STEM degree holders because they leave STEM majors at a much higher rate than their non-URM male peers (PCAST, 2012). In 2009, 37.5% of White and Asian American students completed their STEM degrees after five years, while the average completion rates for Black, Latino, and Native American students were 22.1%, 18.4%, and 18.8% respectively (Hurtado, Newman, Tran, and Chang, 2010).

A longitudinal study conducted by Chang, Hurtado, Newman, and Sharkness (2014) also found that Black and Latino undergraduates were significantly less likely to persist in STEM majors than their White and Asian American counterparts. Their sample included almost 4,000

students (3,670) at 217 institutions who indicated in a freshmen survey that they intended to major in a STEM field. Less than half of the students in this sample (1,634) were URM students. Among the aspiring scientists in the overall sample, 62.5% persisted in a STEM major until the fourth year of college. This rate was lower among URM students (58.4%) than among Asian American and White students (73.5% and 63.5% respectively). Disaggregating by URM groups, African Americans had the lowest rate of STEM major persistence (56.5%), followed by Latino/as (58.9%) and Native Americans (62.8%). Findings from the follow-up analysis of the sample of URMS suggest that institutions can improve URMS STEM persistence by increasing the likelihood that these students will engage in key academic experiences such as studying frequently with others, participating in undergraduate research, and involvement in academic clubs or organizations. Before we look at ways to increase the number of URMS in STEM majors, it is important to look at some factors serving as a deterrent for Black and Latino students in this area.

Sixty percent of all college students and more than 75% of Black and Latino college students who indicate initial interest in pursuing STEM fields do not persist to the point of earning a STEM degree (PCAST, 2012). Castleman, Long, & Mabel, (2014) consider the role financial barriers play in dissuading college students from pursuing and completing study in STEM disciplines. There are four possibilities: 1) High school graduates in need of financial aid often perceive the cost of college to be greater than the benefits, even if they have the aptitude and academic record to excel. 2) Another possibility is that students who can succeed at STEM enroll at lower-cost colleges and universities where there are fewer or lower quality STEM programs. 3) Another option taken by students is they may enroll in a college or university that matches their abilities and interests, but they pursue non-STEM fields if they can graduate earlier

and the financial cost is lower. 4) Finally, students realize they cannot manage the demands of a rigorous STEM program because of the hours they need to work to pay for college.

According to Castleman, Long, and Mabel, these possibilities suggest that if students get additional need-based financial aid, then it can have a positive impact on their pursuit of STEM degrees. It can reduce costs to the point where students decide to enroll, enable them to attend institutions with more STEM offerings, encourage them to pursue a STEM major rather than settling for a cheaper and easier major, or limit the number of hours they need to work, allowing them to devote more time to their STEM-related coursework. In addition to institutions reducing financial barriers, the National Center for Education Statistics (NCES) conducts aggregate tracking of persistence in STEM across all colleges and universities in the United States. Their report on undergraduate attrition finds that 48% of those students who enter college as STEM majors leave those majors before they graduate. According to the NCES, African American students are the ethnic group most likely to leave STEM majors by dropping out of college (29%) or switching to a non-STEM degree (36%). Consequently, colleges and universities have started internal tracking to understand their programs in relation to completion in STEM (Hill et al., 2014; Mercia, 2010; Rask, 2010). Hurtado, Estrada et al., (2016), focus on institutional barriers that need to be removed. They describe five recommendations to increase URMS persistence in STEM at the undergraduate level. This study now looks at these recommendations as well as policies and programs addressing the dearth of Black and Latino students attaining degrees in STEM.

Summary of Recommendations and Policies to Increase the Diversity of Undergraduate STEM Disciplines

Here is the list of the recommendations from Estrada et al. (2016):

1) Increase institutional accountability. Possible actions by colleges and universities are establishing information systems across the institution that document incoming student interest, declared major and department, school, program, and graduation rates based on student ethnicity, gender, socio-economic status, and first-generation status.
2) Create strategic partnerships with programs that create lift. Program directors can start identifying which types of programs they want to direct. Possible variables to consider include: the duration of the program, the context (such as the type of university), and the program's purpose/goals (short-, medium-, and long-term). Program directors can communicate with funders about their knowledge of successful programs.
3) Unleash the power of the curriculum. The learning sciences provide many publications about the curriculum's best practices. Educators can enhance their knowledge about pedagogies in undergraduate science by reading more articles about them.
4) Address student resource disparities. Colleges and universities can create access and support for students to reduce disparity among low-income students through federal and private funding agencies providing support.
5) Fire the creative juices. Faculty, departments, and institutions are encouraged to better connect URM STEM students to community-based learning opportunities. Funding agencies are encouraged to support research in STEM that will advance the fields and benefit at-risk communities. Now here is a brief description of policies and programs which have tried to address URMS in STEM.

Policies and Programs Designed to Increase URMS Graduation Rates in STEM

Programs geared to increase URMS in STEM include but are not limited to: SACNAS (Society for the Advancement of Chicanos and Native Americans in Science/Supporting young Native Americans to Pursue Science Education), NIH Women of Color Project (Spelman), MARC/U-STAR (Maximizing Access to Research Careers/Undergraduate Student Training in Academic Research), LA-STEM (Louisiana Science, Technology, Engineering and Mathematics) Research Scholars, and Meyerhoff Scholars DNIMAS Scholars (Norfolk State University, Dozoretz National Institute for Mathematics and Applied Sciences). This review of literature shows a glimpse of just a few of such programs not mentioned above. For example, it looks at the impact of the PEERS program on students' academic success and persistence in STEM majors at UCLA.

The Program for Excellence in Education and Research in the Sciences (PEERS) serves as a model for universities committed to improving persistence of underrepresented science majors and closing the achievement gap (Toven-Lindsey, Levis-Fitzgerald, Barber, & Hasson, 2015). The PEERS program was established at UCLA in 2003 to address the discrepancy between persistence and success of life and physical science majors from underrepresented backgrounds. In terms of statistics for STEM degree completion outside of PEERS, the overall five-year rate at UCLA was 65%; however, significant disparities exist between URM and non-URM students. For example, registrar data show that almost 70% of non-URM students completed their STEM degrees in five years compared to only 39% of URM students who entered UCLA between 2004 and 2006 completing their STEM degrees.

In 2009 the national average for STEM degree completion rates after five years was 37.5% for White and Asian American students, while the average completion rates for Black/African Americans, Latino/a, and Native American students were 22.1%, 18.4%, and

18.8% respectively (Hurtado, Chang, Newman, Tran, 2016). However, because the PEERS program was established in 2003, 83% of PEERS students graduated with a STEM degree in five years. Compared with a persistence rate of 39% for URM STEM graduates at UCLA and a national average of 20% in 2009, the PEERS program has encouraged much higher graduation rates among its participants. Programmatic elements include: 1) academic and career seminars, 2) holistic academic counseling, 3) research seminars, and 4) Treisman-style collaborative learning workshops for the first year math, chemistry, and physics courses (Treisman, 1992). All of these activities give students the encouragement, academic preparation, and positive peer-group motivation they need to persist in STEM. PEERS socializes students to the roles and expectations of the college/university and their academic major (Chang, Eagan, Lin, & Hurtado, 2011; Walton & Cohen, 2011). These factors are found to be positively correlated with persistence (Chang, Cerna, Han, & Sàenz, 2008).

In similar programs that are addressing URMS in STEM fields, Integrated Post-Secondary Education Data System (IPEDS) data (Goan and Cunningham, 2006) indicate that computer and information science careers were in dire need of having degrees awarded at the associate's and bachelor's levels. This was also the case for engineering and other related technology for degrees awarded at the master's and doctoral levels at the start of the 21st century.

Data from the Computing Research Association (CRA), Taulbee Survey of PhD-granting Computer Science (CS), and Computer Engineering (CE), indicate recipients in the United States and Canada complement the IPEDS data (Vesgo, 2008; Perkins, 2013). Here are the abysmal findings: only 1% of CS and CE degrees were awarded to African American non-Hispanic graduates in the 2006-2007 academic year. Hispanics also earned 1% of these degrees and

Native Americans 0%. White, non-Hispanic graduates received 27% of the degrees and nonresident alien graduates received 56% of the degrees. From the 1999-2007 academic years, nonresident alien groups have received an average of 49.63% of CS and CE PhD degrees. White non-Hispanic graduates represented an average of 33.75% of the total recipients of these degrees. African American, Native American, and Hispanic graduates received an average of 1.25%, 0.25%, and 1.38% of CS and CE degrees respectively during these academic years (Perkins, 2013). Underrepresentation of Black and Latino degree recipients persisted from 1970 all the way to 2001; the actual number of degrees conferred during those years were 8,913 CS and CE doctorates awarded to Whites and 154 awarded to African Americans. From 1984 (when the Taulbee Survey began tracking data for Hispanic graduates) through 2001, 6,737 CS and CE doctorates were awarded to Whites while 232 were awarded to Hispanics (Vesgo, 2008).

This literature includes many strategies about recruiting African Americans and Latinos in the STEM fields. However, the issue of underrepresentation of these minority groups in the science, technology, engineering, and mathematics fields involves a combination of social, cultural, and personal factors. Retention of minorities in the STEM fields is also a great concern. The Louis Stokes Alliance for Minority Participation (LSAMP), the focus of this study, is funded and supported by the National Science Foundation. All LSAMP strategies fall under the headings of recruitment and retention. In accepting the grant, institutions, departments, programs, and individuals commit themselves to the task of enrolling more underrepresented minority students in the STEM disciplines, maintaining them as majors, and encouraging them to consider graduate school. LSAMP alliances have adopted various strategies in their efforts to achieve the overall goals. LSAMP was founded in 1991 by former Ohio congressman Louis Stokes. The

discussion about how policies and programs have tried to address URMS in STEM looks at the practices LSAMP employs.

Best Practices for Recruiting and Retaining African American and Latino Students in STEM

Gafney's (2010) study used a logic model, considering resources, activities, and outcomes. The report provides details of major strategies adopted by the LSAMP and summarizes what the evaluation and research found were best practices in each area leading to the success of minority students in STEM. The seven areas identified were: 1) organizational structures to administer the grant, 2) undergraduate research, 3) academic support, 4) process skills needed in college, 5) social support and community building, 6) interest in graduate school, and 7) success in graduate school. In each area, the report's conclusions are based on data and analysis obtained from surveys, site visits, interviews, focus groups, and observations at meetings. The report is based on a 10-year study which included participants in the State University of New York's LSAMP alliance. The six campuses are SUNY Stony Brook, Albany, Binghamton, Buffalo, New Paltz, and Old Westbury.

Some of the strategies employed by LSAMP alliances nationally and at SUNY's LSAMP alliance include working with admissions offices to improve recruitment of African American, Latino, and Native American students; introducing curricular activities that benefit students of color; working with faculty members who endorse the program's goals of retaining underrepresented minorities (URMS) in STEM offering courses in freshman orientation time management, study skills, and test preparation; and providing academic and social support, advising, and mentoring.

SUNY's LSAMP identified the following practices in the seven activity areas listed above which best met the needs of minority students majoring in STEM. LSAMP worked best

when resources at the six campuses at SUNY were coordinated with projects that had similar goals under the first activity area: organizational structure. Some of these projects that work in conjunction with LSAMP include the Collegiate Science Technology Entry Program (CSTEP) which was created by the New York state legislature in 1986 and is funded by the New York State Education Department Office of Higher Education. The Minority Access to Research Careers (MARC) was established in 1975 and is sponsored by the National Institute of General Medical Sciences. Managed by the United States Department of Health and Human Services, MARC's mission is to develop the talent and increase the number of PhD degrees awarded among certain ethnic groups who have long been underrepresented in the biomedical sciences.

While these programs have different sources of funding, they all share the same mission and strategies. They often share expenses for travel, conferences, and workshops such as those hosted by the National Society of Black Engineers and the Society of Hispanic Professional Engineers. Students of color meet professionals, make presentations, and see possibilities for their future in STEM. LSAMP, CSTEP, and MARC also have minority speakers come to the SUNY campuses to discuss relevant topics pertaining to their STEM careers, challenges, and successes. Usually their issues are similar for today's minority students majoring in STEM and the speakers/professionals tell the students how to cope with these issues. These programs also provide social activities in the organizational structure that are not limited to minority students, so that African American, Latino, and Native American students can take their place as leaders, tutors, and discussion leaders in mixed groups.

1) **Undergraduate Research.** Two important LSAMP goals are to increase retention of underrepresented minority students in the STEM disciplines, and to motivate students to consider graduate school and careers in research.

Studies have found a number of ways students benefit from undergraduate research. Gafney (2001, 2005) found that students' understanding of science changed dramatically as they went from simply learning scientific concepts to actually applying scientific concepts. They were at first surprised at how often things don't work out and how results are unclear. Their relationships with faculty became more informal and collegial. Seymour, Barrie-Hunter, Laursen, and DeAntoni (2004) found that research increases student motivation and interest in science. Alexander, Foertsch, Daffinrud, and Tapia (2000), based on a program that was highly successful in retaining students and moving them to graduate school, identified several elements that they think are necessary for success. Among these are a minority community with students at various levels in a program that continues for several years, providing a forum for discussions of race and ethnicity as well as science, and projects that allow students to work on real open-ended research under the direction of a mentor who is genuinely concerned about the students.

2) **Academic Support.** There are several reasons why underrepresented minority students often need academic assistance. First, many urban secondary schools lack the resources and sometimes the quality teachers to ensure a high level of teaching and learning. Second, minority students are often the first in their families to attend college and, although motivated, may lack role models for college. Third, the STEM disciplines are demanding for all students and require extra learning time, particularly in quantitative areas. So colleges and universities need to be more accommodating and adjust to the newly diverse student population they serve by changing what they teach and how they teach.
3) **Process Skills needed in College/Freshman Success Courses.** College has become more challenging for freshmen for sseveral reasons. First, colleges have reduced

restrictions and do not want to replace parents. Curfews, required class attendance, and restrictions on room visiting have been eliminated or reduced. Freshmen are placed in a sink-or-swim atmosphere. Second, options regarding majors have multiplied. Most colleges have certain distribution requirements, but no core curriculum. Students are left to plan their own sequence of courses, with very little or no contact with their academic advisors. Third, the STEM disciplines have become more complex than they were in the past. Students are required to do more quantitative reasoning and difficult problem solving. Finally, with larger numbers of students attending college, there are more students who are academically underprepared. SUNY's LSAMP offers freshmen success courses to assist incoming students with time management, study skills, tutoring, writing workshops, and help becoming accustomed to college life.

4) **Social Support/Community Building**. Some SUNY LSAMP sites use grade point averages to select students for particular benefits such as stipends for books, trips to conferences, and other benefits. Some sites put a large portion of their LSAMP budgets into more substantial stipends to help defray tuition and other expenses for a relatively small number of LSAMP students.
5) **Community Building.** At a number of the SUNY LSAMP sites the number of minority students majoring in STEM disciplines is small, and these students benefit from activities that bring them into contact with others who share similar backgrounds, interests, challenges, and goals. For example, there are regular lunches for LSAMP students and guests. At some sites these lunches include visits from professors and graduate students who advise undergraduates about their academic

pursuits in STEM. Trips to conferences and local science chapters provide students of color with opportunities to meet peers from other institutions and get information about the STEM industry. LSAMP coordinators have an open-door policy for minority students, informing them about LSAMP events, advising them about switching majors, writing recommendations for internships and graduate school, as well as advising students who are experiencing academic difficulty.

6) **Interest in Graduate School**. One of LSAMP's goals is to foster student interest in graduate school. Undergraduate research, as mentioned earlier, is critical. This has been effective at all of the SUNY LSAMP sites. The experience provides an involvement in the central activity of graduate school and students are able to judge whether they have the temperament and personal resources required for extended research.

Another strategy to develop motivation and interest in graduate school lies in the coordination of LSAMP with the Alliance for Graduate Education and the Professoriate (AGEP), a sister program designed to engage and support underrepresented minority students in the STEM disciplines in graduate school. These two programs are run under different offices at the National Science Foundation. Some activities that are effective include connections with graduate schools. SUNY's LSAMP sites have found that coordination between LSAMP and AGEP can increase an undergraduate's interest in graduate school because the minority students see this as a possible bridge between these support systems. Most colleges administer undergraduate and graduate schools separately. SUNY LSAMP students also attend graduate school fairs and conferences where they obtain ample information and encouragement to stimulate their interest in STEM graduate programs. Students of color are also influenced by

contact with graduate school faculty. Faculty researchers in a particular field can pique a student's interest in graduate school, helping them to advance from the abstract to the concrete and determine which institution is best suited to their individual interests.

7) **Success in Graduate School.** The Learning and Studies Strategies Inventory (LASSI) Survey is administered by the Bridge to the Doctorate program funded by the NSF. It studies the needs of underrepresented minority students who generally enter a master's program with the hope of eventually transitioning to a doctoral program. SUNY LSAMP implemented the Bridge to the Doctorate program in 2005. The grant provided stipends for up to 12 students per year, and almost all of these places were filled.

