Final Report on the Evaluation of the National Science Foundation Louis Stokes Alliances for Minority Participation Program

Prepared for the National Science Foundation
Directorate for Education and Human Resources
Division of Research, Evaluation and Communication

Program for Evaluation and Equity Research (PEER)
The Urban Institute
2100 M Street NW
Washington, DC 20037

November 2005

Final Report

Evaluation of the National Science Foundation Louis Stokes Alliances for Minority Participation Program

Prepared under Contract
REC 9912176

Beatriz Chu Clewell
Clemencia Cosentino de Cohen
Lisa Tsui
Laurie Forcier
Ella Gao
Nicole Young
Nicole Deterding
Caroline West

Program for Evaluation and Equity Research (PEER)
The Urban Institute

Prepared for The National Science Foundation
Directorate for Education and Human Resources
Division of Research, Evaluation and Communication

November 2005

The data collection, analysis and reporting of this material was conducted in accordance with OMB No. 3145-0190.

National Science Foundation, Division of Research, Evaluation and Communication, Evaluation of the Louis Stokes Alliance for Minority Participant Program, NSF 05-XXX (Arlington, VA, 2005).

THE URBAN INSTITUTE

The Urban Institute is a nonprofit, nonpartisan policy research and educational organization established in Washington, D.C., in 1968. Its staff investigates the social, economic, and governance problems confronting the nation and evaluates the public and private means to alleviate them. The Institute disseminates its research findings through publications, its web site, the media, seminars, and forums. Through work that ranges from broad conceptual studies to administrative and technical assistance, Institute researchers contribute to the stock of knowledge available to guide decisionmaking in the public interest. Conclusions or opinions expressed in this report are those of the authors and do not necessarily reflect the views of officers or trustees of the Institute, advisory groups, or any organizations that provide financial support to the Institute.

Program for Evaluation and Equity Research (PEER)

The Urban Institute's Program for Evaluation and Equity Research (PEER) focuses on education research. PEER staff conduct studies in the fields of educational attainment, educational access, minorities in mathematics and science, teacher education, teacher recruitment and retention, and educational assessments. Much of PEER's work has centered around evaluation studies—many of these large, multisite, multi-method evaluations of programs to increase educational access and success among underrepresented groups, as well as programs to increase the teaching pool. Support for PEER comes from multiple sources, including the National Science Foundation and the American Association for the Advancement of Science, as well as private foundations, such as the Ford Foundation, DeWitt Wallace Reader's Digest Fund, Lumina Foundation, and GE Foundation.

Acknowledgments

We would like to acknowledge the invaluable cooperation and assistance that we received from Louis Stokes Alliances for Minority Participation (LSAMP) program directors, staff, faculty, and student participants (both past and present), which enabled us to collect a wealth of data on which this evaluation rests. Their willingness to share their experiences and insights contributed greatly to our understanding of how individual projects function, and the commonalities and differences that exist within the overall Program. We are particularly grateful to LSAMP staff members and participants at the case study institutions for effectively coordinating and graciously hosting the case study site visits, which proved to be informative as well as enjoyable.

We are also grateful to the staff at the National Science Foundation (NSF) for their support and guidance. In particular, we are indebted to A. James Hicks, the program officer for LSAMP, for his strong leadership and responsiveness to our requests for assistance throughout the project. We are also very appreciative of Elmima Johnson, our program officer, whose encouragement and guidance facilitated our work. We benefited tremendously from the invaluable assistance and feedback received from Bernice Anderson, acting director of human resource development. John Tsapogas in Social Behavioral and Economic Sciences/Science Resource Statistics was extremely helpful in answering questions about the National Survey of Recent College Graduates (NSRCG) and facilitating our access to the NSRCG data.

Our special thanks to members of the project's advisory panel: Gerald E. Gipp, Carlos Rodriguez, William Sibley, and Floraline I. Stevens. The insight and suggestions they offered early in the evaluation were helpful in refining its design and contributed substantially to the evaluation's direction.

We wish to acknowledge the invaluable assistance of NuStats, our subcontractor on this project. In particular, we are deeply grateful for the tremendous contributions that Rob Santos, vice president of NuStats, made to our study. Early on and throughout the project, his expertise and advice strengthened our work.

Finally, we wish to thank our colleagues at the Urban Institute: LaTasha Holloway, who provided assistance throughout the long process of data collection, analysis, and report writing and Gary Gates, who advised us on the use of STATA during the analysis phase.

The Evaluation Team

Contents

List of Tables and Figures

Executive Summary

The Louis Stokes Alliances for Minority Participation (LSAMP) Program was established in 1991 by the National Science Foundation (NSF) to develop strategies to increase the quality and quantity of minority students who successfully complete baccalaureate degrees in science, technology, engineering, and mathematics (STEM) and who continue on to graduate studies in these fields. The Urban Institute was commissioned to conduct an evaluation of the LSAMP Program, an evaluation that would answer questions about the structure and implementation of LSAMP and its impact on students, participating institutions of higher education (IHEs), and the diversity of the STEM workforce. The information presented in this report comes from the Urban Institute's multiyear evaluation of the LSAMP program.

The LSAMP Program began with grants to six multi-institution Alliances across the country. Today there are 34 Alliances with over 450 participating institutions that have produced thousands of STEM degrees. Distinguishing it from traditional scholarship programs, LSAMP takes a multidisciplinary approach to student development and retention, creating partnerships among colleges, universities, national research laboratories, business and industry, and other federal agencies in order to accomplish its goals. Hands-on research experiences and interactions with mentors to build minority student interest in STEM are LSAMP's other key characteristics.

The Urban Institute evaluation of this program included both process and summative components, seeking to understand both the implementation of the program and its success in meeting stated goals. The process component of the evaluation utilized qualitative methods to identify aspects of the LSAMP projects that promoted or inhibited the achievement of program goals. Data collection methods included a review of LSAMP project documents, telephone interviews with project staff of all Alliances, case studies involving 18 institutions in three Alliances, and a literature review of research on effective strategies to increase diversity in STEM. The analysis of this information indicates that, at the institutional level, a supportive environment that includes adequate provision of resources and support of faculty and top administrators facilitated the achievement of program goals; at the Alliance level, collaborative activities among partner institutions that result in the leveraging and sharing of both tangible and intangible resources were similarly important. Lack of financial resources and adverse national, state, or institutional political climates were the most common challenges to program success. The process evaluation also revealed that, despite expected variation in practices among Alliances, a recognizable LSAMP model does emerge. That model can be understood as a merging of two prominent streams of research and theory: a model of student retention (the Tinto model) that emphasizes integration of students into the academic institution and the notion of "disciplinary socialization," which is the process through which students become socialized into science as a profession.

In order to answer questions about the program's impact on participating institutions and to examine education and career outcomes for participating students, the summative component of the evaluation utilized a combination of quantitative and qualitative methods. Institutional impacts were measured using interviews with program staff and Alliance site visits, while student outcomes were explored through a retrospective survey of funded LSAMP participants who graduated from the program between 1992 and 1997.

Institutional Outcomes. Project staff members who were interviewed at participating IHEs believe that involvement in the program enables institutions to retain and graduate more STEM students by substantially expanding their capability to develop and support STEM student talent. Staff also believe that LSAMP had an impact on participating institutions by changing the institutional culture, policies, and practices to encourage the recruitment, retention, and graduation of underrepresented minorities (URMs)[1] in STEM majors.

Student Outcomes. Analysis of survey data revealed that the vast majority of program graduates sought additional education after their bachelor's degrees, and two-thirds of participants later enrolled in graduate school—working toward a master's, PhD, or professional degree. One in four LSAMP graduates had completed a STEM graduate degree at the time of the survey. Finally, the majority of LSAMP graduates reported that the program had been helpful as they sought their bachelors' degrees in STEM and had influenced their decisions to attend graduate school. More than 90 percent reported that they either had recommended or would recommend LSAMP to others.