Interviews, focus groups, and the LASSI survey helped uncover a number of important ideas regarding best practices that support minority graduate students in the STEM disciplines. 1) Early knowledge about institutional requirements, departmental procedures, and courses is vitally important. Graduate students need orientation as well as ongoing communications about a program's expectations and their own progress. 2) Underrepresented minority students self-report a number of weaknesses in time management, study skills, and goal setting. They can profit from special classes, advising, and mentoring in these areas. 3) There are significant differences in student preparation for graduate school and consequently the use of an inventory such as the LASSI can help identify particular needs. Following is a discussion of the history of LSAMP and an explanation of why the Houston alliance made a good case study.

Research on the History of LSAMP and the Houston Alliance

Following is a general breakdown of the increase of URMS in STEM at the six oldest LSAMP participants along with the LSAMP activities each alliance entails.

As one of the six oldest National Science Foundation alliances in the nation, the Alabama Louis Stokes Alliance for Minority Participation (ALSAMP) began in 1991 with nine institutions having a combined URMS STEM enrollment of 4,549 and a combined URMS STEM bachelor's degree production of 473. As of 2011, the alliance includes 12 institutions with a combined URMS STEM enrollment of 7,069 and a combined URMS STEM degree production of 1, 397 (NSF, LSAMP Magazine, 2011).

- Combined ALSAMP institutions awarded 16,108 STEM bachelor degrees to URMS in Alabama as of 2011 since its inception in 1991.
- ALSAMP students are involved in international research activities in Australia, Ecuador, Scotland, and Egypt. ALSAMP is a partner with the US-Africa Advanced Study Institute and Workshop Series in Mathematical Sciences.
- ALSAMP students who earned PhD degrees increased from 15 in 1999 to 35 in 2010.
- ALSAMP STEM students participated in the 2010 research conference on Capitol Hill.
- ALSAMP had the first nationwide student research STEM conference in Alabama in 1993 and the first summer bridge program in 1992, and has had annual research conferences since that time.
- ALSAMP in collaboration with the LSAMP principal investigators publishes the LSAMP and Bridge to the Doctorate magazines.
- Each ALSAMP institution has established connections with one or more community colleges in Alabama.

The University of California Louis Stokes Alliance Minority Participation (CAMP) is another one of the original six alliances. It consists of eight institutions and has focused on

recruitment, retention, and degree completion among URMS in STEM. Similar to the Alabama and Houston alliances, CAMP offers summer and academic year research experiences, faculty mentoring, academic excellence workshops, activities fostering academic socialization and professional development, pathways to STEM career opportunities, and an annual system-wide symposium. There was a 178% increase in minority STEM BS degrees granted, from 615 in 1991 to 1,708 in 2010. Minority STEM enrollment increased 182%, from 3,806 from 1991 to 10,745 in 2010. CAMP's effectiveness is attributed to sustained commitment from their STEM deans, faculty, and staff supported by the university's top-level leadership. The alliance fostered local, regional, and national cohesive relationships that enable effective infrastructure within California higher education (NSF, LSAMP, 2011). Again, does the Houston alliance have the same type of sustained commitment moving forward when there is no more federal funding and new leadership coming in? The following compares the remaining original six alliances to Houston.

The Louis Stokes Mississippi Alliance for Minority Participation (LSMAMP) is a consortium of six state-supported universities. During the years of the program, the number of URM STEM students enrolled in the state of Mississippi's institutions increased by 106%—more than double the rate of majority STEM students at 42%. STEM degree production for URMS increased from less than 500 in 1992 to 9,058 in 2008.

- The number of URM students who received a PhD in STEM increased from 5 in 1991 to 36 in 2010 at LSMAMP.
- LSMAMP students participated in international research activities and conference presentations in China, Taiwan, Poland, South Africa, Costa Rica, Japan, Sweden, Guatemala, and Belize.

- LSMAMP has been organizing an annual symposium since 1995 and has expanded to integrate the National Science Foundation, Partnership for Research and Education in Materials, and Centers of Research Excellence in Science and Technology.
- Since its inception in 1991, all LSMAMP alliance institutions have had annual summer bridge programs for incoming freshman STEM majors. Houston also has similar noteworthy accomplishments.
- The Puerto Rico Louis Stokes Minority Alliance Participation (PR-LSAMP) is also one of the six "grand amps." PR-LSAMP's success and institutionalization activities have built the eight participating universities' ongoing efforts to improve STEM education to ensure sustainability efforts. PR-LSAMP's sustained efforts have resulted in the following accomplishments:
- It increased the undergraduate STEM enrollment from 12,572 in 1991 to 26,849 in 2010.
- It increased the Bachelor of Science degree production from 1,709 in 1991 to 2,828 in 2010.
- It contributed to the national pool of Latino doctorates in natural sciences from 12.5% to 24% and in engineering from 18% to 21%.
- It increased the number of STEM PhD degrees awarded in the University of Puerto Rico systems from nine in 1991 to 52 in 2009—more than a fivefold increase. The Houston alliance has followed suit in more than doubling its STEM enrollment and degrees awarded in its 19-year existence as the Puerto Rico and other five original alliances have set the standard after more than 25 years as LSAMP participants.

The Houston alliance is the youngest LSAMP consortium in the state of Texas. The Texas A&M University System Louis Stokes Alliance Minority Participation (TAMUS LSAMP) program is a conglomerate of three universities: Texas A&M University, Research I institution; Prairie View A&M University, an HBCU; and Texas A&M University Corpus Christi, an HSI. It is the oldest LSAMP alliance in the state and also includes community colleges throughout the state of Texas. Its enrollment has increased from 2,782 since its inception in 1991 well over 15,000 STEM degree recipients by 2017. The average first-year freshman continuation rates for URM science, engineering and math students at all three institutions improved to 75% by 2010. TAMUS LSAMP supports international experiences for its students by exposing them to work with people of other cultures. Students have had learning experiences in Spain, Brazil, Costa Rica, Mexico, and Singapore. All three institutions use undergraduate research as a strategy to encourage LSAMP students to pursue graduate degrees. Three hundred seventy-five students have participated in faculty-mentored research and had their research results published.

TAMUS LSAMP hosted its sixth Bridge to the Doctorate cohort in 2010. Students are also being developed for possible academic careers in higher education. In Cohort I, 90% of the fellows completed doctoral degrees, with 40% currently serving in academia. Thirty-three percent of Cohort II, 16% of Cohort III, 58% of Cohort IV, and 100% of Cohort V pursued doctoral degrees. Ten of the TAMUS BTD participants received PhDs in that Cohort in 2011. (LSAMP Publication, 2011). The Houston alliance has a Bridge to the Doctorate program as well as Research Experience for undergraduate students.

The University of Texas system LSAMP is not one of the original six alliances; however, it has been a participant since 1992, making it the second oldest LSAMP alliance in the state and Houston the youngest alliance. Next is a look at the UT LSAMP system and how Houston fits in

with this alliance, followed by the impact of the Western Alliance to Expand Student Opportunities (WAESO LSAMP). WAESO is the last of the six original LSAMP alliance participants since 1991.

The University of Texas system (UT LSAMP) is comprised of nine universities and five community colleges. The total enrollment of URM STEM students in all UT system universities grew from 8,367 in 1991 to 17,593 in Fall 2009. Likewise, the number of undergraduate STEM degrees awarded to underrepresented minorities has grown substantially from 564 in Fall 1991 to 2,004 in Fall 2009.

- In the first five years it received federal funding (1992 to 1997), the alliance started an initiative that promoted the participation of URMS in STEM baccalaureate programs at all nine UT system institutions and created partnerships with community colleges partnered to recruit future STEM majors. Through combined multi-institutional efforts, there was an increase in URMS who received STEM degrees from 564 to 881 per year during these five years.
- In the second phase of receiving federal funding (1997-2002), the alliance started to implement practices that encouraged its graduates to pursue STEM degrees at the master's level. The number of master's degrees awarded to URMS from 2000-2002 grew from 96 to 135 per year.
- In its third phase (2002-2007), UT LSAMP shifted its focus toward doctoral degree enrollment and attainment by underrepresented minority groups. During these five years, the number of PhD degrees awarded to minorities increased from 15 to 33. This phase also introduced the Bridge to the Doctorate (BD) project which allowed the alliance to support 34 PhD-bound students.

- The fourth phase of UT LSAMP from 2007-2012 maintained the focus on doctoral degree enrollment but also re-established the community college connection. Additionally, a new goal was established to include some of the UT LSAMP scholars in international travel opportunities following their research experiences. In Fall 2009 total URMS enrollment in STEM bachelor's, master's, and doctoral programs was at an all-time high of 18,692. In the same semester, 2254 URM students received STEM degrees. Of these, 34 were PhD degrees. This is all according to the Louis Stokes Alliances for Minority Participation (LSAMP) partnership publication (2011-2012).
- Meanwhile, the Houston-LSAMP program has awarded nearly 12,759 baccalaureate URMS STEM degrees from 1999-2015—1,219 masters and 355 PhDs (NSF & Houston-LSAMP Alliance Impact Report, 2015).

The Western Alliance to Expand Student Opportunities (WAESO) is the last of the six original LSAMP alliances profiled in this section. Arizona State University is the lead institution of WAESO with participating colleges and universities in Arizona, New Mexico, western Texas, California, Utah, Nevada, and Colorado. As with the other alliances, WAESO has also significantly increased the number of URM STEM graduates during their fourth phase of federal funding from the National Science Foundation in the years 2006 to 2011.

- At the end of year one (2006 to 2007), WAESO reported 1,376 URM STEM BS degrees awarded, which is an increase over its baseline value of 1,315.
- At the end of the second year (2007 to 2008), WAESO reported that they increased STEM BS degrees awarded to URMS to 1,591—an increase of 21% over the initial baseline after two years.

- In its third year (2008 to 2009), WAESO said they increased their graduation rate to 1,940 STEM BS degrees awarded annually to URM students. This is a 48% increase over the baseline value after three years.
- In its fourth year (2009-2010), WAESO reported increasing their graduation rates to 2,323 URM STEM BS degrees annually. This is an increase of 69% over the baseline value.
- LSAMP/WAESO activities as well as Houston-LSAMP in which students participate include:
    - peer study groups
    - summer bridge programs
    - faculty-directed undergraduate research projects
    - graduate preparation institutes, mentoring, and research presentation

Now that we've looked at how Houston fits in with the other enduring alliances, we will see its success as an individual alliance.

The Houston alliance is being lauded as a shining example to the nation as significantly increasing minority student participation in STEM since it started receiving funding in 2000 (Drew & Bonsangue, 2011). The University of Houston (central campus) and Texas Southern University are the past and current LSAMP participating lead institutions. H-LSAMP consists of University of Houston-Downtown, central campus, University of Houston-Clear Lake, Texas Southern University, Texas State University, Houston Community College, San Jacinto Community College, and the Houston independent school district. Figure 1 below is a timeline chart of the Houston alliance participants.

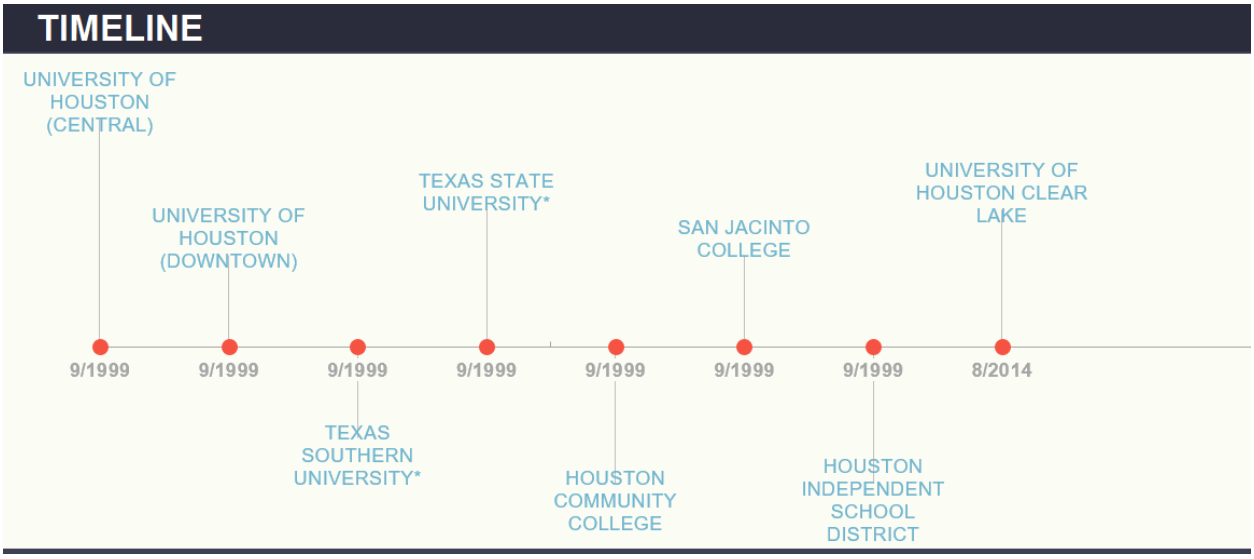

Figure 1. Timeline of Houston Alliance Participants

**William Marsh Rice University and University of Houston Victoria are former members of the Houston alliance and are not on this chart. They joined Houston-LSAMP in 1999 and left the alliance in 2015. University of Houston Victoria campus made some changes in terms of downward expansion and did not match the goals of the grant proposal for Phase IV (2014 to 2019). Rice University was never a funded partner of the proposal and when Alliances for Graduate Education and the Professoriate (AGEP) programs moved, that university's relationship with LSAMP dissolved (C. Cassidy, personal communication, April 13, 2017). AGEP's primary goal is also to significantly increase the number of underrepresented minorities in STEM and enhance the preparation of underrepresented minorities for faculty positions in academia (www.nsfagep.org retrieved July, 24, 2017).*

**Texas Southern University and Texas State University are the current co-leads of the alliance as of 2013 and 2015 respectively, while University of Houston (central) is the original and former lead institution. University of Houston Downtown is another campus in the University of Houston system. It is located in an urban, poor section of Houston while the central campus is located in the heart of the city in the business district.*

Bonsangue and Drew's work in Houston combined process evaluation with outcome evaluation. In other words, they examined the ongoing implementation of the funded activities and provided feedback to the directors involved with giving information on whether the objectives have been achieved. The Houston consortium's goal was to double the number of minority STEM graduates in a five-year period along with the goals of the National Science

Foundation. Here are the results of the Houston alliance from the baseline year 1999-2010: 495, 697, 608, 794, 749, and 818.

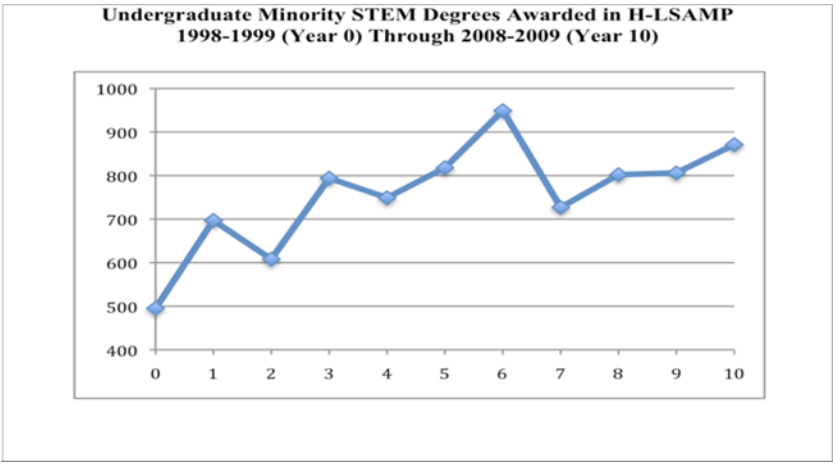

Figure 2. Undergraduate Minority STEM Degrees Awarded H-LSAMP 1998-2008

First, there is a steady increase in the number of degrees awarded over time. Second, there is a "picket fence" effect, in which alternate years are either higher or lower. Bonsangue and Drew say they have seen this picket fence effect in other STEM degree data. The pattern of alternating higher and lower productivity seems real and may have to do with the availability of required advanced courses for STEM majors.

Assuming a linear increase at the rate of 20% per year, the total number of minority STEM degrees necessary for doubling in the five-year period was 3,960. The actual number awarded was 3,666, or 92.6% of the expected number.

Bonsangue and Drew retrieved data from the U.S. Department of Education and made a longitudinal comparison, and found that the growth in degrees awarded to the Houston minority students in science and engineering was *double* that of the national growth rate of STEM degrees awarded to underrepresented minority students.

During this same period (1998-99 to 2003-2004), the total number of bachelor's degrees awarded to African American students in STEM disciplines increased from 14,212 to 18,887, a growth rate of 32.9 %, while bachelor's degrees awarded to Hispanic students increased from 9,892 to 13,262, a growth rate of 34.1 % (U.S. Department of Education, 2001, 2005). Again, while these national numbers are encouraging, the Houston-LSAMP rate of growth was essentially twice that of the national average.

According to the authors, the Houston-LSAMP used four strategies to make their alliance productive. They are 1) extensive recruitment, 2) constant mentoring, 3) creating a peer culture of student support aimed at academic excellence, and 4), engaging the community colleges and tapping the talent of people often from poverty who begin their college education at a community college. There are personal testimonies under each of these categories which showcase the success of the Houston alliance, most of which provide the testimonies of students raised in poor neighborhoods who thought college was out of their reach, much less a STEM degree.