National Comparison. In order to examine the difference between these outcomes and those of STEM graduates nationally, LSAMP graduates' progress in the STEM pipeline was compared to that of nationally representative samples of underrepresented minorities and white and Asian students (using longitudinal data from NSF's National Survey of Recent College Graduates). This analysis revealed that LSAMP participants pursued post-bachelor's coursework, enrolled in graduate programs, and completed advanced degrees at greater rates than national comparison groups. The difference in graduate school enrollment and completion is largely due to the significantly higher percentage of LSAMP students pursuing and completing degrees in STEM fields. In terms of the final phase in the STEM pipeline, LSAMP participants were observed joining the STEM workforce in similar proportions to national samples.

Summary of Conclusions and Recommendations

The information learned about the LSAMP program through the process and summative evaluations resulted in three main conclusions and five key recommendations.

Conclusions

1. LSAMP met its stated goal of increasing the quality and quantity of students who successfully complete LSAMP-supported STEM baccalaureate programs. As the program expanded, the share of national URM undergraduate STEM degrees earned by LSAMP participants increased, coinciding with an increase in the national production of URM bachelor's degree recipients in STEM. On measures of undergraduate academic performance, LSAMP students were found to outperform national comparison samples.

2. The LSAMP program exceeded its stated goal of increasing the number of students matriculating into programs of graduate study in STEM. The LSAMP program produced underrepresented minority students who enroll in and attain graduate degrees in STEM at a higher percentage rate than that of a national sample of underrepresented minority students, and a national sample of white and Asian STEM baccalaureate degree recipients.

3. LSAMP's strategies and approaches constitute a discrete, identifiable program model, grounded in research and theory, that can be tested and replicated. The identification and description of this successful model signifies a critical advance in the knowledge base of intervention program models.

[1] The term "underrepresented minorities" is used to describe racial/ethnic groups who are not represented in the pool of scientific and engineering professionals commensurate with their representation in the general U.S. population, namely, African Americans, Hispanic Americans, and American Indians.

Recommendations

1. *Increase data collection efforts.* Areas of attention should include undergraduate retention/attrition information and up-to-date tracking and contact information for program graduates. Such information would allow for continued analyses of the program's impact.

2. *Strengthen the focus on community college students.* Community colleges enroll over half of all underrepresented minority students in postsecondary education and thus provide a promising source of potential STEM students. In light of the program's success in retaining URM students who begin their degrees in community colleges, increased attention to this component is recommended.

3. *Expand the program to offer graduate school tuition and support to LSAMP graduates.* LSAMP graduates who did not continue taking courses after attaining a bachelor's degree were significantly more likely to cite financial reasons for not doing so than were URMs or white and Asian students in the comparison samples. Given LSAMP's success in preparing students to enter and complete graduate degrees, extending the program's offerings to include financial incentives to encourage these students to enter graduate STEM programs seems a worthwhile investment.[2]-

4. *Emphasize successful factors in selecting sites to receive LSAMP awards.* In awarding LSAMP grants, the program should continue to consider three criteria: (1) evidence of institutional and faculty support; (2) history of, or plans for, a strong collaborative relationship among partners; and (3) well-defined plan and the capacity to provide the integrated services that comprise the LSAMP model.

5. *Replicate and expand the LSAMP program.* The LSAMP model, unlike most intervention efforts for increasing URM participation in STEM, encourages and supports the synergistic efforts of institutional partners, laying the foundation for systemic institutional change. Given LSAMP's demonstrated success, it is important that efforts to replicate and disseminate the model be increased.

[2] NSF recently initiated a program, Bridge to the Doctorate, to provide graduate school tuition and support to LSAMP graduates.

Section I. Introduction

Statement of the Problem

The U.S. science, technology, engineering, and mathematics (STEM) workforce continues to face the challenge of increasing the participation of women and minorities. While strides have been made to address this shortage, women and underrepresented minorities are still not represented in the U.S. STEM workforce in parity with their percentages in the total workforce population. Recently, a confluence of trends has focused the spotlight on the nation's need to develop the talent of underrepresented groups in STEM. These include a surge in the college-age population comprised of minorities, declines in science and engineering (S&E) graduate degrees to white students, declining enrollment of foreign students in S&E graduate programs, expectation of a high retirement rate in the S&E workforce, and rapid job growth in the S&E employment sector. These trends have led the National Science Board (NSB) to conclude that the "number of native-born S&E graduates entering the workforce is likely to decline unless the Nation intervenes to improve success in educating S&E students from all demographic groups, *especially those that have been underrepresented in S&E careers"* (NSB, 2003, p. 1, emphasis added).

In 1991, the National Science Foundation (NSF)—responding to its charge from the Congress to "undertake or support a comprehensive science and engineering education program to increase the participation of minorities in science and engineering" (42 U.S.C. 1885b)—designed the Louis Stokes Alliances for Minority Participation (LSAMP) program. The main goal of LSAMP was to encourage and facilitate access to careers in STEM fields for underrepresented populations. The LSAMP program's approach to fulfilling its goal addresses several of the often intractable barriers that inhibit minorities from pursuing careers in science and engineering.

Students from underrepresented minority groups (URMs)[3] face obstacles at different points in the STEM pipeline that make it difficult for them to attain postsecondary degrees in STEM. First, many students fail to enter higher education prepared to pursue STEM degrees due to inadequacies in K–12 training. Improvements in math and science education including stronger curricula, well-trained teachers, and availability of technological equipment are needed to prepare students adequately for college. Programs that provide academic enrichment and expose students to science experimentation enable precollege students to maintain interest in STEM.

A second obstacle to diversity in STEM is attrition from the STEM pipeline at the college and university level. Underrepresented minorities are less likely than whites and Asians to complete baccalaureate degrees in a STEM major. Reasons that have been cited for this underrepresentation are lack of role models, greater interest in majors unrelated to science and math, poor quality of STEM teaching, inflexible curricula, lack of adequate academic guidance or advice, and low faculty expectations. Those minority students who are successful in obtaining their baccalaureate science degrees often lack the laboratory research skills that make them competitive for graduate school admission. The juncture between undergraduate and graduate school is another point that students leave the STEM education pipeline.

Finally, the high cost of tuition also serves as a barrier for minority students and affects their access to, and retention in, higher education. Tuition costs are one of the factors that have led many students to begin their college education at two-year institutions. There is a strong movement and need for four-year colleges and universities to become more diligent in developing articulation agreements with community colleges. And while community colleges enroll close to half of all students from groups traditionally underrepresented in STEM disciplines, only 26 percent of all students at two-year colleges transfer to

[3] Includes African Americans, Hispanic Americans, and American Indians.

four-year institutions. The LSAMP program is designed as an intervention to help minority students overcome many of the problems and barriers they face as they transition into college and progress toward graduation.

Brief Description and Overview of LSAMP

The Louis Stokes Alliances for Minority Participation (LSAMP) program was established in 1991. It was designed to develop comprehensive strategies intended to increase the quality and quantity of minority students who successfully complete baccalaureate degrees in science, technology, engineering, and mathematics (STEM) and who continue on to graduate studies in these fields. Originally named the Alliance for Minority Participation (AMP), the program was renamed in 1999 in honor of former Congressman Louis Stokes. Congressman Stokes served in the U.S. House of Representatives for 30 years and was a leader and pioneer of congressional efforts to improve minority health and the education of minority health professionals, scientists, and engineers. Despite the name change, the program's goals and design remained the same. LSAMP's continued goal is to make a significant contribution to the attainment of a diverse, internationally competitive, and globally engaged workforce of scientists, engineers, and well-prepared citizens. LSAMP strives to nurture students' desire to pursue research in STEM fields and to facilitate NSF's long-term goal of increasing the production of doctorates in STEM fields. In accordance with that goal, LSAMP has encouraged awardees to develop activities and services that persuade minority students to persist through to graduate school. *As it aims to make a significant positive impact on STEM fields, LSAMP's success will be measured by the program's ability to bring about a significant increase in the number of underrepresented minorities graduating with baccalaureate STEM degrees and persisting through to graduate study.*

The LSAMP program is managed by NSF's Directorate for Education and Human Resources' Division of Human Resource Development (HRD). This office administers LSAMP awards at the national level, as it does with other programs with similar goals and objectives. LSAMP awards are distributed in five-year phases. The level of funding provided under LSAMP depends upon the scope of the proposal. The NSF contribution to a project usually ranges between $300,000 and $1 million per year. Projects are selected for the award based on the intellectual merit of their proposed activities and the excellence of their proposal's plan to broaden the participation of underrepresented minority groups.

LSAMP encourages its awardees to create Alliances that forge partnerships among academic communities (both two-year and four-year institutions) and encourages the inclusion of government agencies and laboratories, businesses and industries, and professional organizations. NSF recognizes that community colleges provide a large pool of minority students that could enter the STEM pipeline. LSAMP awardees are encouraged to promote interaction and collaboration between community colleges and four-year institutions through shared student activities like research experiences and scientific conferences. In this way, Alliances can have an impact on a wide range of students and can share resources in order to fully support students through the pipeline. LSAMP awardees select strategies and approaches that are tailored to their institutional setting and are likely to result in the achievement of program goals. In all cases, potential awardees must describe their plans to create Alliances that work together through joint planning and resource commitment. A project's proposed activities also must show a reasonable and comprehensive effort that focuses on improving the undergraduate educational experience.

LSAMP project leaders use several mechanisms to communicate with national leadership at NSF. Project directors and other staff members have often been invited to the NSF headquarters in Virginia for what are called "reverse site visits." These visits give project leaders an opportunity to talk to NSF about their project's progress. LSAMP projects also have very strict data collection requirements, which enable NSF to monitor the program's growth. Data are collected annually on student demographics, academic progress, faculty involvement, and activities by the projects themselves. Institutional-level data are then assembled by the Alliance's central office staff and used to produce an Alliance-wide annual report. These reports generally showcase the Alliance's yearly and cumulative progress, budget activity, nonacademic partnerships, as well as student-faculty publications and other significant accomplishments. Much of the student demographic data are reported through the MARS (Monitoring and Reporting System) database, an electronic project reporting system developed by NSF.

The LSAMP program began with grants to six Alliances producing fewer than 4,000 underrepresented minorities with baccalaureate degrees in STEM fields. Today there are 34 Alliances with over 450 participating institutions that have produced thousands of STEM degrees. The program has also influenced an increase in minority enrollment in STEM majors from 35,670 in 1991 to over 205,000 in 2003. LSAMP attributes much of its success to the Alliance structure within which its awardees work. Alliance structures exist in different forms: citywide (e.g., New York City), statewide (e.g., California, North Carolina), and multistate (e.g., Florida-Georgia). Most Alliances have a lead institution where the central office is located and where, generally, the project director is employed.

LSAMP Alliances have several opportunities to exchange ideas and best practices amongst themselves. The NSF/EHR Division of Human Resource Development (HRD) sponsors a joint annual meeting where project leaders (including LSAMP project directors) and staff come together and discuss issues facing the STEM student community. This conference offers opportunities to share ideas and gain important information about recruiting, retaining, and producing professionals in STEM fields. Another means for support and collaboration is the national LSAMP listserv. This form of electronic communication allows those who coordinate LSAMP projects across the country to exchange information about opportunities to be distributed to students. The listserv, moderated by the LSAMP senior program director, is often used as an instrument to advertise summer research internships, fellowships, and scholarships. Some LSAMP projects sponsor their own summer research opportunities for LSAMP students, generally in conjunction with their university or another similar science and math intervention program. These summer experiences are sometimes opened up to LSAMP students nationwide in another attempt to promote collaboration across Alliances.

LSAMP awardees implement a variety of activities and services in order to accomplish the goals of the program. These activities focus on strengthening academic skills through student support, academic enrichment, and research skill development. Participants receive a stipend for engaging in LSAMP-sponsored activities. LSAMP projects coordinate a wide range of activities and services based on the needs of their student populations and in accordance with the focus of their award phase.

LSAMP has several components that distinguish it from traditional scholarship programs. Instead of focusing on aiding individual institutions or students through financial support, LSAMP takes a multidisciplinary and comprehensive approach through the creation of Alliances that generate productive partnerships among colleges, universities, national research laboratories, the business and industry community, and federal agencies that help accomplish its goals. In addition, its major emphasis on offering activities designed to sustain minority student interest in STEM fields and graduate study through hands-on research experiences and interactions sets it apart from national programs with similar goals.

This final report of the findings of our evaluation of the LSAMP program consists of six sections, including this introduction. Section II describes the evaluation design as well as the methodology used to conduct the evaluation. Section III discusses the findings of the process component of the evaluation. Section IV describes the components that make up the LSAMP model and explores the model's links to the existing theoretical and research literature. Section V presents the findings of the summative portion of the evaluation. The report ends with the study conclusions and recommendations, found in Section VI.

Section II. Evaluation Design and Methodology

In 2000, the National Science Foundation contracted with the Urban Institute to conduct an evaluation of the Louis Stokes Alliances for Minority Participant program. This section presents the questions, design, and methodology used in carrying out the evaluation.

Evaluation Questions

Our evaluation, which contained both *process* and *summative* components, used a mixed-methods approach to answer the main evaluation questions.

Process Evaluation

The process evaluation concerned the implementation of LSAMP and focused on the following questions:

- How are LSAMP programs being implemented?
- What components/strategies have accelerated the attainment of program goals?
- What factors have inhibited the attainment of program goals?
- Is there a recognizable LSAMP model?

This component of the evaluation used qualitative methods to identify crucial components of LSAMP as well as factors that seemed to promote or inhibit the achievement of program goals. An important aspect of this component was to assess whether or not—in spite of expected variations in practices—the LSAMP Alliances were operating according to a recognizable model, and whether that model could be traced to general theories of student retention and persistence in science that could inform future efforts to achieve and sustain diversity in the S&E workforce.

Summative Evaluation

The summative component of the evaluation sought to document the impact of LSAMP in a number of areas as shown by the following questions:

What has been the impact of LSAMP on

- participants?
- the diversity of the STEM workforce?
- the knowledge base of promoting diversity in STEM?
- participating IHEs?

This component used a combination of quantitative and qualitative methods to answer the relevant questions. A major feature of the summative component was a retrospective survey of all LSAMP participants who graduated with an S&E major from the program's inception in 1992 to 1997 to determine their progress in the S&E pipeline. These participants were then compared to matched counterparts on a national level to determine the impact of having participated in LSAMP.

Evaluation Design and Methodology

The evaluation framework combines both *process* and *summative* evaluations, documenting the mix of strategies used by the Alliances in order to develop models of the processes that yield LSAMP outcomes. The methods undertaken for both of these evaluation components are discussed in this section.

1. Process Evaluation

The process component of the evaluation relied primarily on qualitative data. Methods included a thorough review of LSAMP project documents, telephone interviews with project staff members of all Alliances, case study site visits to a sample of three Alliances, and a literature review of research on effective strategies to increase diversity in STEM.

Project Document Review

In order to become familiar with project structures and strategies employed by the Alliances, the evaluation team undertook a project document review. This process involved the retrieval and review of relevant project documents from NSF files. Evaluation staff from the Urban Institute were granted access to office space and photocopying equipment and spent approximately one week at the National Science Foundation reviewing LSAMP files and making photocopies of the most relevant documents. Documents considered "relevant" included proposals, cooperative agreements, and annual reports[4] as well as descriptive reports, "best practices"-type publications, and any program reviews or evaluations that may have been prepared by internal project staff or outside contractors. Once the retrieval process was complete, documents were organized and filed by Alliance.

Evaluation team members reviewed all retrieved LSAMP documents and prepared short project abstracts for each of the 27 Alliances based on the information contained in the project files. Project documents were closely studied for their descriptions of project activities and a matrix identifying common and uncommon program components was generated. The background information gleaned from project documents further facilitated refinement of the evaluation design, and assisted in the development of appropriate data collection instruments to be utilized during telephone interviews and case study site visits.

Telephone Interviews

Telephone interviews were conducted with LSAMP project staff to gather formative data on project goals, history, and function, as well as on major project activities. These interviews were conducted with staff from all 27 Alliances.