The Houston alliance is called a "Model for the Nation." While there are testimonies and data to illustrate the success of this consortium, as part of LSAMP's 30-year history it is worth looking at how the two lead institutions—University of Houston (central campus) and Texas Southern University—institutionalize innovation and plan for leadership succession with staff changes and pending retirements. LSAMP has actually changed the organizational dyamics at Texas Southern University, and the program has had to adapt to the changes at University of Houston. Both institutions are connected to each other in the alliance. I have visited both campuses to observe and conduct interviews with faculty, staff, and LSAMP administrators. While there is literature on LSAMP administrators, little is said about its history on both

campuses, its institutionalization process, and its leadership succession. University of Houston was the lead institution of H-LSAMP since its inception in 1999 until 2013 and Texas Southern has been the lead institution since that year. The following section looks at studies that apply the diffusion of innovation theory.

Studies About Diffusion of Innovation Theory

As mentioned in Chapter 1, diffusion is the process by which a new practice (an innovation) is communicated over time among members of a social system (Rogers 1995, 2003). It is a process consisting of four stages: 1) dissemination, 2) adoption, 3) implementation, and 4) maintenance (Rohrbach, 1993). Each stage includes processes for how the innovation (such as the Houston-LSAMP) is integrated into standard practice. During dissemination, administrators are made aware of such programs and are encouraged to adopt them. During adoption, administrators form attitudes toward the intervention (recruitment and retention strategies to increase URMS in STEM majors), and commit to initiate the program (LSAMP). During implementation, practitioners begin to use the innovation. Re-invention (changing or modifying an innovation) is especially likely at this stage. Finally, during maintenance or sustainability, the innovation moves from implementation to institutionalization. At this phase, administrators and practitioners make a commitment to continue or discontinue use of the program (Dingfelder & Mandell, 2011). To reiterate, the purpose of this study was to examine how the Houston-LSAMP institutionalized its academic workshops using the diffusion of innovation theory.

Program Components of H-LSAMP

The following details three program components identified in the Houston-LSAMP alliance and then discusses aspects of leadership. The program components are recruitment strategies, in-class pedagogy, and enrichment activities outside the classroom.

1) Recruitment strategy entails the following processes: Houston Prep, Community outreach, and Cougar Connection (described below).

Houston Prep is a pre-freshman enrichment program (PREP), a summer enrichment program for middle and high school students hosted by the College of Sciences and Technology at the University of Houston-Downtown. Houston PREP is designed to encourage students in economically and socially disadvantaged population groups into careers in STEM. Community Outreach is a program in which LSAMP directors and administrators visit high schools in the Houston area to speak to and encourage students about the LSAMP program when applying to colleges. They also visit the homes of prospective students and meet with parents and other family members to pitch the program. LSAMP directors call feeder schools to get a list of names of prospective students to join the program once in college (governing board meeting, personal communication, April 1, 2016; B. Brown, personal communication, April 13, 2017).

Cougar Connection is an open house event for University of Houston faculty, staff, and administrators to connect with admitted African American students and their parents. The university hosts a dinner event to give current LSAMP students the opportunity to share their experiences and reasons why these newly admitted students should choose the University of Houston and the LSAMP program (B. Brown, personal communication, April 13, 2017).

2) In-class pedagogy entails the following structures to be examined: Summer Bridge program, Scholar Enrichment Program (SEP), and Academic Excellence Peer Led/Team Led workshops.

Summer Bridge Program is a six-week program for incoming freshmen accepted into the LSAMP program that prepares them for the rigorous STEM curriculum when they start full-time in the Fall semester. When Summer Bridge participants were compared to students with similar

backgrounds outside of the program, the Summer Bridge participants performed better than the students in the nonparticipating group, passing more credit hours and earning a high overall term GPA. The Summer Bridge 2014 students also earned higher average course grades in Calculus I, Biology, and Chemistry.

The Scholar Enrichment Program (SEP) is the University of Houston's component of H-LSAMP that was established in 1992 for the academic enhancement and retention of undergraduate students majoring in STEM. SEP creates collaborative learning communities for students at risk of dropping out or not completing their course work.

Academic Excellence workshops are taught by professors and student facilitators in STEM subjects. The workshops focus on calculus, physics, chemistry, and biology—subjects that have traditionally high student failure rates. Students gain support through peer tutoring, research experiences, study centers, and mentor programs. In Fall 2014, SEP workshop enrollment was 734 students in 36 different workshops. In Spring 2015, the workshop enrollment was 736 (Houston-LSAMP Alliance Impact Report, 2015).

Outside Classroom Enrichment Activities include the following structures to be examined: Research Experiences for Undergraduates, Real World International Experiences, and summer research internships.

Research Experiences of Undergraduates (REU): The Cullen College of Engineering (CCoE) at the University of Houston hosts a Research for Undergraduates (REU) program for 10 weeks in summer. Student participants earn a $5,000 dollar stipend to work closely with leading materials engineers at CCoE and contribute to cutting-edge research in materials for sustainability in energy and manufacturing. Students at the University of Houston-Downtown present posters and deliver presentations on their findings at the Student Research Conference on

campus. This encourages them to participate in National Research Conferences and creates an interest in graduate programs.

Texas Southern University LSAMP students participate in conferences and internships at NASA, and the (National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCCHE). LSAMP scholars present their abstracts for poster or oral presentations. LSAMP students get to present their research in cities such as New Orleans, Orlando, Washington, D.C., San Diego, and others. They also participate in the American Chemical Society national meeting and the Emerging Researchers National Conference in STEM (ERN).

Real World International Experiences allow LSAMP students to conduct scientific research abroad now that the Houston alliance has expanded its partnerships internationally. Students are required to complete four continuous weeks of research or 12 credit hours of courses after they complete a preparation program.

- Texas State University LSAMP partners with universities in China, Indonesia, and Cambodia.
- Texas Southern University LSAMP partners with Beijing Jiaotong University.
- University of Houston (central) partners with universities in Cyprus, Mexico, Taiwan, Czech Republic, India, Vietnam, and the Philippines.
- University of Houston (Downtown) partners with universities in Poland.

Summer Research Internships is an outside classroom enrichment activity that includes LSAMP students completing internships at NASA-Johnson Space Center, Center for Disease Control, Department of Energy, National Institute of Standards and Technology, Food and Drug Administration, Google, and Intel, as well as local and out-of-state universities (C. Cassidy,

personal communication, April 13, 2017; H-LSAMP Alliance Impact Report, 2015; H-LSAMP Senior Alliance Evaluators Site Visit Presentation compiled by Tolbert, M., March 31, 2016).

Following is the timeline for when each component was started in the Houston-LSAMP Program (Houston-LSAMP Alliance Impact Report, 2015; H-LSAMP Governing Board Meeting, April 13, 2017; B. Brown, personal communication, May 16, 2017)

- Houston Prep: 1989 to present
- Scholar Enrichment Program & Academic Excellence Peer Led/Team Led workshops: 1992 to present
- Community Outreach and Cougar Connection: 1999 to present
- Summer Bridge: 1999 to present
- Summer Internships: 1999 to present
- Research Experiences for Undergraduates (REU): 1999 to present
- Real World International Experiences: 2014-2015 academic year to present

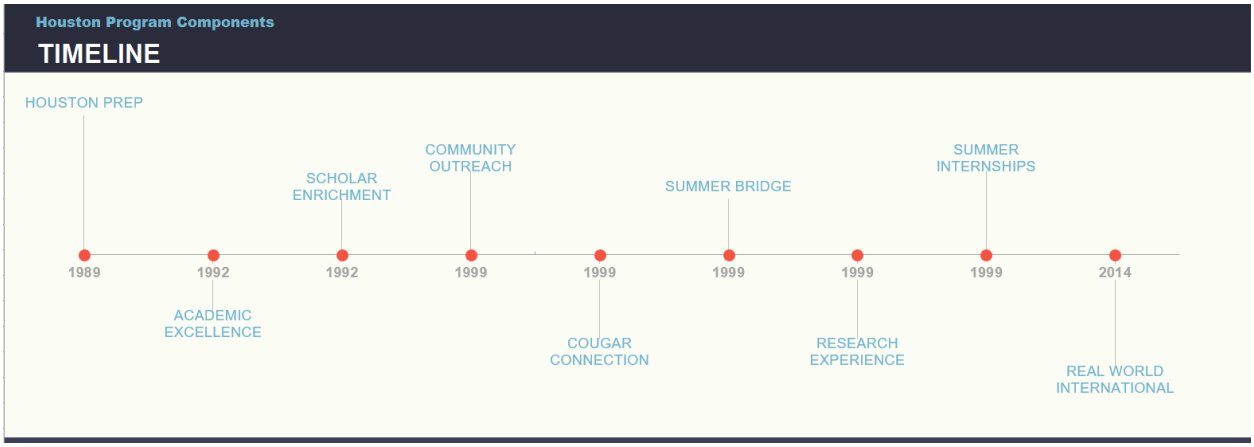

Figure 3. Timeline of Houston-LSAMP Program Components: Recruitment Strategies, In-Class Pedagogy, Outside Class Enrichment

With the above components identified as well as when they started, the following explains the impact of leadership, organizational dynamics, and inter-organizational dynamics on the said program. Although this is not the focus of this case study, it is important to explain how

these factors can influence the institutionalization of the LSAMP workshops. It takes people to disseminate, adopt, implement, maintain, and ultimately institutionalize a program. Therefore, it is important to explain the relationships among the LSAMP participants as well as different units at their own organizations.

What role did leadership play in the institutionalization of the above components and their processes described of the Houston-LSAMP?

Two aspects of leadership are transactional leadership and transformational leadership (Piccolo & Coloquitt, 2006). Transactional leadership involves the development of a reward system that recognizes excellent performance. Employees, for example, are willing to extend extra effort toward the goals of LSAMP because they know the leaders will reciprocate with rewards such as bonuses, pay raises, and promotions. Bennis & Nanus (1985) suggest that managers are people who do things right, but leaders are people who do the right thing. Transformational leaders, on the other hand, encourage workers to transcend their own self-interests for the sake of the team, university, or larger society. These leaders don't just stick to the status quo—they are agents for change.

What role did organizational dynamics play in the institutionalization of these processes within the components mentioned above?

Before we answer this question, let's define organizational dynamics. Organizational dynamics are changing aspects, underlying forces, or undercurrents between different groups or units within the same institution or organization; in this case, college or university (Bess & Dee, 2008; Hellriegel, Slocum, & Woodman, 1995). Organizational dynamics can also be called intra-organizational dynamics. One aspect of organizational dynamics is continuity—definitely an element required for effectiveness. LSAMP and similar programs are guided by long-term goals; success for a year or two is not good enough. Turnover in personnel, particularly in the area of LSAMP coordinators, was a liability for the general program (Gafney, 2010). Throughout the

life of the national LSAMP program (not Houston), there has also been considerable transition in the representatives to both the academic and evaluation groups. The program is complex, encompassing not only science and engineering departments but also the financial aid offices, admissions, and external grants. Changes in leadership presented additional challenges to maintaining continuity in the evolution of the program goals. In the best of circumstances, a university's bureaucracy is difficult to chart and navigate. Changes in one campus's program participants could create communication problems until the new representative learns about the program (Andrade, 2002).

This is what happened at the University of Houston, one of the two lead institutions in that city's LSAMP alliance. There was a huge turnover rate in the last several years, which caused a rocky transition (B. Brown, personal communication, February 16, 2016). Texas Southern University, the current lead institution in the Houston alliance, has a new president effective as of the fourth funding phase. The former president was not involved in the process of institutionalizing LSAMP, and if he could not dismantle the program, then LSAMP is here to stay (B. Wilson, personal communication, April 1, 2016). With these changes occurring at both lead institutions, it is worth considering if changes in leadership have deterred or facilitated the institutionalization of Recruitment strategies, In-Class Pedagogy and Outside Class Enrichment. Another aspect of organizational dynamics is values. Do the new leaders share the same values as the original leaders for LSAMP? Whether they were hired internally or externally in these Houston institutions can impact whether they shared the same feelings about the components of Houston-LSAMP. Like-minded leaders tend to be hired from within the actual institution, whereas someone hired from outside the university may have different goals for LSAMP (Brady & Helmich, 1984).

Another example of organizational dynamics can be the relationship between LSAMP at the University of Houston (central campus) and PROMES (Program for Mastery of Engineering Studies) at the same campus. LSAMP is housed in the College of Natural Sciences and Mathematics and PROMES is located at the Cullen College of Engineering. PROMES is a separate program from LSAMP, yet both have similar goals. PROMES' mission is to recruit and retain students of diverse backgrounds in engineering, while LSAMP's mission is to recruit and retain Black and Latino students in STEM (K. Zerda, personal communication, July 26, 2013). These are two programs at the University of Houston that collaborate and perhaps may have had conflicts over the same students, resources, goals, etc.

What role did inter-organizational dynamics play in the institutionalization of these LSAMP components?

Finally, it is worth mentioning how inter-organizational or alliance dynamics can influence the institutionalization of the processes of recruitment strategy, in-class pedagogy, and outside classroom enrichment activities. Inter-organizational dynamics are manifested in relationships between different organizations (colleges/universities) participating in the Houston alliance in contrast to organizational dynamics as described above. Change is inevitable during the process of institutionalization, continuous innovation, and leadership succession. Conflict often comes with change in any type of organization. Inter-organizational dynamics may consist of a group of colleges that are in competition for the same types of resources—students, research grants, prestige—and such interactions between these colleges can erupt into open conflict (Bess & Dee, 2008; Rahim, 2001). Texas Southern University, hypothetically speaking, could have been in conflict with other members of the Houston alliance such as Houston Community College about the amount of federal funding each institution receives from the National Science Foundation for outside classroom enrichment activities like the Research Experience for

Undergraduates, International Partnerships, and internships. Inter-organizational dynamics may also occur between the University of Houston (downtown campus) and other types of organizations such as community or neighborhood associations about the location of their new LSAMP research facility, which could have a negative impact on processes or structures of their in-class pedagogy.

Other examples of inter-organizational dynamics could include the fact that the Houston alliance had a failed grant application in 1997 before their proposal was accepted by the NSF in 1999 (C. Cassidy, personal communication, April 13, 2017). This was one factor that deferred the innovation and of course institutionalization of the entire Houston-LSAMP program. However, email messages from the external program evaluators clarified this point. The initial proposal by the University of Houston was not funded by the National Science Foundation. University of Houston together with Texas Southern University resubmitted the following year and the Phase I proposal was funded by NSF (M. Bonsangue, personal communication, June 13, 2017). "The PIs on the original proposal were all from the University of Houston. The reviewers/LSAMP management in Washington felt that a Texas Southern leader, specifically, Dr. _____, should have a prominent role in alliance management, since this is a national program about minority participation. That second proposal was funded when Dr. _____ became the PI" (D. Drew, personal communication, June 27, 2017).

Summary

Chapter 2 discussed studies about the underrepresentation of Black and Latino students in STEM majors. Policies and programs addressing the shortage of Black and Latino students in STEM were introduced, along with the history of LSAMP and the Houston alliance. The four stages of the diffusion of innovation theory were explained to frame this study and generate the research questions. Finally, program components of the Houston-LSAMP were identified and

explained followed by different types of leadership as we look at the institutionalization of the pipeline program, particularly the academic workshops.

Chapter 3 restates the research questions, the methodology that provides a design for this case study including how the research questions will be answered, details of the case institution or institutions of H-LSAMP, and how the data was collected and analyzed.

Chapter 3: Methodology

Qualitative Study

In an effort to understand how the Houston-LSAMP ensures sustainability through institutionalization and leadership succession, a qualitative method was employed for this study. A comparative case study of Houston-LSAMP documents was conducted, as well as observations and recordings. This is discussed in greater detail later in this chapter. Qualitative research, unlike quantitative research, gives in-depth understanding of how and why some strategies have worked to institutionalize and constantly innovate the Houston-LSAMP alliance over the past 20 years. The qualitative method delves into this LSAMP program that impacts people by connecting it to a theory such as the diffusion of innovation method and the information from the literature. Learning about people and the inner workings of their LSAMP environment can help me glean inclinations that paint broad strokes and lead to deep interpretation (Creswell, 2009). This study focuses on one core component of the Houston-LSAMP workshops. The Academic Excellence workshops started in 1992 at the University of Houston, and the Mathematical Excellence and the Chemistry Excellence workshops began in 1999 at Texas Southern University. These workshops are subcomponents of the in-class pedagogy aspect of the Houston-LSAMP program mentioned in Chapter 2. University of Houston and Texas Southern University were examined as the past and current leaders of the Houston-LSAMP alliance. Following is a restatement of the research questions.

Research Questions

1) How did the University of Houston and Texas Southern University institutionalize the central academic component of their LSAMP program—the Academic Excellence workshops—between 1992 and 2019?

2) How did past and current leaders (such as the Deans of the Colleges of Sciences at the University of Houston and Texas Southern University) become aware of this LSAMP program component and how was the program disseminated to their respective institutions (DOI-dissemination)?
3) In terms of adoption, what prompted these leaders to actually initiate these workshop programs? When did they take action and how did they get the program started (DOI-adoption)?
4) In terms of implementation, how did leaders re-modify the program over the years? What were the specific changes (DOI-implementation)?
5) Finally, in terms of maintenance, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of their respective institutions as reflected in staff job descriptions, budgetary lines, space allocation, curricula, and mission?