Development of the Interview Protocols. Protocols for the telephone interviews were developed based on the evaluation design and information taken from the LSAMP project documents. The protocol was field tested in a telephone environment by UI staff in early October 2001. UI staff debriefed interviewees for their feedback following the field test and took notes regarding respondents' comments and criticisms. These debriefing sessions revealed that while project directors were usually most able to respond to questions pertaining to the overall project, others such as a project manager or coordinator were more suitable in answering questions about the daily operation of the project and project components. Consequently, the initial telephone interview protocol was split into two parts. Part I contained questions about the daily operations and was generally directed to the project director, while Part II focused on more general questions about the project and its components and was generally directed to the project

[4] Updated annual reports for each of the Alliances were requested from NSF periodically over the course of the project.

manager or coordinator (refer to appendix B for copies of these instruments). These protocols were submitted for OMB clearance and approval was obtained.

Interviews. In preparation for the interviews, senior staff conducted a telephone interview training session for junior members of the evaluation team. Subsequently, evaluation team members reviewed assigned project files as well as program activity reports generated for each Alliance from the LSAMP project database (MARS),[5] and customized individual interview protocols as appropriate. An introductory script was used in conjunction with interview protocols. NSF provided the evaluation team with contact information for key project staff who were reached through email or telephone to schedule the Part I interview. Telephone Interview Part I covered the following topics:

- Background information
- Administrative and governance structure
- Project staffing
- Program goals and history
- Program functions
- Collaboration among Alliance partners
- Evolution of the Alliance model
- Program outcomes
- Contact information on graduates

Interviewees were also asked if there were other project staff that they felt the evaluation team should speak with in order to have a better understanding of their Alliance. These additional interviews were generally structured to obtain answers to questions that the original interviewees were unable to address.

Following the initial interview, the respondent was asked to refer evaluators to the most appropriate person to speak with for the Part II interview. Telephone Interview Part II asked the interviewee to discuss in-depth the components implemented by the Alliance. For the purpose of the interviews, the components were divided into categories:

- Precollege to college
- Student development (academic)
- Student disciplinary professional development
- Faculty development
- Curriculum development
- College to graduate school
- Community college
- Uncommon components
- "Top five" components

Interviewees were also asked to talk about any other STEM intervention programs that were present at the Alliance institutions and to specify when a project component represented the joint efforts of more than one program.

A total of 59 interviews were conducted from October 2001 to January 2002, two interviews for each Alliance and five additional follow-up interviews. Each interview lasted approximately one hour.

---

[5] The Urban Institute obtained from NSF a copy of the LSAMP program database, known as the MARS database. This Microsoft Access database contains data submitted annually by the individual projects on such items as STEM enrollment, STEM degree production, LSAMP participant data, and LSAMP project activities.

Write-up and Analysis. Data reduction forms were created to ease the transcription of data. A Microsoft Access database containing customized forms and reports was designed for the purpose of entering and storing these interview data in a way that would be useful for future analysis.

In analyzing the telephone interview data collected from project directors and/or coordinators, UI staff entered relevant responses into a customized matrix that facilitated data synthesis and analysis. Staff reviewed the matrix to identify emerging patterns and to develop a coding scheme for the data. The coded data were then entered into Microsoft Excel to aid exploration of significant relationships that existed within the data. In writing up the telephone interview results, UI staff reviewed quantitative results of the coded data, and utilized the richness of detail that was captured by the interview matrix.

Case Study Site Visits

Case Study Site Selection. Sites for the case study component of the evaluation were chosen using a stratified random sampling design. Prior to sampling, the original pool of 27 sites was reduced to 15 using the criteria listed below.

- Only Alliances that were currently receiving funding, and were operational during the period of this evaluation were considered.
- Only Alliances that had been in existence for 5 years or more were considered.[6]
- Alliances that were considered atypical on an important dimension (e.g., an Alliance that is exceptionally large in size) were omitted from the sampling pool.

The final sampling pool of 15 Alliances was then stratified by placing the remaining Alliances into one of three regional categories: Northeast/East Coast (5 Alliances), South (6 Alliances), and West/Southwest (4 Alliances). A single site was randomly selected from each of the three geographic regions. The three Alliances chosen for case study through this process were the Colorado Alliance, the Florida/Georgia Alliance and the New York City Alliance.

Development of Interview and Focus Group Protocols. Interview protocols and focus group guides were developed based on our evaluation plan and data collected on the three Alliances during the telephone interviews (copies of these protocols can be found in appendix B). Standard protocols were developed for interviews and focus groups with

- project directors
- project managers/coordinators
- high-ranking administrators
- site/institutional coordinators
- activities/academic coordinators
- faculty mentors
- institutional staff
- junior/senior students focus group
- freshman/sophomore students focus group
- community college students focus group

When warranted, specialized protocols were developed for interviews with people or groups that fell outside of these parameters, as in the case of interviews with project staff from related STEM intervention

[6] Given that the purpose of the case studies was to examine how established projects operate, those in existence for less than five years were omitted as they may not have had adequate time to mature in terms of development of services and implementation.

programs or an internal project evaluator. The standardized protocols were submitted for, and granted, OMB clearance.

Coordination and Preparation. Once the case study sites were selected, the project director at each of the Alliances was informed of their selection via a letter from the NSF LSAMP program officer. This was followed by e-mail and telephone correspondence from the evaluation team. Project directors were informed of the types of interviews that the evaluation team was seeking to conduct during their visits and were asked for guidance in choosing the most appropriate Alliance institutions for participation in the visits. To determine the sites, project directors were asked to rank the top six institutions in their Alliance in terms of level of activity. In all cases this included the lead institution. Following the selection process, the project director informed the coordinators at each of the institutional programs that they had been chosen for inclusion in the site visits, and requested that each site draft a tentative schedule based on their assigned date and the criteria put forward by the evaluation team. These draft schedules were submitted to UI for review, and any necessary adjustments were made in direct cooperation with the appropriate institutions.

Before commencing the site visits, senior staff held a training session for junior staff, with a focus on face-to-face interviewing and conducting focus groups. Prior to each trip, a folder of materials was prepared for evaluation staff to aid in preparation for the visit. Detailed interview schedules, relevant contact information, campus maps, the most recent Alliance annual report, and an Access report of the responses generated from the telephone interviews were included in these folders. Documentation about each of the institutions to be visited was downloaded from each of the schools' Internet sites and also included in the preparation materials.

Visits. Teams of four researchers visited a total of 18 institutions belonging to three Alliances to observe project activities, interview the project director and staff at partner sites, and conduct focus groups with faculty and students on their perceptions of project strategies, inhibiting and facilitating factors, links to other Alliance partners, and changes in implementation over time. The timing of the LSAMP site visits is presented below in figure 1.

Figure 1. Timing of LSAMP Site Visits

Alliance	Dates of Visit(s)
NYC LSAMP	November 2002 March 2003
FL/GA LSAMP	February 2003 April 2003
CO-LSAMP	April 2003

A team of four evaluators visited larger, more active institutions together, generally splitting into two teams of two for visits to smaller, less active institutions. One evaluator typically led interviews, which lasted 45 minutes to an hour, while focus groups, which lasted about an hour, were typically led by one evaluator while a second "assistant" evaluator took detailed notes. A total of 148 interviews and focus groups were conducted across the three sites. A summary of the number of interviews conducted, broken out by type of interview and Alliance is presented in table 1.

Table 1. Number of Interviews and Focus Groups Conducted at Each Alliance

	CO-LSAMP	FL/GA-LSAMP	NYC-LSAMP
Project directors	1	1	0[a]
Project managers/coordinators	1	1	1
High-ranking institutional administrators	6	3	4
Site/institutional coordinators	6	6	6[b]
Activities/academic coordinators	7	7	6
Faculty/faculty mentors	11	14	13
Institutional staff	8	2	0
Project-related staff	2	0	0
Student focus groups	11	10	16
Total interviews and focus groups	53	44	47

[a] The project director is the institutional coordinator at his institution, and that was the protocol that was administered in this instance.
[b] In one instance, the institutional coordinator and the academic coordinator protocols were combined because there was no separate person in that position.

Prior to each interview, evaluators spent a few minutes talking to the interviewee(s) or focus group members about the national LSAMP evaluation. Evaluators sought to emphasize that the Urban Institute was not conducting an evaluation of the Alliance they were visiting in particular, but rather that the site visits were a small piece of a much larger national evaluation. Participants were also ensured of the confidential nature of the interviews and focus groups and were encouraged to speak openly about their perceptions and experiences with the LSAMP project. Whenever possible, interviewees were asked for permission to audiotape the session. In the case of larger group interviews or focus groups, audio taping became less feasible and the interviewer or an assistant took detailed written notes. At the conclusion of each interview, participants were thanked for their participation and asked if they had any questions. Following each trip, thank-you e-mails were sent to all the non-student participants, thanking them for their time and following up on any questions that had been left unanswered.

Data Write-up and Analysis. Following each trip, a debriefing session was held to discuss the findings of the visit. Evaluators then transcribed audiotapes and written notes. Once this was completed for an Alliance, site abstracts were developed for each of the sites, containing a brief overview of the Alliance as a whole and providing details about the project activities implemented across the institutions. Following this step, the entire body of interviews was then synthesized into a multi-tab matrix in Microsoft Excel. Data were organized by question under the headings of Administration and Governance, Project Background, Goals and Strategies, Mentoring, Quality of Instruction, LSAMP Participants, Impact on Students, Impact on Institution, Collaboration with other Programs, Collaboration within the Alliance, Project Implementation, Institutionalization, Evolution of the Model, and Recommendations.

Once the matrix was completed for one of the Alliances, senior staff developed an outline to be followed in writing up the case studies and drafted the first case study. All staff that had participated in the site visits reviewed the documents and made suggestions for additions and changes. Staff then used this case study as a model in writing up the other two case studies. Each case study went through multiple levels of review and revision. Once a solid draft was achieved, the case study was sent to the project director of the Alliance. Alliance staff members were asked to review the entire document with a particular eye for any breaches in confidentiality or any inconsistencies of fact.

Once the individual case studies write-ups were completed, UI staff conducted a cross-case analysis of data within the three case studies. Important relationships identified in this multi-case analysis are discussed in the section entitled "Critical Issues Emerging from the Case Studies," which highlights key elements about these three sites that may help explain their effectiveness.

Literature Review

A review of the relevant research on effective practices/strategies to increase diversity in STEM fields was conducted to inform the model-building component of the evaluation (see section IV). An extensive search of the literature was carried out utilizing resources such as AskERIC, the Social Science Citation Index, ProQuest, Dissertation Abstract, and the Internet. Articles were only selected for inclusion in the review if they were able to provide at least some empirical evidence of effectiveness. Any scholarly articles produced by the Alliances were also reviewed at this point for possible inclusion in the literature review.

The review, which can be found in appendix A, provides an examination of findings on major strategies for which there is a considerable amount of research, followed by a presentation of other approaches for which there is some supporting evidence. Findings on three notable intervention programs are also presented. These programs were chosen because they are well known, have empirical data to substantiate their effectiveness, and have been either widely replicated or influential in the development of other programs. The review also includes a discussion of the need for institutional collaboration and partnership in efforts to boost the national production of qualified individuals in STEM fields.

2. Summative Evaluation

The summative component of the evaluation required a combination of quantitative and qualitative methods to answer the relevant questions. These methods included further project document review, telephone interviews with project staff, development and administration of a retrospective survey of past LSAMP participants, and statistical analysis of survey (LSAMP) and national (NSRCG) data.

Project Document Review and Telephone Interviews

Both the project document review and Part I of the telephone interviews (described above under Process Evaluation) also contributed to the summative evaluation. The Alliance annual reports were analyzed for evidence of project institutionalization. A few of the questions from the telephone interview protocol also addressed institutionalization, such as:

- What would you say have been the major outcomes of your LSAMP program?
- What has been the impact of your program on the infrastructure of Alliance institutions in terms of promoting diversity in STEM?
- Have there been any scholarly publications that have emerged from your program? Has your program contributed to any efforts at dissemination or replication of practices developed by LSAMP?

Retrospective Survey of Graduates

A key component of the summative evaluation is a retrospective survey of former LSAMP participants. The goal of the survey, conducted several years after graduation, was to obtain demographic information about participants, inquire about their experiences in the LSAMP programs in which they participated, and collect outcomes information (graduation with a BA degree, further post-BA studies, employment, etc.). This section provides detailed information regarding the selection of the survey pool, the design and administration of the survey (included in appendix C), the creation and use of a database to store and analyze the data collected through the survey, and the national data used for comparison.

Selection of the Survey Sample. Because the survey questionnaire was intended to examine program impact on participant outcomes, only the earlier LSAMP cohorts were included in the survey pool. More recent cohorts were excluded because it was expected that these graduates may not have had adequate time to pursue graduate studies and/or establish a career. Therefore, all Level 1 (i.e., funded) LSAMP participants who earned their baccalaureate degree in STEM sometime between 1992 and 1997 were chosen to respond to a survey questionnaire on their experiences. The survey pool was selected using student information housed on the LSAMP program database (MARS). The initial "population" consisted of 1,853 former LSAMP participants.

Development of the Survey Instrument. A retrospective survey was developed by the UI evaluation team, containing questions pertaining to respondents' background, education, employment, professional experiences, and LSAMP experiences (see appendix C). The survey instrument was submitted for, and granted, OMB clearance. A number of the questions appearing in the LSAMP graduate survey were keyed to national surveys (such as the National Survey of Recent College Graduates) to allow for comparison with national data sets.

To increase the response rate, three versions of the survey instrument were developed—paper, web-based, and CATI (computer assisted telephone interview)—and respondents were given the opportunity to complete the survey in any of the available forms. The paper version of the survey went through a number of revisions, with the assistance of our subcontractor NuStats,[7] before it was adapted for use as both an Internet and telephone protocol. Field-testing was conducted jointly by UI and NuStats staff and final revisions were made as needed.

Prior to the administration of the survey, the web-based version was tested rigorously by Urban Institute staff, and changes were made in order to ensure the ease of use and the integrity of the data collection (e.g., checks on skip patterns, error messages if a respondent forgot to fill in a piece of data, etc.). The evaluation team also provided materials for use in the training of NuStats staff members who would be conducting the telephone interviews.

As part of the survey development process, staff from UI and NuStats also developed introductory postcards and a cover letter. These items were written and designed with the intention of capturing respondents' attention and sparking their interest. Postcards were printed on brightly colored paper and posed the question: "Is there life after AMP?" The cover letter was printed on National Science Foundation letterhead and signed by the NSF LSAMP program director. The letter adopted a friendly, informal tone and provided user-friendly instructions for the completion of the survey (see appendix C for copies of the postcard and cover letter). Additionally, a letter advising the Alliance project directors about the administration of the graduate survey (along with a tentative schedule of administration) was drafted at this time by the evaluation team and signed by the NSF LSAMP program director.

Administration of the Survey. Using the student information retrieved from the MARS database, NuStats was charged with retrieving contact information for students. The resources of a locator service, Experian, were initially used, but obtaining current addresses for past participants proved difficult given that many had changed residence since completing their undergraduate degree. Members of the UI evaluation team made contact with the various Alliances in an attempt to retrieve the most recent known contact information for students whose information Experian could not confirm. During this process, student information was further verified for accuracy and eligibility, reducing the survey pool from the initial

[7] NuStats, a survey research firm based in Austin, TX, contributed significantly to the retrospective survey of graduates and was a subcontractor to this effort. Tasks in which NuStats participated included tracking contact information for students in the survey sample; development, production and administration of the paper, telephone and Internet versions of the survey; and extensive follow up with nonrespondents.

1,853 to 1,540. UI staff worked closely with NuStats throughout the data collection process, meeting over the telephone weekly to monitor progress and discuss next steps.