Following is a description of the elements of the Academic Excellence workshops.

Elements and Indicators of Institutionalization of Academic Excellence Workshops/Sources of Data

The subjects taught in the Academic Excellence, Mathematical Excellence, and Chemistry Excellence workshops are named in this section, as well as five indicators of institutionalization of these workshops. The institutionalization indicators are 1) funding, 2) facilities, 3) administrative titles/LSAMP staff job descriptions, 4) University of Houston and Texas Southern University mission statements, and 5) the curricula of the workshops.

The Academic Excellence workshops at the University of Houston are taught by student facilitators and consist of calculus, physics, biology, and chemistry. These subjects traditionally have high student failure rates (Houston-LSAMP Alliance Impact Report, 2015). Of the

subcomponents of SEP listed in Chapter 2, we will look at the institutionalization of the Academic Excellence workshops at the University of Houston (which pre-dated LSAMP, as they were started in 1992 along with SEP), and of the Mathematical Excellence workshops and Chemistry Excellence workshops at Texas Southern University (which began in 1999 at the start of the Houston-LSAMP alliance).

The Mathematical Excellence workshops are conducted during the academic year by the Associate Director of H-LSAMP at Texas Southern and full-time faculty. The subjects taught at these workshops are Pre-Calculus, Calculus and Differential Equations, and Discrete Mathematics. The Chemistry Excellence workshops are offered during the academic year and are also taught by full-time faculty members. They teach General Chemistry, Physical Chemistry, and Quantitative Analysis. LSAMP students from the University of Houston often go to Texas Southern to be tutored by the Associate Director of H-LSAMP on weekends, as the Academic Excellence workshops at the University of Houston are taught by student facilitators during the week (Houston-LSAMP Alliance Impact Report, 2015).

Written Questionnaire

The following people were interviewed via email for this study and were recorded during two Governing Board meetings attended by the researcher in 2016 and 2017. They were asked to answer the research questions:

The PI of H-LSAMP, Interim Provost and Vice President Academic Affairs at Texas Southern University, who apparently got the funding for the first proposal for LSAMP in 1999. He answered questions about changes made in the budget, space, and administrative titles of H-LSAMP at Texas Southern, as well as all four stages of DOI which ultimately lead to institutionalization.

The Associate Director of H-LSAMP at Texas Southern and instructor of the Mathematical Excellence workshops, facilitated these workshops from the start and has hence assisted in getting them institutionalized. He answered questions about what changes were made in the workshops during the implementation stage of DOI. The H-LSAMP Program Coordinator/STEM Recruiter at Texas Southern University, who was recruited by the PI and director and has been involved with H-LSAMP since the beginning. She answered questions about the dissemination stage of DOI: recruitment strategies for the program, adoption, implementation and maintenance, and ultimately institutionalization of the workshops. (She provided me with a history of the Houston alliance).

The original and current H-LSAMP external evaluators were interviewed. They do annual on-site visits and evaluations of each participating institution, and have written books and reports in addition to delivering PowerPoint presentations. They evaluate the entire alliance and it was not clear if they could answer specific research questions about the workshops—the sole component of H-LSAMP being studied.

The LSAMP and SEP Program Director at the University of Houston, who worked as the sole person operating SEP and oversaw the Academic Excellence workshops at this campus since 2002. She can answer questions regarding funding, space, and administrative titles for this aspect of LSAMP.

The current Associate Dean of the College of Mathematics and Natural Sciences at the University of Houston does NOT have LSAMP in his job description. (It is not clear at this juncture whether he has been instrumental in obtaining funding for the program.)

Although the University of Houston was the original lead institution in 1999, there have been leadership changes for the LSAMP component. It was interesting to see how solid these

academic workshops are compared to workshops at Texas Southern University (TSU), the current lead institution. The (TSU) LSAMP leadership has been more stable whereas, the University of Houston has experienced changes in staff due to retirement and job changes.

Now that we've looked at the workshop component of the former and current lead institutions of the Houston-LSAMP, the following links these components to the diffusion of innovation theory. The variables related to the program to be examined include four stages (as mentioned in Chapter 2): dissemination, adoption, implementation, and maintenance (Rohrbach, 1993). Following is a brief explanation of the four stages, particularly the difference between the adoption and implementation stages.

Each stage includes processes for how the innovation (such as the three workshops) were integrated into standard practice. During dissemination, administrators are made aware of such programs (workshops) and are encouraged to adopt them. During adoption, administrators form attitudes toward the intervention (recruitment and retention strategies to increase URMS in STEM majors), and commit to initiate/try these workshops on both campuses. During implementation, practitioners begin to use the innovation on a regular basis. Re-invention (changing or modifying an innovation in the Academic Excellence, Mathematical Excellence and Chemistry Excellence workshops) is especially likely at this stage. Finally, during maintenance or sustainability, the innovation moves from implementation to institutionalization. At this phase, administrators and practitioners make a commitment to continue or discontinue use of these workshops in the Houston-LSAMP program (Dingfelder & Mandell, 2011). The following introduces the case study design, data collection types, and rationale.

Case Study Design and Data Collection Types

This case study explored the Houston-LSAMP program in terms of the workshops in the former and current lead institutions. The study looked at their sustainability and

institutionalization over the past 20 years in the context of leadership succession. To better understand how sustainability fits in with the concept of institutionalization, the difference between the two is defined and explained. Sustainability means to prolong or keep up; a synonym for sustainability is maintenance. Maintenance means to persevere, keep up, carry on, or sustain. Institutionalization means to incorporate into a structured and often highly formalized system. Based on the research questions above, this study sought to answer how and when the Academic Excellence workshops, Mathematical Excellence workshops, and he Chemistry Excellence workshops were incorporated or institutionalized into the fabric of the University of Houston and Texas Southern University. Indicators of institutionalization of these workshops include how these workshops are funded, how space is allocated, the job descriptions of those in workshop leadership positions, the workshop curricula, and the mission statements of both universities.

This case study included collecting multiple sources of data, including the alliance's grant proposal submitted to the National Science Foundation in 2014, the Houston Alliance Impact Report of 2015, external evaluators' site visit presentations (2016 and 2017) , the NSF's report of the LSAMP alliance's success (2011), recordings and reports of two governing board meetings (2016 and 2017), and a PowerPoint presentation delivered by the LSAMP program coordinator and recruiter at Texas Southern University.

Data was collected in the field on the site of the Houston-LSAMP participants—the University of Houston (central campus), and Texas Southern University. This up-close information was gathered by emailing research questions to principals and observing their behavior within their context. The questions were asked of Houston-LSAMP leaders and

participants over time as previously stated. The advantages and limitations of each data collection type used in this qualitative study were as follows.

Observation

I will be a participant and observer in two governing board meetings. The leaders of each of the Houston-LSAMP institutions knew I would be there as a researcher. I had two advantages: 1) I had firsthand experience with the participants, and 2) I was able to record information in the meetings as it occurred. One limitation to observing and recording the governing board meetings was that the presence of a recorder may have affected responses.

Governing Board Meetings

Governing board meetings were at Texas Southern University, the current lead institution of the Houston-LSAMP, every April. They were conducted at the New Science Center for one morning from 11 a.m. to 1 p.m. with the Interim Provost, Vice President for Academic Affairs, and Houston-LSAMP Principal Investigator residing. The agenda of the governing board meeting included the following:

1) Principal Investigator explained why LSAMP is a worthy program.
2) Associate Director of Research Advancement, University of Texas Medical Branch in Galveston presented a history of the success and overview of the Houston Louis Stokes Alliance for Minority Participation Program.
3) External Program Evaluator since the beginning of H-LSAMP and Professor of Education and Joseph B. Platt Chair in the Management of Technology, Claremont Graduate University discussed how H-LSAMP is a national role model.
4) External H-LSAMP Program Evaluator since the beginning and Professor of Mathematics, California State University Fullerton talked about the highlights of each year and progress towards institutionalization.

5) Open discussion and plans for the next annual governing board meeting were facilitated by H-LSAMP Director and PI. Each LSAMP director or coordinator of each participating institution discussed their individual LSAMP progress and plans moving forward.

Documents

The type of data collection for this comparative case study included grant proposals, 2015 Houston Alliance Impact Report, external evaluators' and Texas Southern Program coordinator/STEM Recruiter's PowerPoint presentations, Houston-LSAMP program evaluations, and recordings and observations of two governing board meetings. The data did the following: 1) enabled me to obtain language and words of participants; 2) was accessible at a time convenient to me—an unobtrusive source of information; 3) represented thoughtful data in that participants gave attention to compiling them; 4) as written evidence, saved me the time and expense of transcribing; and 5) reduced or even eliminated the chances of inaccuracies or misinterpretation. (Creswell, 2009). One possible limitation was that the document material collected may have been incomplete.

Actual Data to Be Collected

As explained in this chapter, the three indicators of institutionalization of the workshops were funding, space, and administrative titles. The variables to be examined in this study included the four stages of the DOI theory linked to the impact of funding, space, and leadership job descriptions on the Academic Excellence workshops—the main focus of the Houston-LSAMP in this study. Here is a breakdown of the variables.

1) **Funding.** Looked at through the four stages of the DOI theory, particularly how it was disseminated and how it was started, changed, and maintained throughout the existence of these workshops. I looked for the location of the financial budget in the

grant proposal to the NSF, and the location of the operating budget. What percentage of the funding is located in the institutional operating budget for University of Houston and Texas Southern University versus the percentage of the funding in the annual grant budget?

Data Sources: Grant proposals Phase I through Phase IV (1999-2019) and PowerPoint presentation by the LSAMP Coordinator/STEM Recruiter at Texas Southern University.

2) Facilities. I looked at the facilities allotted over the years, the workshop location changes, the desirability of these locations, the amount of space and its exclusivity (whether it is shared with another department or owned by the LSAMP program), permanent locations, and how the space was funded for these workshops. I took this variable through the four stages of the DOI theory as well. Where was the space over the years? Where did they move the LSAMP space and when?

   Data Sources: Grant proposals from Phase I through Phase IV (1999-2019) and 2015 Houston-LSAMP Impact Report.

3) Houston-LSAMP administrative titles—job descriptions at University of Houston and Texas Southern University (the former and current lead institutions). I examined how job descriptions and administrative titles changed over the years from the innovation/dissemination to the adoption stage, to the implementation and finally maintenance stage to their current institutionalization stage.

   This information was collected during nearly 20 years of the H-LSAMP (1999-2018). I looked at the changes in the job descriptions from the last four phases of NSF funding: Phase I (1999-2004), Phase II (2004-2009), Phase III (2009-2014), and

Phase IV, the current funding phase (2014-2019). How much funding do these jobs get, what space is allotted for the LSAMP administration at both institutions, and how have the job descriptions and responsibilities regarding the workshops changed over the years? When was LSAMP added to their job descriptions (if it wasn't there from the beginning dating back to 1999)? What are the responsibilities between the LSAMP administrator and the actual academic department they serve? Is LSAMP part of the faculty workload or is it overload? (LSAMP at Texas Southern has been consistent since 1999; however, there has been more of a turnaround at University of Houston over the years. I suspected LSAMP at Texas Southern University is more stable and has a stronger form of institutionalization, and that University of Houston's institutionalization of LSAMP might be more fragile). The large turnover rate, changes in job descriptions, and the fact that the workshops at University of Houston are run by student facilitators, whereas the Mathematical and Chemistry Excellence workshops at Texas Southern are run by the Associate Director of LSAMP and full-time professors, support this notion. Also Texas Southern is an Historically Black College and University (HBCU), whereas University of Houston is not. It is a large public research university and a Hispanic Serving Institution (HSI)—a system that consists of the central campus, downtown campus, Clear Lake campus, and Victoria campus (former member).

Data Sources: Grant proposals from 1999-2019, interviews of LSAMP employees, Houston Alliance Impact Reports, presentations at governing board meetings (2016 and 2017), *STEM the Tide* by external evaluators Dr. David Drew and Dr. Martin

Bonsangue, National Overview of LSAMP Alliances by National Science Foundation.

4) **Mission Statement**. Is LSAMP included in the mission statement at both universities?

5) **Curricula.** I looked at how the curricula of the Academic Excellence, Mathematical, and Chemistry workshops have changed from 1999 to 2019. How has they evolved and gone through the steps of the diffusion of innovation theory?

Data Sources: University websites, grant proposals, Texas Southern and University of Houston-LSAMP administrator inquiries.

Table 1.

Indicators of Institutionalization, the Data They Yield, and Data Sources

Indicators of Institutionalization	**Data Sought**	**Data Sources**
Funding	1) Location of the financial budget. I looked for the location of the operating budget. What percentage of the funding is located in the institutional operating budget for University of Houston and Texas Southern University vs. the percentage of the funding in the annual grant budget? How has the budget for LSAMP changed over the years?	**Data Sources:** Grant proposals Phase I-Phase IV (1999-2019), PowerPoint presentation by LSAMP Coordinator/STEM Recruiter at Texas Southern University.

Space	2. I looked to see if space was permanently allocated to LSAMP at both institutions. I will looked at the quality of the space and how desirable it is. Square feet and if it is exclusive to LSAMP or shared with another department. Where was the space over the years? Where did they move the LSAMP space and when?	**Data Sources:** Grant Proposals from Phase I-Phase IV (1999-2019); 2015 Houston-LSAMP Impact Report.
Job Descriptions	3. I looked to see if the LSAMP is mentioned in any of the job descriptions of the administrators, and in whose. When was LSAMP added to job descriptions (if it wasn't there from the beginning dating back to 1999). What are the responsibilities between the LSAMP administrator and the actual academic department they serve? Is LSAMP part of the faculty workload or is it overload? LSAMP at Texas Southern has been consistent since 1999; however, there has been more of a turnaround at University of Houston over the years.	**Data Sources:** Grant proposals from 1999-2019 and questions asked of the current LSAMP project coordinator at University of Houston. (LSAMP records were not carefully monitored during the early 2000s at this institution as they were at Texas Southern). Found out what happened and how they got back on track with keeping job descriptions. How effective were these job descriptions? Did the LSAMP administrators actually practice their LSAMP responsibilities, or was the title in name only?

	Suspect LSAMP at Texas Southern University is more stable and has a stronger form of institutionalization; University of Houston's institutionalization of LSAMP might be more fragile. Due to the large turnover rate, changes in job descriptions, and the fact that the Academic Excellence workshops are run by student facilitators, whereas the Mathematical and Chemistry Excellence workshops at Texas Southern are run by the Associate Director of LSAMP. Also Texas Southern is an HBCU, whereas University of Houston is not. It is a large public research university—a system that consists of the central campus, downtown campus, and Clear Lake and Victoria campuses (former member).	
Mission Statements	**4)** Is LSAMP included in the mission statement at both universities? How important is LSAMP to the actual universities even though it is	**Data Sources**: University websites, grant proposals, inquiries of LSAMP administrators at Texas Southern and University of Houston.

	institutionalized? Have the universities as a whole embraced LSAMP, or is it independent of the actual mission of University of Houston and Texas Southern?	
Curricula	**5)** How have the curricula changed at these Academic, Mathematical, and Chemistry Excellence workshops over the years?	**Data Sources:** Sample syllabus for each workshop

The five dependent variables were funding, facilities, job descriptions, mission statements, and curricula. The Academic Excellence, Chemistry Excellence, and Mathematical Excellence workshops were the independent variables. This study looked at how funding, facilities, job descriptions, and curricula for LSAMP administrative personnel along with University of Houston and Texas Southern University mission statements have been impacted by all three workshops, which are components of the Houston-LSAMP alliance. The data was obtained from the documents and sources mentioned above.

Data Analysis and Interpretation

The process of data analysis involved making sense out of the text and image data in the said documents. It was an ongoing process of asking analytical questions, writing memos throughout the study, making interpretations, and writing reports on the analyzed H-LSAMP documents. This case study involved a detailed description of the setting or individuals followed by analysis of themes or issues (Stake, 1995; Wolcott, 1994). Analyzing the data from collected documents and recordings from the two governing board meetings were emphasized in the

following steps: 1) **Organize and prepare data for analysis.** This involved optically scanning material for computer entry, typing up field notes, and sorting and arranging data into different types depending on the documents. 2) **Read through all the data.** I needed to get a general sense of the data and reflect on its overall meaning by creating a description of the institutionalization process. I explained how the Academic Excellence workshops went through the four stages explained in the diffusion of innovation theory process, hence reaching the institutionalization stage and becoming embedded into the fabric of both University of Houston and Texas Southern University. 3) I started the detailed analysis with a coding process by organizing the material into chunks or segments of text before attaching meaning to the information (Rossman & Rallis, 1998). I took text data or pictures gathered during data collection, segmenting sentences or paragraphs into categories and labeling those categories with a term. 4) I generated a description of the categories or themes for analysis. I identified modes in terms of words used consistently in the data when describing funding, space, job descriptions, mission statements, and curricula. This analysis was useful in designing detailed descriptions for the case study. 5) I made an interpretation or meaning of the data collected from the documents and recordings of governing board meetings. I asked myself, "What were the lessons learned?" The interpretation of the data came from comparing the findings with the information gleaned from the literature or diffusion of innovation theory. The interpretations suggested new questions that need to be asked about the institutionalization of the Houston-LSAMP alliance and the specific workshops over time. The interpretation of the content of the collected documents may call for action agendas for change (Creswell, 2009).