LSAMP Survey Response Rate. The final response rate achieved for the survey was 60.2 percent. A total of 1,540 former LSAMP participants were contacted repeatedly to complete the survey. Of these, 54 (or 3.5 percent) turned out to be ineligible for participation, while an additional 27 (1.8 percent) denied having participated in LSAMP or any of the activities sponsored by LSAMP. These respondents, as well as five (.3 percent) who had passed away, were considered ineligibles in calculating the response rate. The response rate was also slightly adjusted to reflect the probability that, had we reached the 557 remaining respondents (36 percent of the original survey pool), some of them would have also turned out to be ineligible. Finally, NuStats conducted bias analyses and concluded that no bias was introduced in the sample as a result of nonresponse.

LSAMP Dataset Validation. After achieving a sufficiently high response rate, NuStats finalized data entry and prepared an electronic file with the data collected, as well as supporting documentation. Upon receipt of the data file from NuStats, members of the UI evaluation team performed extensive data cleaning. This process focused primarily on ensuring that all responses were logically consistent with the survey's skip pattern. This was not an issue for surveys administered via telephone or the Internet, since respondents using these methods were asked the questions in correct order based upon their responses. With the paper surveys, however, logical consistency needed to be confirmed (see table 2). Investigations using SAS analysis subsequently led to hand-checking of suspect paper surveys against the electronic database. In the end, all 397 paper surveys were hand-verified for skip pattern consistency and overall accuracy, and the correct coding of missing versus nonapplicable responses was ensured. During this process, additional minor data entry errors were identified and resolved in 17.1 percent of the paper surveys.

Table 2. Respondents to the LSAMP Retrospective Survey by Mode Employed

Mode	Number of Respondents	% of Respondents
Mail	397	47
Internet	103	12
Outgoing telephone	330	39
Incoming telephone	13	2

Notes: "Outgoing telcphone" reprcsents the number of people who responded to the survey via telephone once NuStats contacted them. "Incoming telephone" represents the number of respondents who used the telephone response option presented to them as part of their survey packet.

National Comparison Data: the NSRCG Longitudinal File. As mentioned earlier, an important component of the LSAMP evaluation design was a comparison of survey findings to those of a nationally representative sample of STEM BA recipients. The data used for this comparison came from the National Survey of Recent College Graduates (NSRCG restricted-use files). Initially, evaluators sought to utilize the public use files, which are part of the National Science Foundation's Scientists and Engineers Statistical Data System (SESTAT). UI staff received from NSF and reviewed the SESTAT Public Use File (CD-ROM containing 1993/1995/1997/1999 data), but determined that they were not adequate for the purposes of the present analysis. Basic demographic information (such as race and gender) is excluded from the public use files, as are answers to several important questions regarding additional studies and employment/careers. After meeting with NSF to inquire about the possibility and adequacy of using the restricted-use version of the NSRCG data, UI evaluators proceeded to undergo NSF's licensing process to obtain access to those files.

Originally, UI researchers hoped to create a single file containing a comparison group of college graduates who completed their degrees between January 1992 and December 1997, matching the graduation dates established for the LSAMP sample. Since the data needed to construct such a database turned out to be unavailable at the time of UI's request, NSF staff furnished evaluators instead with a longitudinal data file containing information on individuals receiving either a bachelor's or a master's degree between 1990 and 1992, the two years immediately prior to those used for selection into the LSAMP sample. Originally surveyed in 1993, these individuals were surveyed again in 1995 and 1997. While the survey dates do not match our sample, we were able to create a data set that provides a reasonable comparison for LSAMP by selecting records based on the time elapsed between graduation (with a BA) and the date of the NSRCG survey. The goal was to construct a comparison data set that contained information on BA recipients in a STEM field who had had about the same amount of time after obtaining their BA as did the LSAMP cohort. We hoped in this way to avoid having a biased sample. This is particularly important in the present study because many of the outcomes we seek to measure are time-sensitive. We operationalized this decision by calculating the amount of time elapsed between the students' undergraduate graduation and the date of the survey (in the case of NSRCG, between graduation and April 15, 1997), and only including in the comparison data set records for students whose time elapsed was within the range of those in the LSAMP sample. In the LSAMP sample, the range of months elapsed between graduation and the survey was between 60 and 115. We therefore limited the national data to those respondents with a similar time lapse.[8] This led to the exclusion of only 34 (4,965 weighted) records.

Advantages and Disadvantages of the NSRCG Longitudinal File. There are several good reasons for using the NSRCG longitudinal file. The first is that it permits us to calculate statistics that are nationally representative, thereby allowing us to compare the LSAMP program outcomes to those of a national sample. The second advantage is that the NSRCG data are likely unbiased. As mentioned before, NSRCG respondents graduated in the two-year period prior to the beginning of LSAMP. Therefore, there is no risk of LSAMP contaminating the national sample (as no LSAMP participants could have been randomly sampled for inclusion in the 1993 NSRCG), while we benefit from having a comparison data set composed of respondents whose educational and employment experiences take place under very similar programmatic (educational funding opportunities, for example), political, and economic conditions.

There is, however, one important potential disadvantage that is worth mentioning. As we noted earlier, this data set is not a perfect match for the LSAMP sample in terms of graduation dates. We attempted to solve this problem by matching records on the "time-lapsed" between graduation and survey, but this left us with a somewhat biased LSAMP sample. This is because about 30 percent of the LSAMP sample had more time between graduation and survey—i.e., more time for time-sensitive outcomes to occur (such as graduate school completion)—than did respondents in the national sample. This could potentially bias our conclusions in favor of LSAMP. On the other hand, excluding this 30 percent would reduce our sample significantly. To resolve this problem, we calculated all time-sensitive statistics both with the full LSAMP sample and with a restricted version that excludes the records that could bias results. *Differences in results were very small and did not change any of the relationships found*, although in some instances they may have affected the size of the differences found. When present, these differences are noted throughout the tables.

We also encountered some technical problems that are worth mentioning. During the process of data analysis, a few inconsistencies across time in the NSRCG survey instruments became evident. This was problematic because information from all three surveys was used in constructing variables used in the analyses. More specifically, some variables were constructed by selecting information in reverse-time order across the longitudinal NSRCG data file. Thus, if a respondent provided an answer in 1997, that information was used. If there was no 1997 answer, information was selected from the 1995 survey

[8] The actual range for the national sample was 59 to 115 months. The national sample thus included some records for respondents whose time elapsed since graduation was one month less than the LSAMP minimum of 60. This was done to avoid excluding a large number of records (149).

administration, and likewise repeated for the 1993 survey. This process allowed us to capture the most recent available information on outcomes such as coursework taken in the period between 1993 and 1997. Inconsistencies in the questions, or available choices of answers, or skip patterns across years of the NSRCG created problems. The most serious problem encountered concerned coursework information (post-bachelor's degree). In the 1993 survey instrument, a skip pattern error resulted in missing field of study information for a significant number of respondents. In the 1995 instrument, information about field of study was collected only for those who had completed additional degrees between April 16, 1993, and April 15, 1995; field of study information was not collected for those who were studying but who had not yet completed a degree during that time. These problems were corrected in the 1997 survey instrument and, in that year, field of study was answered by all respondents who had either taken courses or completed degrees between 1995 and 1997. If respondents indicated that they had taken courses, but there was no information about their fields of study, that information was obtained from the other survey years in the database wherever possible. Nonetheless, because of the differences between survey instruments, field of study post-bachelor's degree is missing for some national survey respondents. As suggested by this example, we made every attempt to find valid and creative ways of resolving this and other problems encountered, and documented all decisions to facilitate replication of the analyses.

Final National Comparison Data Set. The original NSRCG longitudinal file included 4,296 records for individuals receiving a bachelor's or master's degree in science or engineering between July 1, 1990, and June 30, 1992, representing 706,653 degrees conferred. These individuals were first surveyed in 1993, with subsequent surveys in 1995 and 1997. The information collected through these three surveys provided information about respondents' educational experiences and employment during the 6 years following their graduation with a BA. Many respondents, however, had to be excluded from the analysis because they did not meet established selection criteria (BA degree, in STEM field, obtained within 5–10 years of 1997 NSRCG survey, among U.S. citizens or permanent residents). The specific exclusions made are as follows (see table 3).