Summary

Chapter 3 detailed the methodology for this study. It consisted of a content analysis, observations and written questions of Houston-LSAMP leadership, as well as the rationale for

the individuals chosen for this study. Elements of the focal point of the Houston-LSAMP—the Academic Excellence workshops at the former and current lead institutions (University of Houston and Texas Southern University, respectively) of the alliance—were explained, as well as the data sources and content of data collected. The independent and dependent variables were identified as they relate to the institutionalization process using the diffusion of innovation theory as a framework. Data analysis and interpretation of that data were included. A chart showing the indicators of institutionalization—funding, space, job descriptions, and mission statements—was also explained.

Preview of Chapter 4

Chapter 4 of this study consists of the findings. It answers the research questions mentioned in Chapter 3 and includes the sources of the data. Chapter 4 also has an interpretation of the data and a description of the themes of analysis. The themes of analysis were the five indicators of institutionalization: funding, facilities, job descriptions, mission statements, and curricula for the Academic Excellence LSAMP workshops at University of Houston and Texas Southern University. There is a comparative case study of the University of Houston, a Carnegie research tier-one public university, and Texas Southern University, an Historically Black College and University.

Chapter 4: Findings

This chapter answers the research questions shaped by the conceptual framework—the diffusion of innovation theory. The questions were framed by the four stages of DOI: 1) dissemination/awareness, 2) adoption/trial, 3) implementation, and 4) maintenance. The analysis of the maintenance stage was operationalized with five indicators of institutionalization: 1) funding, 2) facilities, 3) job descriptions, 4) curricula for the LSAMP workshops at University of Houston and Texas Southern University, and 5) mission statements. This case study compared the findings for the University of Houston, a Carnegie research tier-one public university, and Texas Southern University, an Historically Black College and University. Finally, it examines the impact of leadership on the institutionalization of the LSAMP workshops—a core, central academic component of this federally-funded program.

This chapter is organized into the following sections:

- A restatement of the research questions
- An explanation of the data collected and its application to the diffusion of innovation theory
- An explanation of the findings for the University of Houston based on diffusion of innovation theory (fourth stage of DOI operationalized via an empirical analysis of multiple dimensions of institutionalization)
- An explanation of the findings for Texas Southern University based on diffusion of innovation theory
- An explanation of the findings for Texas Southern University based on operational indicators of institutionalization factors

- An explanation of leadership changes at UH that could impact LSAMP workshops and the entire program
- An explanation of leadership at Texas Southern University which impacts LSAMP workshops and the said program
- An interpretation of the findings that describes what the results mean for this federally-funded academic component (workshops) of a small and large institution of the Houston-LSAMP

The research questions that were addressed in this case study are reiterated below. The questions focus on two processes: institutionalization of these workshops and how leadership succession impacted them at these two lead institutions.

Restatement of Research Questions

1) How did the University of Houston and Texas Southern University institutionalize the central academic component of their LSAMP program—the Academic Excellence workshops(between 1992 and 2019?
2) How did past and current leaders (such as the Deans of the Colleges of Sciences at the University of Houston and Texas Southern University) become aware of this LSAMP program component and how was the program disseminated to their respective institutions (DOI-dissemination)?
3) In terms of adoption, what prompted these leaders to actually initiate these workshop programs? When did they take action and how did they get the program started (DOI-adoption)?
4) In terms of implementation, how did leaders re-modify the program over the years? What were the specific changes (DOI-implementation)?

5) Finally, in terms of maintenance, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of their respective institutions as reflected in staff job descriptions, budgetary lines, space allocation, curricula, and mission?

Explanation of Data Collected and Applied to the Diffusion of Innovation Theory

Data was collected during 2017 and 2018. It covers almost 20 years of the H-LSAMP's existence: 1999 to 2018. The data includes interviews, emails, printed documents, reports, and grant proposals to the National Science Foundation that are constructed in a narrative of the diffusion of innovation theory. It documented the changes in the four stages of the DOI theory from four phases of NSF funding: Phase I (1999-2004), Phase II (2004-2009), Phase III (2009-2014), and Phase IV, the current funding phase (2014-2019). These four (DOI) stages are dissemination/awareness, adoption/trial, implementation, and maintenance of the Academic Excellence workshops at the University of Houston and the Mathematical and Chemistry Excellence workshops at Texas Southern University. The maintenance stage of the DOI theory serves as a springboard to the five indicators of institutionalization. To reiterate the difference between maintenance and institutionalization to explain how the former fits in with the concept of the latter, maintenance means to keep up, prolong, sustain, or persevere. Institutionalization, on the other hand, means to incorporate into a highly formalized, structured system. Operational indicators of institutionalization of these workshops include how these workshops are funded, the facilities allocated, the job descriptions of those in leadership positions pertaining to the workshops of the Houston alliance, the workshop curricula, and the mission statements of both universities. These institutionalization factors are examined in a later section of this chapter. I will now take the LSAMP workshops at the University of Houston through the four stages of the DOI theory.

Explanation of Findings for the University of Houston
Based on Diffusion of Innovation Theory

As this study attempted to answer these questions at both the former and current lead institutions of the Houston-LSAMP, we will look at a timeline of the stages of the diffusion of innovation model at the University of Houston. The stages of the LSAMP workshops are 1) dissemination/knowledge of the workshops, 2) adoption/trial of the workshops, 3) implementation of changes to the workshops, and 4) maintenance of the workshops. There was a time span of six to seven years from the time the workshops were first introduced and administrators were made aware of them (disseminated) at the University of Houston (1992) until it was actually adopted into the College of Natural Science and Mathematics (1999) when the grant proposal to the National Science Foundation was accepted (trial and implementation). The workshops have been maintained (federally funded) since 1999 up to and including the present date.

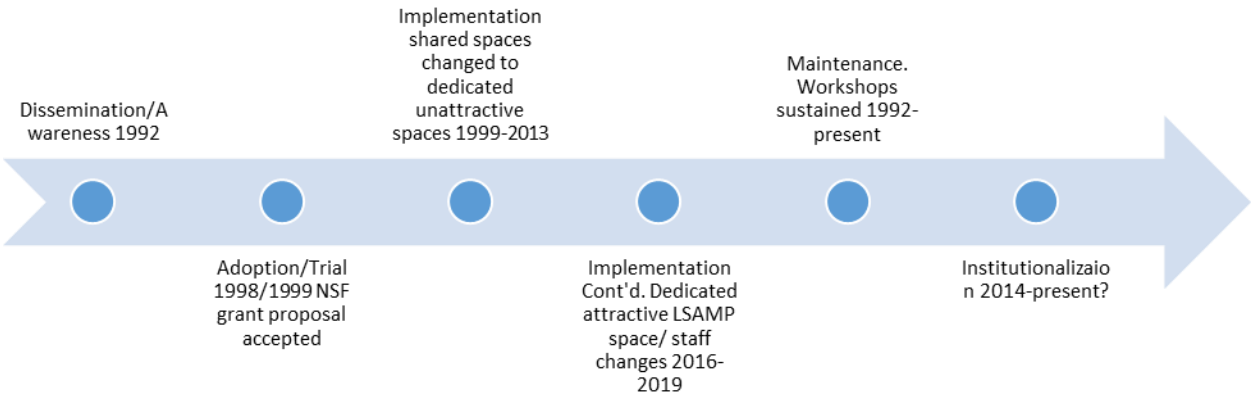

Figure 4. Diffusion of Innovation Timeline, University of Houston-LSAMP Workshops

Each stage is initiated in sequence; however, the activities within that stage continue as developments move to subsequent changes in the sequence. The phase continues, and by the time

the fourth stage is reached, activities in all four stages of the DOI theory are operating concurrently although their precise contours may have changed (see Table 2 below). For example, the dissemination/awareness stage extends throughout all four funding phases, with the exact form of dissemination changing slightly in terms of audience. The decision to adopt and try the LSAMP workshops are seen as the NSF continues to fund the LSAMP workshop and programs and changes were being implemented during the last 20 years. The workshops have been maintained and preserved for two decades. They were institutionalized as they were being federally funded since 1999, and as of 2013 during the third funding phase, space was dedicated specifically for the LSAMP workshops.

Table 2.

University of Houston Table 2—DOI Model of LSAMP Workshops

Diffusion of Innovation Stage	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
Dissemination	**Treisman-like workshops pre-dated LSAMP workshops in 1992 with PROMES**	**Recruits sought to join LSAMP workshops**	**LSAMP external evaluators publish book, *STEM the Tide* about LSAMP**	**LSAMP CO-PI publishes article about shortage of minority STEM faculty/promoting workshops**
Adoption/Trial	**Grant proposal to NSF to start LSAMP submitted and accepted**	**Second grant proposal to NSF to continue LSAMP submitted and accepted**	**Third grant proposal to NSF to continue LSAMP submitted and accepted**	**Fourth grant proposal to NSF for LSAMP continuation accepted**
Implementation	**LSAMP workshops held in shared outdated classrooms**	**LSAMP workshops include biology, calculus, chemistry**	**LSAMP workshops held in basement of building, dedicated but unattractive**	**LSAMP workshops held in dedicated 6,000-square-foot attractive facility**

Diffusion of Innovation Stage	Phase I, 1999-2004	Phase II, 2004-2009	Phase III, 2009-2014	Phase IV, 2014-2019
			facility	
Maintenance	10-20 workshops held per semester	Workshops increase to 20-25 per semester	Workshops increase to 30-40 per semester	Workshops increase to 40-50 per semester

Answers to Research Questions

1) How did past and current leaders (such as the deans of the College of Natural Sciences at University of Houston) become aware of this LSAMP program component and how was the program disseminated to their institution (DOI-dissemination)?

   Answer: Dissemination. Past and current leaders of the Houston-LSAMP first became aware of the effectiveness of the workshops through an Engineering Pipeline National Conference held in Houston in 1992 and sponsored by the ARCO Foundation. A professor at the Cullen College of Engineering at the University of Houston was the organizer and founder of its groundbreaking PROMES (Program for Minority Engineering Students). He presented the Scholar Enrichment Program (SEP) pilot and results of the workshops at this conference. The LSAMP manager at the University of Houston emailed a typed version of this 1992 report (B. Brown, personal communication, October 17, 2018). The external evaluators did not attend this conference because it pre-dated the start of the LSAMP program, and PROMES is not a part of LSAMP (although it can be seen as a forerunner).

The PROMES professor explained that minority students had high failure rates in mathematics, calculus, and physics. However, he found that they excelled when put into group studies and peer-led/team-led workshops. He modeled his calculus workshops after the Treisman

math and science workshops established in 1978 at the Berkeley campus at the University of California. Calculus workshops at the University of Houston showed that students participating in those workshops outperformed their peers who did not participate in the said academic component. The results from the Fall of 1990 are as follows:

Fall 1990 Calculus I Workshop

The lecture section into which PROMES students were clustered had 112 students, 23 of whom were PROMES students in the special workshop. The effectiveness of the workshop is best seen by a comparison of final grades in the lecture course.

Table 3.

Distribution of Final Grades, PROMES Students, Fall 1990

	Workshop Students	Rest of Class
A	26.1%	9%
A to B-	60.8%	22.3%
A to C-	83%	34.6%

A comparison of PROMES students enrolled in the workshop with minority students taking Calculus I that semester but not enrolled in the workshop is also interesting.

Table 4.

Distribution of Final Grades in Calculus I, Minority Students, Fall 1990

	Workshop Students	Other Minority Students
A	26.1%	3.3%
A to B-	60.8%	33.2%
A to C-	83.0%	56.6%
Avg. SATM	543	544

Most of the students in the Calculus I workshop continued on to Calculus II in the spring and attended the Calculus II workshop *under the same workshop leader* with comparable results.

Table 5.

Distribution of Final Grades, Calculus II Students, Spring 1991

	Calculus II Workshop Students	Rest of Class
A	39%	11%
A to B-	72%	25%
A to C-	94%	43%

The professor made the following observation: "One should not infer, however, that the mere existence of a workshop will inevitably result in this kind of magic. Workshops are very sensitive to training and personality of the workshop leader, who has to be able to really get groups to work together; to guide students having difficulty with a tough problem; to integrate a few 'loners'; and to deal successfully with the occasional bright student who resents having to help a weaker one" (Paskusz, 1992; B. Brown, personal communication, October 17, 2018). The professor concluded that the usefulness of the Treisman workshops in the PROMES program was beyond dispute. Some elements pre-dated the program including Houston PREP (1989), which recruited students interested in STEM from local middle and high schools into the LSAMP program, along with the Academic Excellence workshops that started as part of SEP in 1992.

It is important to note that dissemination has continued throughout the 20-year existence of the LSAMP workshops.

This stage does not just end at the first funding phase as indicated in Table 2 above. Dissemination/awareness of these workshops continued by seeking recruits, the publication of a book profiling the program by its external evaluators, and publication of an article by the Co-Principal Investigator of LSAMP promoting the program and discussing the shortage of minority STEM faculty at University of Houston. Based on these findings, the dissemination/awareness

stage of the DOI theory started internally with the introduction of the Treisman-like workshops in the PROMES program, and extended outside of the university by recruiting at local middle and high schools and publication of a book and an article by the external evaluators and Co-PI.

2) Adoption. What prompted these leaders to actually initiate these workshop programs at University of Houston? When did they take action and how did they get the program started (DOI-adoption)?

   Answer: Adoption/Trial. It was in 1992 that the professors and associate deans at the College of Natural Science and Mathematics at the University of Houston adopted the Treisman workshops that became the Academic Excellence workshops, and produced similar successful results. These professors and associate deans eventually became the executive directors of the Scholar Enrichment Program (SEP) and then LSAMP, as well as Co-PI of the Houston-LSAMP in the late 1990s and early 2000s (B. Brown & J. Hardy, personal communication, July 25, 2013).

Current and past leaders at the University of Houston experienced the success of these workshops after seeing them flourish at the PROMES program. The mission of LSAMP is to increase the graduation rate of URMS in STEM majors. Once these workshops continued to grow along with graduation rates for Black and Latino students, the Houston-LSAMP leaders submitted a grant proposal to the National Science Foundation. This began the federal funding process as showcased in Table 2 above. To an extent, this stage during the second funding phase can be considered implementation, and eventually maintenance as changes and additions to grant proposals were made and the NSF continues to fund it. Based on these findings, the DOI stages are not purely sequential, but rather nonsequential.

3) Implementation. How did they re-modify the program over the years? What were the specific changes that were implemented (DOI-implementation)?

Implementation. Specific changes were made to the program when the Summer Bridge program (1999), Internships (1999), Research for the Undergraduate (1999) and Real World Experience (2014) were added. (These LSAMP components are explained in greater detail in Chapter 2.) The program has been federally funded since 1999 in various amounts (see Table 6--University of Houston chart on institutional indicators below). The Houston alliance had a failed grant application in 1997 before their proposal was accepted by the NSF in 1999 (C. Cassidy, personal communication, April 13, 2017). This was one factor that deferred the innovation and of course institutionalization of the entire Houston-LSAMP program. However, email messages from the external program evaluators clarified this point. The initial proposal by the University of Houston was not funded by the National Science Foundation. University of Houston together with Texas Southern University resubmitted the following year and the Phase I proposal was funded by NSF (M. Bonsangue, personal communication, June 13, 2017). The PIs on the original proposal were all from the University of Houston. The reviewers/LSAMP management in Washington felt that a Texas Southern leader—specifically, the director of the Houston-LSAMP who served as interim president and provost—should have a prominent role in alliance management because this is a national program about minority participation. The second proposal was funded when the director of H-LSAMP became the PI (D. Drew, personal communication, June 27, 2017).

4) Maintenance. Finally, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of the University of Houston as reflected in staff job descriptions, budgetary lines, curricula, space allocation, and mission?

   Answer: Maintenance. These workshops have not only been sustained but also have become a part of the organizational fabric of the University of Houston. There is an institutional budget for the workshops, as the university has paid each student facilitator $3,000 per semester since the beginning of LSAMP in 1999 and $400,000 to date in support of the workshops (B. Brown, personal communication, November 17, 2018). There have been approximately four paid student facilitators per semester who have come and gone for the past 20 years. This maintenance stage is reflected in the institutionalization factors of the workshops. As shown in Table 2, the number of workshops has increased over the years. Expanding or increasing the number of workshops is a phase in the institutionalization process (Zida, Lavis, Sewankambo, Kouyate, & Ouedraogo, 2018). Those factors in addition to how the workshops are funded include facilities allocated, job descriptions of LSAMP employees, curricula of the workshops, and mission statements of the colleges which sponsor the LSAMP workshops. This leads us to questions that identify the operational indicators of institutionalization.

The following questions identify the operational indicators of the institutionalization factors:

- **Funding**: How much money did the University of Houston and Texas Southern University receive during each funding phase? Are they receiving more money now

than they did during the first funding phase? Are they increasing the number of workshops and receiving less money?

- **Facilities**: How have the facilities for the workshops changed during the four funding phases? Can the space be categorized as temporary or dedicated? How large is the space in terms of the number of square feet? How attractive is the space (old basement, or new and well-equipped)?
- **Job descriptions**: Is the LSAMP program explicitly identified in job descriptions of administrators (project coordinator, recruiters, managers)?
- **Curricula**: How many workshops are conducted every semester? How many students are served?
- **Mission**: How have organizational mission statements changed during the four funding phases? Do they mention LSAMP, diversity, or minorities? Are the words *LSAMP*, *diversity*, or *minorities* mentioned in the mission statement of the actual college/departmental unit in which the LSAMP program is located?