Table 3. Composition of the National Comparative Sample

	Excluded				Remaining			
	Raw		Weighted		Raw		Weighted	
	N	%	N	%	N	%	N	%
"Full" NSRCG Longitudinal File					4296		706,653	
Records Excluded:								
Ineligible								
MA Recipients Sampled	1513	35.2%	101,264	14.3%	2783	64.8%	605,389	85.7%
Non-US Citizens	17	0.4%	4,057	0.6%	2766	64.4%	601,332	85.1%
Earned Social Science BA	825	19.2%	286,169	40.5%	1941	45.2%	314,163	44.5%
Eligible								
Those not matching LSAMP lapsed time	34	0.8%	4,965	0.7%	1907	44.4%	309,198	43.8%
"Final" NSRCG Longitudinal File								
Of Full NSRCG (Eligibles + Ineligibles)		55.6%		56.1%		44.4%		43.8%
Of Eligible Respondents Only		1.8%		1.6%		98.2%		98.4%

SOURCE: National Science Foundation, Division of Science Resources Studies, National Survey of Recent College Graduates Longitudinal File: 1993-1997.

A large portion of the records in the full longitudinal file were ineligible for comparison to the LSAMP graduate survey based upon the earned degrees used to select them into the survey sample. The NSRCG includes students who obtained either a bachelor's or a master's degree in the target time period, in this case July 1990 to June 1992. Since only BA recipients are an appropriate comparison to LSAMP, we excluded 1513 records (or 14 percent of the weighted NSRCG sample) for students who were selected because they obtained a *master's degree*. We also excluded records of 825 students (or 40 percent of the weighted sample) who had majored in a *social science* field, as we needed to restrict the comparison group to recipients of STEM degrees. In addition, we excluded 34 records (1 percent of the weighted sample) of respondents who did not meet the *"time-elapsed since graduation"* criterion designed to select records for comparison (for more details, see above section entitled "Procuring the national comparison data"). Finally, since the LSAMP program is open only to *United States citizens or permanent residents*, we excluded an additional 17 records (less than 1 percent of the weighted sample) that did not meet this criterion.

The final national comparative dataset includes 1,907 raw records, representing 309,198 individuals graduating with bachelor's degrees in science and engineering during the 1990–91 and 1991–92 academic years. This dataset covers slightly over 98 percent of eligible records and about 44 percent of the original NSRCG longitudinal file.

Data Analysis Methodology. Different methods were utilized to analyze the available data, including descriptive statistics, correlation, and regression analyses. Conducted using SAS, a widely used statistical software package, all analyses were first performed using the LSAMP data set and, when appropriate, using the nationally representative comparison data (NSRCG). Prior to focusing the analysis for national comparison, a broad examination of the LSAMP graduate survey data was performed, including extensive analyses of program outcomes by student characteristics, including gender, year of bachelors' graduation, and field of undergraduate study. This preliminary process allowed us to better understand the full picture of LSAMP graduates' experiences and zero in on salient national comparisons. Throughout the report, these analyses of LSAMP-only data remain where appropriate.

For the comparative analyses, the NSRCG data set was divided into two samples—one with white and Asian respondents and one with black and Hispanic respondents. The latter sample was created to facilitate comparisons of the LSAMP students (all minority) to a national sample of underrepresented minorities; the former was used to compare LSAMP to a national sample of non-underrepresented minorities. When applicable, appropriate significance tests were conducted to ascertain whether differences found between LSAMP and the two national comparison groups were statistically significant.

Estimation and Significance Testing. Adjustments were made to account for the different sampling strategies used in the two data sets (LSAMP and NSRCG) in order to obtain unbiased estimates and specifically unbiased standard errors needed to test for significance. The LSAMP data set is based on a census of participants and, due to nonresponse, amounts to a large element sample. The NSRCG, on the other hand, is based on a complex sampling design using replicate weights. The Urban Institute conducted all analyses, unadjusted, and later contracted with NuStats (1) to create a data set that would permit adjusted analyses and (2) to conduct those analyses to compare against those produced by UI. The challenge was to produce a single data set (merging the LSAMP and NSRCG Panel) with replicate weights that can be used to generate contrasts and appropriate sampling errors (i.e., sampling errors that account for the complex design of the NSRCG data set and the weighted element sample of the LSAMP design). WesVar was then used to produce reported estimates and standard errors. Significant differences between statistics for both samples (LSAMP versus NSRCG) were computed using standard formulas. The p-values associated with the resulting statistics were used to characterize the significance levels of interest, at $\alpha = 95\%$, 99% and 99.9%. Comparison of UI (unadjusted) and NuStats (adjusted) results indicate that the estimates reported herein are quite robust; all relationships reported were significant in both analyses, both as one-tailed and two-tailed tests. The only notable and expected difference was that, in some cases, the level of significance of differences across groups was lower in the case of adjusted estimates.

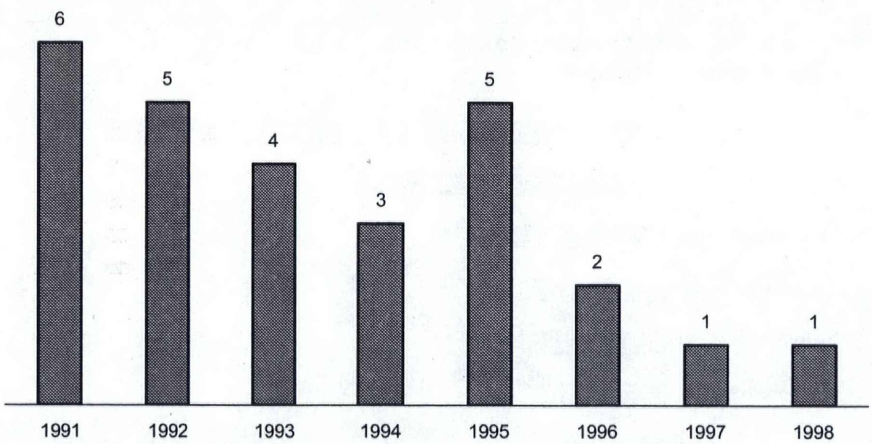
Section III. Process Evaluation Findings

This section reports on the findings from the process component of the evaluation, which was conducted in two stages: telephone interviews with staff at all Alliances and case studies of three selected Alliances.

Telephone Interviews

Data were collected from the 27 Alliances that were in existence at the start of this program evaluation. Figure 2 shows the year of origin for the 27 Alliances. Of these, currently four of the projects are in funding Phase I, 16 are in Phase II, and six are in Phase III.[9] There is quite a bit of variation in terms of the partner composition of an Alliance. On average, an Alliance has 11 institutional partners, with approximately nine four-year institutional partners and two two-year institutional partners. In addition, LSAMP projects on average tend to include a handful of other types of partners. These typically include industry partners that offer student internships and professional associations and organizations that contribute to career awareness efforts. The central office of an Alliance is usually located at the lead institution, which is typically where the PI or project director is employed. Approximately half the LSAMP lead institutions are Research I universities (as defined by the Carnegie classification).

Figure 2. Number of Alliances Created, By Year



Source: UI Telephone Interviews of Project Staff

LSAMP Governance, Structure, and Implementation

All Alliances have a project director, and 85 percent also have a project manager. Project directors described their primary responsibilities as providing leadership in project planning and implementation, overseeing coordination among partner institutions, directing the central office and overall budget, fundraising and procuring internship opportunities, and overseeing partners' compliance with the cooperative agreement and project goals. The project manager supports the work of the project director and typically oversees day-to-day operations of the project, provides support and direction to Alliance partners, maintains regular communications with site coordinators, and manages administrative work such as record keeping, budgeting, and data collection for the annual report.

[9] One of the 27 projects is no longer in operation.