This study has attempted to answer these questions in the following chart and narrative.

Table 6 is divided into the five institutionalization factors along with subrows during the four federal funding phases. They are:

1) **Funding.** Sub-rows include NSF funds for the whole alliance, NSF grants to the University of Houston, and the university's financial contribution to the LSAMP workshops.
2) **Changes in facilities.** Sub-rows include size, location and quality, and shared/proprietary LSAMP workshop space.

3) **Job descriptions.** Sub-rows include principal investigator and their status in the organization, percentage of jobs dedicated to LSAMP, number of LSAMP program managers and their status in the organization, and the percentage of program managers' jobs dedicated to LSAMP.
4) **Curricula.** Sub-rows include the number of workshops, the number of students served, and the range of workshops.
5) **Mission statements.** The words *LSAMP*, *diversity*, and/or *minorities* are mentioned sporadically in the College of Natural Sciences and Mathematics and the university mission statements during the four funding phases.

Table 6.

University of Houston Institutionalization Indicators of LSAMP Workshops

Institutionalization Indicators	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**	
NSF Funding, Whole Alliance	**$4,263,500**	**$5,085,500**	**$3,500,500**	**$3,840,484**	
UH Portion of NSF Grant	**$850,000**	**$850,000**	**$850,000**	**$397,195**	
UH Funding	**$850,000**	**$850,000**	**$850,000**	**$395,000**	
Changes in Facilities	**Classrooms**	**Classrooms**	**Changed to basement of Fleming Bldg. CNSM**	**Changed to M.D. Anderson Library**	
Size	**Approx. 900 square feet**	**Approx. 900 square feet**	**2,000 square feet**	**6,000 square feet**	
Location/Quality	**Attractive classrooms**	**Attractive classrooms**	**Unattractive basement in Fleming Bldg. CNSM**	**Attractive location in M.D. Anderson Library**	
Shared/Proprietary	**Shared**	**Shared**	**Proprietary**	**Proprietary**	

Institutionalization Indicators	Phase I, 1999-2004	Phase II, 2004-2009	Phase III, 2009-2014	Phase IV, 2014-2019	
Job Descriptions (Involvement in LSAMP)	Phase I, 1999-2004	Phase II, 2004-2009	Phase III, 2009-2014	Phase IV, 2014-2019	
PI: Org. Level	Dean/ CNSM	Dean/CNSM	Assoc. Dean/CNSM	Assoc. Dean/CNSM	
No. of PM	4	3	3	2-1	
PM Org. Status	Exec. director/faculty 3 Prof. staff	Prof. staff	Prof. staff	Prof. staff	
Curricula	Phase I, 1999-2004	Phase II, 2004-2009	Phase III, 2009-2014	Phase IV, 2014-2019	
No. of workshops/students	10-20 workshops per semester, approx. 20 students served	20-25 workshops/ 20 students per workshop	30-40 workshops/20 students per workshop	40-50 workshops per semester, approx. 20 students per workshop	
Range of Workshops	2-3 fields	4 fields	4 fields	4 fields	
Mission statements mention diversity	No	Yes	No	Yes	
Mission statements mention LSAMP	No	No	Yes	No	
Mission statements mention minorities	No	No	No	No	

Explanation of Findings for the University of Houston Based on Operational Indicators of Institutionalization Factors

Question: Funding: How much money did the University of Houston receive during each funding phase? Are they receiving more money now than they did during the first funding phase? Are they increasing the number of workshops and receiving less money?

Answer: Funding. The institutionalization of the LSAMP comes into question during this current funding phase of the years 2014 to the present year due to the following three findings in Table 6. First, the University of Houston's portion of the NSF grant is now less than half of what it was when it was the leader of the LSAMP alliance ($850,000 per funding period compared to its current contribution to workshops of $397,195). The number of workshops have increased by the fourth funding phase, but the university is getting less money for them as shown in Table 6. The current associate dean of the College of Natural Science and Mathematics stated in an email that he had no access to the budget prior to the time he was hired in that role in 2016. He did state that the University of Houston budgeted $170,000 dollars per year for student support in the workshops when it was the lead institution in the alliance during the first three funding phases. It currently budgets only $79,000 per year for student support in the workshops because it is no longer the lead institution in the alliance. University of Houston matched the NSF investment for the workshop at a 1:1 ratio by the second funding phase, 2004-2009. This continued until Texas Southern became the lead institution in 2014 at the start of the fourth funding phase (A. Hamilton, personal communication, March 14, 2019).

Note: The researcher could not obtain specific information about how UH calculated its budget for the workshops during each funding phase, as it is proprietary information which cannot be shared. The LSAMP manager verified this when she checked with the former co-principal investigator of LSAMP (B. Brown, personal communication, March 3, 2019).

It was much easier to see how the facilities for the LSAMP workshops became more accommodating, which leads to the next question and answers based on the results of this study.

Question: Facilities. How have the facilities for the workshops changed during the four funding phases? Can the space be categorized as temporary or dedicated? How large is the space in terms of the number of square feet? How attractive is the space (old basement or new and well-equipped)?

Answer: The facilities for the workshops have changed from various classrooms on campus to the basement of the Fleming building in 2013 to their current 6,000-square-foot facility in the M.D. Anderson Memorial Library on campus. While there were variations in the number of square feet, the external evaluators gave an explanation about the previous facilities for these workshops at University of Houston. The workshops were in the basement of the Fleming building during the third phase of H-LSAMP (2009-2013). The space was approximately two standard (40-person) classrooms (M. Bonsangue, personal communication, December 18, 2018).

"We sent a letter to the UH administration … complaining about how offensive the physical facility was … about health hazards … and about the negative message all that sent to LSAMP participants … For years prior to that, the workshops were held in a set of contiguous (to each other) one story buildings that were old … similar to WW II era 'Quonset huts" … with fading paint and holes in some walls" (D. Drew, personal communication, December 4, 2018).

The workshops are currently in a wall-to-wall carpeted 6,000-square-foot area and instructed by student facilitators. Approximately 935 students are taught per semester and nearly 2,000 students per year are impacted via workshops and tutoring services. Workshops on ethics, finance, and other social issues are offered on all campuses and open to any student. The space

includes the SEP computer lab, two classrooms, four offices, and a large group study area. This begs the question of whether the LSAMP workshops would have been given more attractive spaces had the external evaluators not challenged the LSAMP staff. Would the LSAMP students have settled for the less attractive facilities described above? The dedication of LSAMP staff to the participants has also taken an interesting turn. This answer now leads us to the following questions and results regarding staff job descriptions.

Question: Job descriptions. Is the LSAMP program explicitly identified in job descriptions for either administrators (project coordinator, responsible administrator)? Have the number of LSAMP employees increased or decreased?

Answer: Job description. The following positions were explicitly identified in job descriptions as part of the LSAMP program during all four funding phases: Co-PI/Dean of CNSM, LSAMP Director/Associate Dean of CNSM, LSAMP Manager, and LSAMP Coordinator (B. Brown, J. Hardy, & J. Hall, personal communication, July 24, 2013; governing board meeting agenda, April 13, 2017). The number of full-time employees devoted to LSAMP has decreased from the first funding phase to its current funding phase. Table 6 shows that LSAMP had four full-time employees in Funding Phase I, then three program managers, and finally just two full-time employees in the fourth funding phase. One of those remaining full-time LSAMP managers retired in March of 2019, thereby leaving just *one* full-time LSAMP employee at the University of Houston central campus! (The decrease in UH funding for the workshops, number of full-time LSAMP employees, and omission in the college's mission statement could mean a gradual reduction of the LSAMP workshops or program). This signals that this federally-funded program could cease to be a priority or even exist.

Question: Curricula. How many workshops are conducted every semester? How many students are served?

Answer: Curricula have remained the same because syllabi describing course requirements for Calculus, Chemistry, and Biology have not changed. Copies of syllabi were emailed from the LSAMP program manager (B. Brown, personal communication, October 17, 2018). The number of Academic Excellence workshops has increased during each funding phase. The average number of workshops during the first funding phase from 1999-2004 was 10-15 per semester. The average number of workshops per semester increased to 20-25 during the second funding phase (2004-2009). A more precise breakdown is given in the following data for the third funding phase: Fall 2010: 26 workshops, Spring 2011: 29 workshops, Fall 2011: 32 workshops, Spring 2012: 34 workshops, Fall 2012: 38 workshops, and Spring 2013: 44 workshops. Currently 40-50 Academic Excellence workshops in STEM subjects are offered per semester in this funding phase (2014-2019), and approximately 740 students are served per semester (Houston Alliance Impact Report, 2015; Scholar Enrichment Program Overview, 2013). This could mean that while the number of LSAMP workshops increased, the Treisman-like workshops are constantly offered; thus the curriculum has not changed. If so, then how innovative are the current LSAMP employees? It appears they are simply maintaining the status quo and not reinventing the content of the workshops.

Could it be that the LSAMP workshops/program at University of Houston are at the beginning of the end? Are the current LSAMP staff phasing it out? Let's take a look at the change in its mission statement in answering the next question.

Question: Mission. How have organizational mission statements changed at multiple organizational levels during the four funding phases? Do they mention LSAMP, diversity, or

minorities? Are the words *LSAMP*, *diversity*, or *minorities* mentioned in the mission statement of the actual college/departmental unit in which the LSAMP program is located?

Answer: Mission. The mission of the Houston-LSAMP at the University of Houston is to increase URMS in STEM majors and increase the STEM graduation rates in those groups. Students of all nationalities are part of the Houston-LSAMP program. The words *diverse* and *LSAMP* were not mentioned in the university or College of Natural Sciences and Mathematics mission statements until the third funding phase. The exact wording of the mission statements in the first and second funding phases (1999-2004) and (2004-2009) were as follows:

1) To provide a rich learning environment in which students may pursue programs of higher education that will advance their career objectives while at the same time instilling a broad perspective of society, a sense of values which will foster responsible participation in civil and public affairs, and the motivation to continue to learn and grow intellectually throughout life.
2) To strive for excellence in the creation of new knowledge through the quality of its faculty and their creativity in research and scholarly activities, and through the quality of its academic programs, which integrate the knowledge of mankind into productive use and benefit (UH-course catalogue-NSM 1999-2009).

The word *LSAMP* is finally mentioned in the mission statement during the third funding phase (2009-2014).

Mission Statement
The College of Natural Sciences and Mathematics (NSM) is committed to excellence in teaching and research in the natural sciences and mathematics.

Academic departments within the college are: Biology and Biochemistry, Chemistry, Computer Science, Earth and Atmospheric Sciences, Mathematics, and Physics.

Because NSM faculty members are engaged in creation of new knowledge through research, they bring the latest information to their classrooms and teaching laboratories.

Departmental curricula and courses are designed to help students acquire appropriate content knowledge and develop well-honed critical thinking and scientific literacy skills.

NSM graduates are competitive in the job market, and students aspiring to graduate or medical school often have opportunities to participate in research with faculty members.

The college sponsors several academic support programs.
The Scholar Enrichment Program (www.sep.uh.edu) and The Houston-Louis Stokes Alliance for Minority Participation (www.hlsamp.uh.edu). These programs offer excellence workshops associated with certain core courses in mathematics, chemistry, and physics. Participation in these programs hones problem-solving skills for success in more advanced coursework, and facilitates mentoring relationships.
The Center for Academic Support and Assessment (CASA) provides tutorial services for students in lower level mathematics courses (UH-course catalogue-NSM 2012-2013).

The word *diverse* is mentioned in the college's current mission statement, but there is no mention of LSAMP.

Mission, Values, Vision

Mission

The College of Natural Sciences and Mathematics is committed to the success of our students, the pursuit of knowledge through fundamental and applied research, and continued engagement in community and professional service. The College is dedicated to cultivating an environment of intellectual growth and serving as a leader in innovative research.

Now that we have looked at the findings of University of Houston based on the DOI theory and institutionalization factors, we will now explain the findings at Texas Southern University based on the DOI theory.

Explanation of the Findings for Texas Southern University LSAMP Workshops Based on Diffusion of Innovation Theory

These findings are based on information obtained from documents about the Houston-LSAMP program, written emails from LSAMP leaders and external evaluators, and printed information and recordings from two governing board meetings in 2016 and 2017. Table 7 takes us through the four stages of the DOI theory. It is important to note that the four stages at Texas Southern University are *not* purely sequential. As indicated for the University of Houston, the stages once initiated continue. For example, the dissemination/awareness stage continues throughout the four funding stages as illustrated in the following timeline:

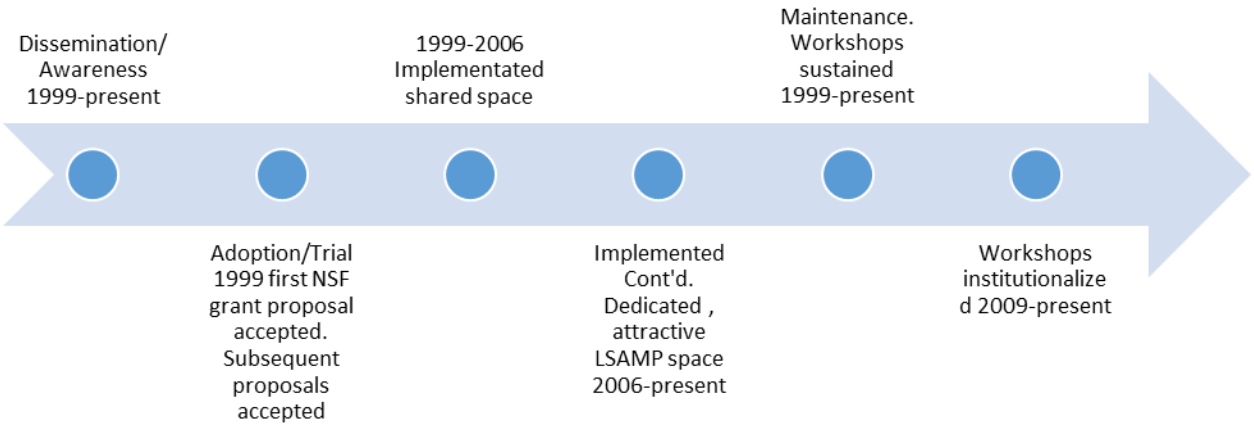

Figure 5. Diffusion of Innovation Timeline, Texas Southern University LSAMP Workshops

Table 7.

Texas Southern University DOI Model for LSAMP Workshops

Diffusion of Innovation Stages	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
Dissemination	**LSAMP associate director conducts workshops on weekends for ALL participants.**	**Recruits sought to join LSAMP workshops.**	**LSAMP external evaluators publish book entitled *STEM the Tide* about LSAMP.**	**LSAMP PI and STEM faculty promoting workshops through Research Experience for Undergrads and International research**
Adoption/Trial	**Grant proposal to NSF to start LSAMP submitted and accepted.**	**Second grant proposal to NSF to continue LSAMP submitted and accepted.**	**Third grant proposal to NSF to continue LSAMP submitted and accepted.**	**Fourth grant proposal to NSF for LSAMP continuation accepted.**
Implementation	**LSAMP workshops held in classrooms in Nabrit Building (approx. 800 square feet).**	**LSAMP workshops in dedicated 4,300-square-foot $35 million facility.**	**Texas Southern becomes leader of H-LSAMP.**	**Interim LSAMP executive director hired; changes to be covered in upcoming Steering Committee meeting.**
Maintenance	**Workshops conducted on weekends.**	**Workshops continue.**	**Workshops continue.**	**Workshops continue.**

Answers to Research Questions

1) How did past and current leaders (such as the deans of the College of Science, Engineering and Technology at Texas Southern) become aware of the LSAMP

program component and how was the program disseminated to their institution (DOI-dissemination)?

Dissemination/Awareness. The LSAMP associate director at Texas Southern University started tutoring students on weekends during the late 1990s. The external evaluators observed students from other Houston universities quietly coming to get help in math. This practice birthed the Mathematical and Chemistry Excellence workshops on that campus (Bonsangue & Drew, 2012; W. Taylor, personal communication, October 29, 2018). The LSAMP recruiter frequently visits local high schools to encourage these soon-to-be college students to join LSAMP, the external evaluators wrote a book profiling the Houston alliance entitled *STEM the Tide,* and LSAMP participants actually traveled to different cities and countries to present their scientific projects. This information was presented at two governing board meetings (B. Wilson, M. Tolbert, C. Cassidy, D. Drew, & M. Bonsangue, personal communications, April 1, 2016, April 13, 2017). The dedication of the LSAMP associate director and recruiter is indicative of current and past attitudes toward these workshops, as the answer to the next question further explains.

2) Adoption. What prompted these leaders to actually initiate these workshop programs at Texas Southern University? When did they take action and how did they get the program started (DOI-adoption)?

Adoption/Trial. The external evaluators of the Houston-LSAMP clarified in an email what prompted the LSAMP leaders to initiate the program and when. “The original grant proposal was rejected because all the principal investigators were all from the University of Houston. The LSAMP management at the National Science Foundation

felt that the Director of the Houston-LSAMP at Texas Southern and interim President and Provost should have a prominent role in the alliance since this is a national program about minority participation. When Dr. _____ became a PI in the next Proposal in 1999, that proposal was federally funded. That is what made the difference" (D. Drew, personal communication, June 27, 2017). This adoption/trial was continued or "maintained" during the last 20 years. However, Texas Southern did not simply maintain these workshops and the program. There were additions to better serve the LSAMP students, as seen in the answer to the question about implementation.

3) Implementation. How did they re-modify the program over the years? What were the specific changes (DOI-implementation)?

Implementation. Specific changes were made to the program when the Summer Bridge program, Internships, Research for the Undergraduate, and Real World Experience were added. These programs were explained in greater detail in Chapter 2. The program has been federally funded since 1999 for various amounts (see Table 8 Texas Southern University Chart below), and the facilities for the workshops have changed. The workshops moved from classrooms in a campus building to a dedicated 4,300-square-foot $35 million facility in 2006, during the second funding phase (Table 7 above and Table 8 below). Texas Southern University became the leader of the Houston-LSAMP alliance during the third funding phase in 2013 as the program continues to be maintained.

4) Maintenance. Finally, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of Texas Southern University as reflected in staff job descriptions, budgetary lines, mission, curricula, and space allocation?

Maintenance and Institutionalization. These workshops were sustained by integration into the organizational fabric due to the stable staffing at Texas Southern, its $35 million facility, and the fact that it is the current lead institution of the alliance and its mission has remained the same (see Table 8 below). Texas Southern University's undergraduate student enrollment of 7,967 shows that size matters in terms of different types of institutionalization. Texas Southern University, a small HBCU, has made the workshops and LSAMP a top priority from the beginning. It has its own center in the $35 million science building dedicated to just the workshops. The workshops at Texas Southern University are taught by full-time faculty members.

It is important to note that the workshops were institutionalized during the third and fourth funding phases (2009-present), as the amount of funding by Texas Southern University actually exceeds the funding from the National Science Foundation as shown in Table 8 below.

Next I look at the institutionalization indicators in the charts for Texas Southern University. Texas Southern University's commitment to the LSAMP program is evidenced by its own funding in support of the program in addition to federal funding (M. Tolbert, personal communication, May 11, 2018).

Table 8 is divided into the five institutionalization factors along with sub-rows during the four federal funding phases. They are:

1) **Funding.** Sub-rows include NSF grants to Texas Southern University and its financial contribution to the LSAMP workshops.

2) **Changes in Facilities**. Sub-rows include size, location and quality, and shared/proprietary LSAMP workshop space.
3) **Job Descriptions**. Sub-rows include Principal Investigator, their status in the organization, and the percentage of their jobs dedicated to LSAMP; the number of LSAMP program managers, their status in the organization, and the percentage of their jobs dedicated to LSAMP.
4) **Curricula.** Sub-rows include the number of workshops, the number of students served, and the range of workshops.
5) **Mission Statements.** The word *diverse* is mentioned in the university mission statement during the four funding phases but the words *LSAMP*, *minorities*, and *diversity* are *not* mentioned in the College of Science, Engineering and Technology mission statement, the unit that sponsors LSAMP. Houston-LSAMP, however, does have its own section when a search is conducted.

Table 8.

Texas Southern University Findings Based on Institutionalization Factors for LSAMP Workshops

Institutionalization Indicators	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
NSF Funding Texas Southern and State	**$884,852 $968,133**	**$1,229,319 $994,704**	**$745,592 $1,274,125**	**$350,601 $1,049,845**
Facilities	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
Size	**1,000 square feet**	**4,300 square feet**	**4,300 square feet**	**4,300 square feet**
Location/Quality	**Attractive; Nabrit Science Bldg.**	**Attractive; $35 Million Collaborative Learning Center**	**Attractive; $35 Million Collaborative Learning Center**	**Attractive; $35 Million Collaborative Learning Center**

Institutionalization Indicators	Phase I, 1999-2004	Phase II, 2004-2009	Phase III, 2009-2014	Phase IV, 2014-2019
Shared/Proprietary	**Shared**	**Proprietary**	**Proprietary**	**Proprietary**
Job Descriptions	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
PI/Org. Level	**Director of H-LSAMP**	**Acting President/Provost**	**Director of H-LSAMP**	**Interim Provost**
No. of PM	**3**	**3**	**3**	**4**
PM Org. Status	**2 faculty, 1 prof. staff**	**2 faculty, 1 prof. staff**	**2 faculty, 1 prof. staff**	**3 faculty, 1 prof. staff**
Curricula	**Phase I, 1999-2004**	**Phase II, 2004-2009**	**Phase III, 2009-2014**	**Phase IV, 2014-2019**
No. of workshops/students	**6 workshops per year, 20-25 students served per year**	**6 workshops per year, 20-25 students served per year**	**6 workshops per year, 20-25 students served per year**	**6 workshops per year, 20-25 students served per year**
Range of Workshops	**2 fields**	**2 fields**	**2 fields**	**2 fields**
Mission and diversity mentioned	**Yes**	**Yes**	**Yes**	**Yes**
LSAMP mentioned	**No**	**No**	**Yes**	**Yes**
Minorities mentioned	**No**	**Yes**	**Yes**	**Yes**

Explanation of Findings for Texas Southern University Based on Operational Indicators of Institutionalization Factors

Question: Funding. How much money did Texas Southern receive during each funding phase? Are they receiving more money now than they did during the first funding phase? Are they increasing the number of workshops and receiving less money?

Answer: Funding. Based on an email from the LSAMP program manager, Texas Southern University's institutional funding for the program including workshops increased from the first federal funding phase to the third funding phase. Their institutional amount dropped slightly in the fourth funding phase. The NSF gave TSU more than half a million dollars from 1999-2014. TSU only received approximately $350,000 from the federal government during the

fourth funding phase. While the funding from the NSF has now decreased, the university's financial contribution is greater than the federal funds, with more than a million dollars going toward the LSAMP program. This could indicate that the workshops and the LSAMP program are institutionalized at Texas Southern because the university can sustain the program and workshops when the federal funding goes away. This was the assessment of the NSF LSAMP national director, as stated in Chapter 1 during the introduction of the study (Abdul-Alim, 2012). The number of workshops and the number of students served at Texas Southern have remained the same over 20 years. Texas Southern is receiving less money from the NSF and has contributed more money to LSAMP than the federal government gave them for the program. TSU has outspent the NSF in every funding phase except the second funding phase (M. Tolbert, personal communication, May 18, 2018).

Question: Facilities. How have the facilities for the workshops changed during the four funding phases? Can the space be categorized as temporary or dedicated? How large is the space in terms of the number of square feet? How attractive is the space (old basement or new and well-equipped)?

Answer: Facilities. Texas Southern University changed its original facilities for their workshops from classrooms in the Nabrit science buildings (approximately 20 persons and 1000 square feet) to its $35 million Collaborative Learning Center in the science building. This has been the home of the Mathematical and Chemistry Excellence workshops since 2006. The 4,300-square-foot facility is equipped with 30 computers, printer, expo board two flat screen televisions, and capability for video conferencing. Students spend 15 hours a week in the lab working on assignments, studying for tests, and attending meetings. They also benefit from

graduate recruitment visits, internships, lecturers, and other invited guests (Houston-LSAMP Alliance Impact Report, 2015).

Question: Job Descriptions. Is the LSAMP program explicitly identified in job descriptions of either administrator (project coordinator, responsible administrator)?

Answer: Job Descriptions. The job descriptions for the PI varied, as he served as acting President and Provost of Texas Southern more than once during the life of Houston-LSAMP. One thing that hasn't changed however is his commitment to this federally-funded program, and he is a distinguished professor of chemistry. This PI really got the first grant proposal accepted back in 1999 and it has grown under his leadership. The associate director is a full-time faculty member of the Mathematics Department and is committed to LSAMP's success, still tutoring students from other Houston participants. The LSAMP program manager has also been a full-time employee for LSAMP since 1999 and continues to recruit students from local high schools to the program. The executive director joined the Houston-LSAMP program in 2018 as a professor of chemistry. The LSAMP staff is small, but has stayed the same without any change in leadership except the addition of the executive director. The following breakdown of the LSAMP employees' explicit job descriptions were emailed by the program coordinator:

> The LSAMP Director and PI has distinguished himself as a scientist, professor, department chair, principal investigator, provost, and served as Interim president in the past. His career has spanned over 42 years of dedication in teaching students of color at an HBCU. Earning a BS in chemistry from Alabama State University and an M.S. in chemistry from Southern University at Baton Rouge, he culminated his academic training with a PhD in chemistry from Michigan State University.

He has been a driving force in shaping academic science programs nationally, and he has served as a program director for the National Science Foundation. Holding memberships in numerous professional organizations, he is a fellow of the American Institute of Chemists, Texas Academy of Science, Sigma Xi, and The Scientific Research Society, National Organization for the Professional Advancement of Black Chemists and Chemical Engineers, and the American Chemical Society. He was a former chairman for the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers for several years. He presently sits on the board of the Texas Space Grant Consortium comprised of several Texas universities for NASA.

His combination of discipline, experience, and command of his subject area has enabled him to produce over one-hundred refereed publications in scientific journals and books. He holds three patents and is listed in several "Who's Who" publications. This LSAMP Director and PI has been instrumental in building the research component of the science programs at Texas Southern University. His efforts have generated over $100 million in research grants to the university. He was recently recognized by the AAAS with the "Lifetime Mentor Award" in Vancouver, Canada with a monetary award of $10,000.00. He recently was awarded in September 2018, the prestigious "Percy Julian Award" recognized at the 45th National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) Conference in Orlando, Florida. "The Percy L. Julian Award is given for significant contributions in pure and/or applied research in science or engineering and is NOBCChE's most prestigious award". "Dr. Julian was an African-American who obtained his BS in Chemistry from DePauw University in 1920. Although he entered DePauw as a "substandard freshman," he

graduated as the class valedictorian with Phi Beta Kappa honors. His first job was an instructor at Fisk University. Julian left Fisk and obtained a master's degree in chemistry from Harvard in 1928, and his PhD in 1931 from the University of Vienna, Austria. Dr. Percy Julian was elected in 1973 to the National Academy of Sciences" Source: NOBCChE Conference p. 53 (M. Tolbert, personal communication, October 31, 2018). The next section discusses the associate director's influence on the LSAMP workshops' mission and curriculum.

LSAMP ASSOCIATE DIRECTOR

He is a full professor in the Department of Mathematics and the TSU Associate Director for the LSAMP program. His career spans over forty years. He was the 1st black male to receive a PhD in mathematics from the University of Houston. He has had the strongest impact on the programs curriculum and mission. The Associate Director is legendary for coming to work on Saturdays to teach and tutor mathematics to the LSAMP scholars and other TSU students over the span of 20 years of the program. He does not get paid for this tutoring work on Saturdays. He does it because he loves helping students succeed. He works with the students one-on-one and challenges each one to do their best. As he always states "Mathematics is the Basis of all Knowledge." We will now look at the impact the program coordinator has on the workshops and the program itself.

LSAMP Program Coordinator

She recruits, advises, monitors the academic progress of each student; hold monthly meetings with the students, and other job duties as needed. She has maintained the mission and job descriptions of LSAMP. She helps the students with schedules, internship applications, conferences, and also engages the scholars to participate in

service learning projects in the community. She is responsible for the daily operations of the LSAMP Collaborative Learning Center, the LSAMP program and is required to prepare reports as needed for the National Science Foundation projects for TSU. Her position was institutionalized from the beginning, in 2000 showing a strong commitment by TSU.

Texas Southern University for each academic year sets aside approximately from $300,000.00 to $350,000.00 in scholarships awarded to LSAMP Scholars. The scholarships are institutionalized in the budget forecast for the university as are the LSAMP job descriptions and program at Texas Southern University (M. Tolbert, personal communication, May 11, 2018).

The following question addresses the change in curriculum.

Question: Curricula. How many workshops are conducted every semester? How many students are served?

Answer: Curricula have remained the same; there are two types of workshops: Mathematical and Chemistry Excellence workshops. There are no syllabi for the workshops at Texas Southern University, as stated in emails from the LSAMP program recruiter and LSAMP associate director (M. Tolbert, personal communication, October 31, 2018; W. Taylor, personal communication, October 29, 2018). The Mathematical Excellence workshops consist of Calculus and Differential Equations, Mathematics, and Pre-Calculus; the Chemistry Excellence workshops include General Chemistry I & II, Organic I, Physical Chemistry, and Quantitative Analysis (Houston-LSAMP Alliance Impact Report, 2015). Approximately 25 students are served in six workshops per semester.

Question: Mission. How have organizational mission statements changed at multiple organizational levels during the four funding phases? Do they mention LSAMP, diversity, or

minorities? Are the words *LSAMP*, *diversity*, or *minorities* mentioned in the mission statement of the actual college/departmental unit in which the LSAMP program is located?

Answer: Mission. The mission of the Houston-LSAMP at Texas Southern University is to increase URMS in STEM majors and increase the STEM graduation rates in those groups. Students of all nationalities are part of the Houston-LSAMP program. The mission of LSAMP at Texas Southern has remained the same, as well as the LSAMP leadership on that campus. The word *diverse* is mentioned in the mission statements during all four funding phases for Texas Southern University. Historical Black institution and underrepresented minorities were mentioned in the second, third, and fourth funding phases respectively at the College of Science, Engineering and Technology, the unit which sponsors LSAMP. The word *LSAMP* was mentioned in Texas Southern University's mission statement during the third and fourth funding phases (http://www.coset.tsu.edu/lsamp).

This concludes the explanation of the institutionalization factors on the LSAMP workshops. The following discussion explains the implications of these findings.

What Do These Findings Mean for the Institutionalization of This Federally-Funded Component of LSAMP at Small and Large Institutions of the Houston-LSAMP?

The University of Houston is a much larger institution than Texas Southern University, with an undergraduate enrollment of 38,348 encompassing different campuses and serving a more diverse population. Texas Southern University is a small Historically Black College with an undergraduate enrollment of 7,604. Its mission is to serve primarily the African American student population. Its cohesive unit allowed for stable leadership, mission, budgets, and staff compared to the frequent staff changes at the University of Houston. LSAMP staff at University of Houston is currently much smaller, although the institution is much larger (just the program manager runs it) compared to a slightly larger but more stable staff at Texas Southern University.

The smaller HBCU has apparently made the LSAMP workshops more of a priority compared to the larger university. This can be seen in the difference in space allocation, staff job descriptions, and missions. The funding is slightly higher at the University of Houston due to its size and resources, while the curricular components of the workshops are similar. The institutionalization of the workshops at Texas Southern University appears to be stronger and more stable compared to the institutionalization of the workshops at the University of Houston. The Houston-LSAMP is now in its 20th year. The question is, will the program survive for another 20 years at the University of Houston and, if so, how will it compare to the institutionalization of the program at Texas Southern University? This case study focused on the institutionalization of just *one* central federally funded academic component of the Houston-LSAMP. It begs the question of how the other components of this program were institutionalized. How were the Summer Bridge, Summer Internships, Research for Undergraduates, Real World International, and Bridge to the Doctorate components institutionalized not just at these two lead institutions, but also at the remaining participating universities of this alliance? There are so many layers to this alliance that it might warrant one case study for each component. Each participating institution has its own unique history of how the program was implemented. While most studies report the outcomes and effectiveness of such programs, very little is said or studied about the process of implementing them. With the full-time LSAMP staff at University of Houston now reduced to just one person on the bottom floor of the campus library building, although an attractive space, it does not appear to have a solid future compared to that of Texas Southern University which has carved out its own facility, maintained the same dedicated staff, and kept its mission and curriculum in place. University of Houston has institutionalized the workshops; however, they don't currently appear to be a top priority or as prominent as they once were compared to the

LSAMP program at Texas Southern. This shows that there are different levels or different degrees of institutionalization. A program can be maintained and streamlined; however, if it lacks organizational funding, allocated space, mission, job descriptions, and committed staff, it can easily be dismantled and therefore it is *not* considered to be institutionalized.

Summary

This chapter restated the research questions about institutionalization of the federally funded workshops of the Houston-LSAMP, explained the data collected, and provided charts of the institutionalization indicators at the University of Houston and Texas Southern University as well as LSAMP leadership changes at both campuses. The chapter included a discussion of the current state of the workshops, answers to the research questions, and an explanation of the findings. It concludes by inquiring what's next for the Houston alliance in the next 20 years and which form of institutionalization better serves URMS in STEM majors. Limitations of this study, conclusions, and recommendations for future studies are explained in chapter 5.

Chapter 5: Conclusion and Recommendations for Future Research

Chapter 5 provides a summary of the purpose of this study, its conceptual framework, research questions, and methodology. It then focuses on a discussion of research findings and implications for practice as leadership changes at both institutions. This chapter concludes with the limitations of the study and recommendations for future research on the institutionalization of the remaining components of the Houston-LSAMP alliance as well as other federally-funded programs.

Purpose of the Study

The study focused on the Houston-Louis Stokes Alliance Minority Participation Program. Its mission is to increase the number of underrepresented minority students in STEM majors. The National Science Foundation has been funding this program for the past 20 years. Studies have been conducted about its success; however, little has been said about *how* the program was formed and prospects for its future amid changes in leadership due to retirement and turnover of staff members. This study looked at the sustainability of LSAMP, specifically how one central academic program component—the Academic Excellence workshops—was institutionalized/ integrated by funding into the organizational life of each of the two lead institutions of the Houston alliance. This study examined how over time the Houston-LSAMP achieved sustainability through institutionalization of the pipeline program. Rogers' diffusion of innovation theory was the conceptual framework employed to frame this case study and formulate the research questions and subquestions. The institutionalization of the workshops at the University of Houston and Texas Southern University were studied as they are the respective past and current leaders of the Houston-LSAMP alliance.

Conceptual Framework

Four overarching elements of the diffusion of innovation theory served as lead-ins to the research questions. They were 1) dissemination, 2) adoption/trial, 3) implementation, and 4) maintenance/institutionalization (Rohrbach, 1993). The research questions included the following:

Research Questions and Answers

1) How did past and current leaders (such as the Deans of the Colleges of Sciences at the University of Houston and Texas Southern University) become aware of this LSAMP program component and how was the program disseminated to their respective institutions (DOI-dissemination)?
2) In terms of adoption, what prompted these leaders to actually initiate these workshop programs? When did they take action and how did they get the program started (DOI-adoption)?
3) In terms of implementation, how did leaders re-modify the program over the years? What were the specific changes (DOI-implementation)?
4) Finally, in terms of maintenance, how did these workshops become institutionalized; i.e., become a part of the organizational fabric of their respective institutions as reflected in staff job descriptions, budgetary lines, space allocation, curricula, and mission?
5) How did the University of Houston and Texas Southern University institutionalize the central academic component of their LSAMP program—the Academic Excellence workshops—between 1992 and 2019?

Methodology

This case study drew upon multiple sources of data including as the alliance's grant proposal submitted to the National Science Foundation in 2014, the Houston Alliance Impact Report of 2015, external evaluators' site visit presentations (2016 and 2017) and book entitled *STEM the Tide* (2011), the NSF's report about LSAMP alliances' success (2011), recordings and reports of two governing board meetings (2016 and 2017), and a PowerPoint presentation delivered by the LSAMP program coordinator and recruiter at Texas Southern University in 2018.

Data was collected from the Houston-LSAMP participants at the University of Houston (central campus) and Texas Southern University. This information was gathered by emailing research questions to LSAMP staff and observing their behavior within their context.

Discussion of Research Findings/Relevance to Previous Research

Diffusion of Innovation Theory

The LSAMP Academic Excellence workshops at the University of Houston and Texas Southern University were examined (viewed) through the diffusion of innovation stages. The findings are consistent with those of Rogers (1995, 2003), Rohrbach (1993), and Dingfelder and Mandell (2011). Both campuses experienced the four stages of this process in the institutionalization of the workshops as shown in table 2 and table 7. Administrators became aware of the workshops during the dissemination stage through the earlier Treisman-like workshops that pre-dated the LSAMP workshops at the University of Houston in 1992, and workshops were conducted on weekends at Texas Southern University. Students were then recruited to the workshops during the second funding phase. The external evaluators published a book entitled *STEM the Tide* during the third funding phase. This publication as well as an article published by the LSAMP co-PI on the shortage of URMS STEM faculty at the University of

Houston helped spread the word about the Houston-LSAMP workshops. Administrators also became more aware of the workshops through different components of LSAMP at Texas Southern University when the Research Experience for Undergraduates and International Research were launched in the fourth funding phase.

Administrators at both campuses decided to adopt these workshops as federal funding became available (and has persisted for the last 20 years). The workshops were implemented on both campuses as the facilities were changed, and eventually designated areas were built or assigned for LSAMP participants. Finally, the workshops have been maintained throughout the four funding phases, increasing in number and becoming embedded in the formal structure at both universities. Having applied the four stages of the DOI theory, this study sought to explain the difference between maintaining (the last stage of the DOI theory) and institutionalizing the LSAMP workshops.

Institutionalization

Maintenance means to persevere, keep up, carry on, or sustain. Institutionalization means to incorporate into a structured and often highly formalized system. The workshops are being maintained and institutionalized as these stages overlap. They have been conducted over the years (maintenance), and they have been institutionalized as funds and proprietary spaces are allocated. This study answered the research questions about how and when the Academic Excellence workshops, the Mathematical Excellence workshops, and the Chemistry Excellence workshops were incorporated or institutionalized into the fabric of the University of Houston and Texas Southern University. Indicators of institutionalization of these workshops include how they are funded, the space allocated, LSAMP employees' job descriptions pertaining to the workshops of the Houston alliance, workshop curricula, and the mission statements of both universities (Table 6 and Table 8). Both universities have institutionalized these workshops and

can fund them independently from the NSF. The senior program director of LSAMP at the National Science Foundation has called on university program administrators to create *sustainability plans* so that LSAMP can continue to thrive at their own institutions when the federal funding stops with the shifting of funds due to ongoing fiscal crises in American higher education. “They understand that the federal government didn’t intend to support such programs forever” (Abdul-Alim, 2012).

As detailed in Chapter 4, the two universities exhibited different forms of institutionalization of the LSAMP workshops. University of Houston experienced staff changes and changes in workshop facilities during the 20 years of LSAMP. The federal funding and the budget set aside by the university for the program and workshops remained relatively constant while it was the lead institution, until the fourth funding phase when Texas Southern became the leader of H-LSAMP. The decrease in federal funding as well as the decrease in staff may signal a need for significant intervention for the program and workshops to survive. However, it should be stated that although the workshops can continue, they might not necessarily serve LSAMP students. The University of Houston is about five times the size of Texas Southern. This might indicate that there are other priorities at UH which can curtail or undercut the continuance and growth of LSAMP.

Texas Southern University, on the other hand has maintained the same staff for the whole 20 years they have been LSAMP participants. They have an actual facility dedicated to LSAMP workshops and each of the three original staff members share the same vision. Texas Southern has been the lead institution of the alliance for more than five years and contributes more money than the NSF for the LSAMP program, thus there is a stronger cohesive unit to continue and build on the institutionalization of the workshops.

This teaches us that there are different degrees of institutionalization of the same program at different institutions, although they are all members of the same alliance. It also shows that decisions are not the same for STEM programs across the United States, particularly when it comes to increasing the number of URMS in STEM.

Implications for Practice

This study shows that as LSAMP staff members retire or move on, it is imperative to have managers who share the same vision for the program and stay wholly dedicated to the population it is designed to serve. The implication of practice is to hire staff who share the same vision for a program even though change is inevitable with time. Dedication to the target population of URMS is key for success, and that population cannot be neglected.

Comparing how the organizational cultures of the University of Houston and Texas Southern University shape institutionalization is twofold:

1) **Size Matters**. There is a huge difference in the sizes of the two universities. University of Houston's undergraduate student enrollment is 38,348 compared to Texas Southern University's undergraduate student enrollment of 7,967 (US News & World Report-Best Colleges, 2019; univstats.com, 2019; collegetuitioncompare.com, 2019). Since University of Houston's undergraduate student enrollment is more than five times larger than that of Texas Southern University, one can say that the size of an institution matters in terms of its mission to serve URMS in STEM. University of Houston is a public tier-one university, highest research activity institution elevated by the Carnegie Foundation for the Advancement of Teaching (www.uh.edu, 2011, 2016). University of Houston consists of an entire system with several campuses. They include the central campus (former lead of H-LSAMP), downtown campus, Clear Lake campus, and Victoria campus (former H-LSAMP participant). Large

institutions like University of Houston may have other priorities in serving such a huge undergraduate student population and therefore a different form of institutionalization of LSAMP (B. Brown, personal communication, February 18, 2019). Texas Southern University is a public HBCU with a much smaller undergraduate student body. Its mission is to enhance opportunities for the URMS body which they serve. They have the time to make LSAMP a top priority based on the facilities to accommodate these LSAMP workshops— a $35 million Collaborative Learning Center compared to a space on the bottom floor of the campus library building at University of Houston.

2) **Change versus Stability**. University of Houston had a major turnover of LSAMP leadership, as some of the individuals who enacted the Academic Excellence workshops and sought funding for them have retired, moved on, or passed away. Initially, University of Houston was the lead institution of the Houston alliance and its first grant proposal was rejected by the NSF. Federal funds were awarded to this alliance when the original (and still current) principal investigator at Texas Southern University wrote the grant proposal in 1999. Houston is still getting federal grants today. It is believed that the PI at Texas Southern University is the constant driving force of the Houston-LSAMP. An email from external program evaluator David Drew clarifies this point (D. Drew, personal communication, June 27, 2017).

This is not to say, however, that the University of Houston had difficulty institutionalizing the Academic Excellence workshops, only that it was different due to the changes in leadership and the fact that these workshops are run by student facilitators who come and go. Texas Southern University, in contrast, has had the same LSAMP leadership since its

start in 1999 and their commitment to the Mathematical and Chemistry Excellence workshops has remained consistent. Their workshops are also taught by full-time professors compared to the workshops being taught by students at the University of Houston. This teaches us that the mission of an HBCU is different from that of a large public research university. Texas Southern University as an Historically Black College and University is committed to serving underrepresented minorities, particularly African Americans, whereas the University of Houston is a large institution which serves a more diverse student population and is open to everyone.

Limitations of the Study/Recommendations for Future Research

This study only focused on the two lead institutions of the Houston alliance and not the other participating campuses. It was difficult to get a thorough look at the institutionalization of the workshop component of the other five colleges in the Houston consortium in one case study. Just one LSAMP component of the Houston-LSAMP was studied; however, it is recommended that the institutionalization of the remaining components mentioned in Chapter 2 such as the Summer Bridge program, Research Experience for Undergraduates, Internships, Real World International, and Community Enrichment be examined as well to get a good sense of the entire alliance along with the other five campuses.

This study was also limited to looking at just one component of one LSAMP alliance: the Academic Excellence workshops. It was impossible to study all 46 alliances and 600 participants at once. It is recommended that various case studies can be conducted for future research to determine how other LSAMP alliances and similar programs are institutionalized. The diffusion of innovation theory is an effective conceptual framework to use for looking at the four stages of ways to increase URMS in STEM. Researchers can show how 1) administrators and students first become aware of such programs through dissemination, 2) their attitudes toward such programs and the different components to prompt adoption, 3) changes were implemented over

the almost 30 years of the original six alliances introduced in Chapter 2, and 4) these programs and components are maintained.

The findings described in Chapter 4 are consistent with the literature discussed in Chapter 2, with one variation. While the four stages of the diffusion of innovation theory are evident in both lead institutions of the Houston alliance, the stages are not sequential. Activities characterizing all four stages were employed during the fourth funding phase as indicated in Figures 4 and 5 (UH and TSU DOI Timeline), and in Tables 2 and 7 (UH and TSU DOI). The dissemination, adoption, implementation, and maintenance stages explained in previous studies (Dingfelder & Mandell, 2011; Rogers, 2003; Rohrbach, 1993; Scott & McGuire, 2017) can be seen in activities practiced during each stage. The dissemination/awareness stage pre-dated the LSAMP workshops at the University of Houston by seven years, as Treisman-like workshops were conducted on that campus since 1992 before the LSAMP alliance was formed in 1999 (Figure 3, Figure 4, Table 2). Administrators and practitioners on both campuses made the decision to adopt/try the LSAMP workshops and implement changes to the budget, staff, facilities, curriculum, and mission. Finally, they decided whether to continue or discontinue the LSAMP workshops in the maintenance stage. While both campuses maintained the workshops as seen in Tables 2 and 7, (Institutionalization Indicators of LSAMP workshops), there appears to be a stark contrast in the way the LSAMP workshops were institutionalized at UH (Table 6) compared to the way TSU institutionalized them (Table 8). The workshops were formally incorporated into the fabric of both universities over the 20-year span, but UH fiscal commitment to the workshops has decreased significantly by the fourth funding phase. It is less than the amount of the NSF grant, while TSU's fiscal commitment to the workshops has not only increased but is now greater than the amount they receive from the federal government. This

comparison begs the question of what sustainability plans (if any) UH has for the LSAMP workshops when the NSF funding stops. TSU, on the other hand, has a sustainability plan. This finding supports the notion that insofar as the federal government will not fund these programs indefinitely, LSAMP administrators should be committed to maintaining these workshops independently (Abdul-Alim, 2012).

It is worth noting the conflict experienced by the researcher operating in a dual role for this study. There were limitations and advantages to being an investigator/participant or outsider/insider. The researcher's identity influences and possibly biases their understanding of the institutionalization of the Houston alliance. We acknowledge the presence of positionality.

Some identify the insider as one whose biography (gender, race, class, etc.) gives them a lived familiarity with and a prior knowledge of the group being researched, while the outsider is a person/researcher who does not have any prior intimate knowledge of the group being researched (Griffith, 1998; Mercer, 2007).

Insider/Outsider Positionality Conflict

The insider scholar questions the outsider scholar's ability to understand the experiences of those inside the culture—in this case, the culture of the two lead institutions of the Houston alliance. Meanwhile, the outsider scholar questions the insider scholar's ability to detach themselves from the Houston alliance to be able to study it without bias (Kusow, 2003).

The researcher functioned as an outsider/investigator, not being an employee or student of either institution. The researcher did not reside in the Houston area and was not a STEM educator or STEM graduate. The researcher is not an LSAMP employee or participant at any one of the 46 alliances. Based on the description above, it can be said that the researcher did not have any prior intimate knowledge of the LSAMP culture at University of Houston and Texas

Southern University. Insider scholars can easily question the researcher's ability to understand the Houston higher educational culture.

On the other hand, the researcher is a woman of color. According to Griffith and Mercer, the researcher was an insider/participant because her gender and ethnicity gave her a "lived familiarity and prior knowledge" of the group she researched, as LSAMP primarily serves Black and Latino students in STEM. An outsider/investigator scholar, in turn, can question the insider's ability to detach themself from the LSAMP culture and study the institutionalization of its workshops without bias, as explained by Kusow.

The following specific experiences on the part of the researcher support the above argument/conflict:

Advantages of Being an Insider

1) The researcher probably had easier access to the Houston-LSAMP culture, as she was seen by the employees/participants as "one of them." She was invited to luncheons at the governing board meetings. One LSAMP employee vented about another former LSAMP employee in front of the researcher.
2) The researcher may have had the ability to ask more insightful questions because of "lived familiarity," and was able to understand nonverbal cues (Sanghera & Thapar-Bjokert, 2008).
3) LSAMP participants may have trusted the researcher with more secure and honest answers.
4) The researcher did not experience culture shock at either institution.

Disadvantages of Being an Insider

1) The researcher may have been overly sympathetic to the LSAMP culture and unknowingly biased.
2) The researcher may have been too familiar with the culture of the LSAMP participants and hence unable to ask provocative or tough questions.
3) Some LSAMP employees who treated the researcher as a family member may have assumed that she had better insider knowledge than she actually did (which she may not have), and that her understandings of the LSAMP workshops may have been the same as theirs (which they may not have been). Therefore, information that should have been "obvious" to the researcher might not have been articulated (Naaek, Kurlylo, Linton, Grabowski, & Radford, 2010).

However, there were times when the researcher was reminded that she was an outsider. She was informed in an email that detailed financial information was proprietary (B. Brown & J. Hardy, personal communication, January 18, 2019). The researcher was also asked by one of the principal investigators to "leave the room" while she was interviewing an LSAMP employee. The PI needed to discuss some confidential information with the LSAMP employee. The researcher also was not informed of or invited to subsequent governing board meetings in 2018 and 2019 concerning the latest developments in the Houston-LSAMP program. She received detailed emails after the meetings occurred (M.Tolbert, personal communication, May 11, 2018; B. Wilson, personal communication, January 18, 2019). Geographical distance may have played a role, as the researcher was invited to prior meetings when visiting the Houston area. This shows that the researcher is neither an insider or outsider—but she is both.

General Implications for Innovation in Higher Education

This case study has shown that financial resources need to be allocated to develop new programs, as well as a strong commitment among staff members and special facilities in order for innovations to flourish. There has to be a willingness to make adjustments to existing programs with the evolution of the student body. Universities must continue to meet the diverse needs of the populations they serve. This is not only limited to ethnicity, socio-economic status, and multiple viewpoints, but also includes different learning styles. For example, Disability Resource Centers are present on almost every campus to help students succeed in their college education and beyond. These centers are equipped with staff members dedicated to these students and the institutionalization of the services needed. Such services were nonexistent a generation ago.

Barriers to innovation in American higher education include: 1) financial resource constraints, 2) tradition (doing the same thing in the same old way even as traditional methods become outdated with changing student populations, 3) innovation fatigue coupled with skepticism about the motives and commitment of advocates for academic transformation, and 4) systems of governance. American universities need to be less decentralized and more unified to achieve shared goals and visions for their students. Different colleges within the university-wide system need to work together not only to maintain new programs but also to institutionalize them so they are embedded in the fabric of the university. New models of student support need to be established. Bridge programs, boot camps, supplemental instruction, peer mentoring, and peer-led study groups should be offered as answers to barriers of innovation. Students should also not be allowed to stand alone when they declare their majors. Mentors should help them structure a sequenced pathway to help them obtain a meaningful degree (Mintz, 2019). These are just a few

suggestions about how to combat the challenges of innovation in various programs in higher education.

The Houston-LSAMP program can be seen as an example of innovation, maintenance, and ultimately institutionalization as we start the third decade of the 21st century.

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