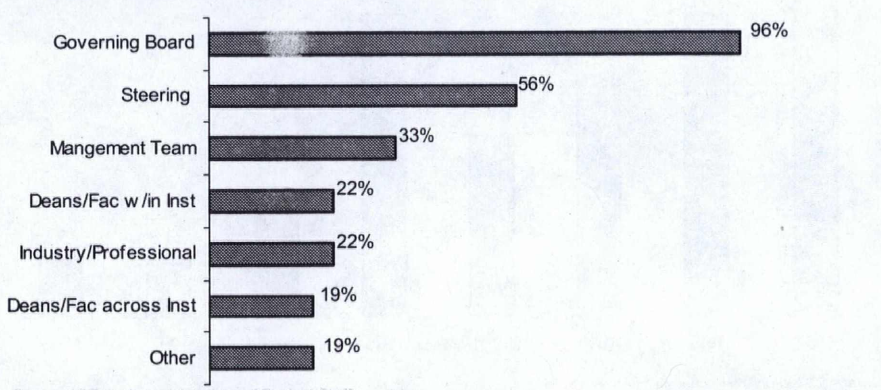
On average, the central office of an Alliance is staffed by 4.5 persons. Alliance staff is typically composed of a project director and project manager and, in some instances, an administrative assistant, data analyst, and evaluator. Of the LSAMP project directors that were interviewed, 40 percent reported that they are also in charge of directing LSAMP activities at their institution (which serves as the lead institution for the Alliance). Seventy percent of the project directors hold a faculty position, 35 percent hold an administrative position (e.g., chair, dean), and 20 percent hold some other type of position at their institution. Most project directors said that, with regard to their LSAMP project, they report to the president of the institution or someone higher, such as the chancellor.

In terms of the LSAMP project's location within the institutional structure of partner campuses, in about a third of the cases the project is run out of the office of a high-ranking administrator (e.g., president, provost, or dean), while in another third of the cases it is situated within a school division (e.g., the School of Engineering). In a fewer number of cases the project is located at the department level (19 percent), or in a non-academic unit (15 percent), such as the school's center for educational partnerships or office of research administration.

All of the LSAMP projects have a number of formal committees that meet on a regular basis. Alliances vary in the number of different types of committees they have, ranging from one to seven. The average number of committees per Alliance is three. Figure 3 displays the percentage of Alliances that include the various types of committees.

Figure 3. Types of Advisory Committees

Percent of Alliances Offering (N=27)



Source: UI Telephone Interviews of Project Staff

The most prevalent type of advisory committee is governing boards (96 percent), which typically consist of the presidents of partner institutions. A governing board usually meets annually in sessions that include a PI review of project progress, with the board providing direction and policy guidance. Steering committees are the second most common and are usually composed of site coordinators from the various partner institutions (56 percent). Steering committees tend to meet once a month to discuss implementation issues and various concerns of partner institutions. Third most common are management teams (33 percent), which usually involve all the co-PIs on the project or the deans of partner institutions. The management team generally makes the programmatic, policy, and financial decisions for an Alliance. In addition, a number of Alliances have committees involving faculty members and deans at the same institution (22 percent), committees involving faculty members and deans from across institutions (19 percent), and committees composed of industry and other professional partners (22 percent). Nineteen percent of Alliances involve some additional type of committee, such as an AMP operations oversight committee (made up of vice presidents of academic affairs from across institutions), a committee of institutional officers (made up of institutional research personnel who provide registrar data), and an evaluation committee.

Each Alliance was asked about its main goals. As expected, all Alliances cited increasing the number of STEM bachelor's degree recipients as a major goal. Sixty-three percent also spoke about the goal of increasing the number of minority students going on to STEM graduate studies or obtaining a Ph.D. in a STEM field. Sixty percent of Alliances identified other main goals, such as improving the quality of the STEM learning environment, providing undergraduates with research experience, developing institutional cultures where members value diversity at all levels, creating linkages with business and industry, and developing a true partnership with community colleges in working on pipeline issues. About half of the Alliances indicated that their goals had not changed over time. Meanwhile, about a third indicated that the project's goals had changed through a greater emphasis on graduate school attendance. A third of the Alliances cited other changes in project goals, such as greater emphasis on curriculum reform, community college students, and expanding undergraduate research opportunities.

When asked why their institution wished to establish an LSAMP program, respondents most commonly cited their institution's wish to increase diversity in STEM enrollment and degree attainment (41 percent) and to continue with previous efforts in the area of increasing minority representation in STEM (60 percent). When asked how and why partners were chosen, respondents said that partner institutions tend to include those with whom they have collaborated in related activities (42 percent), to have high minority enrollments (39 percent), and to offer certain STEM programs of interest such as engineering (15 percent). In addition, a few projects spoke about how partnership invitations were extended to all minority-serving institutions in the state or area, to all members of the same university system, and to institutions that act as feeder schools for partner institutions in the Alliance.

In terms of how approaches were determined, about a third of respondents reported a series of initial meetings in which representatives from the partner institutions gathered to identify solutions to barriers commonly encountered by minorities in STEM education. Respondents also said that they tend to adopt strategies that are based on their own experiences of what works (56 percent), that are shown to be effective by the research literature (37 percent), and that build on current or past efforts at partner institutions (15 percent).

The most commonly employed student recruitment strategies reported are the use of personal contacts or referrals by LSAMP faculty, student, or administrators; LSAMP presentations at community colleges and high schools; and LSAMP advertisement and recruitment efforts at college fairs, career fairs, and science fairs. These strategies also turned out to be the top three most effective recruitment strategies identified through telephone interviews by project directors and managers.

In terms of a formal application process, 78 percent of the Alliances have one. Half of these reported that the nature of the application/selection process varies across partner institutions within the Alliance. It is reported that more than half have a minimum GPA requirement, while fewer than half ask for a written essay, test scores, and letters of recommendation.

All the Alliances reported that they monitor student participants' progress. Most projects monitor at least all Level 1 (i.e., funded) students. LSAMP students are typically monitored every semester or quarter. The overwhelming majority of projects use course grades to monitor student progress, while about a third also use coursework information to assess progress (e.g., type and level of coursework, coursework completion, and reports from faculty).

Nearly three–quarters of Alliances reported that they provide systematic feedback to LSAMP students. Of those projects that provide such feedback to students, the overwhelming majority does so through meetings with project staff or faculty mentors. It is estimated that students typically receive such feedback once every semester or quarter, though some projects provide feedback to students more frequently.

When asked the main ways in which partners in the Alliance have interacted, interviewees spoke specifically about student research conferences (56 percent), campus coordinator meetings (37 percent), conference calls and e-mails (37 percent), resource sharing (33 percent), and steering committee and management team meetings (30 percent). In terms of the most effective strategies to promote collaboration, more than half (63 percent) of the interviewees cited meetings, conferences, workshops, and site visits. The lead institutions are said to foster linkages among Alliance partners by providing leadership, direction, and coordination. Lead institutions coordinate meetings and organize information exchange and dissemination.

Most Alliances (78 percent) have undergone a change in institutional partnership membership. Of those who have experienced a change in partnership composition, 48 percent have added a partner(s), 19 percent have lost a partner(s), and 33 percent have both added and lost partners. Most Alliances reported that their project has evolved through adding or expanding a major project component (68 percent), increasing the focus on transition to graduate school (32 percent); becoming more effective or efficient in certain respects (23 percent); and institutionalizing the project or components of the project (18 percent).

When asked about the major outcomes of their project, interviewees spoke about positively affecting STEM retention and degree production (85 percent), infrastructure change and institutionalization (33 percent), graduate school enrollment (29 percent), an increase in institutional awareness of minority issues (29 percent), and collaboration among partner institutions (22 percent). Asked about project impact on the infrastructure of Alliance institutions in terms of promoting diversity in STEM, interviewees most commonly discussed creating or enhancing diversity support systems and revising the STEM curriculum.

About three-quarters of the Alliances reported making efforts to disseminate or replicate project practices. A large number of Alliances reported that they have given a conference presentation on their project (70 percent), produced a publication on the project (45 percent), or published a scholarly article about the project (22 percent). A handful of Alliances said that they have disseminated information about their project in some other way (15 percent). Furthermore, a number of Alliances reported that student participation in faculty-mentored research has resulted in co-authorship of scientific journal articles.

When asked about factors that accelerate the attainment of project goals, the most common responses pertained to support from faculty and staff (35 percent), support from top institutional administration (35 percent), and close collaboration of Alliance partners (27 percent). In terms of the biggest challenges that Alliances have had to overcome, interviewees perceived these to be the lack of resources (37 percent) and the political climate, racism, or institutional indifference (26 percent).

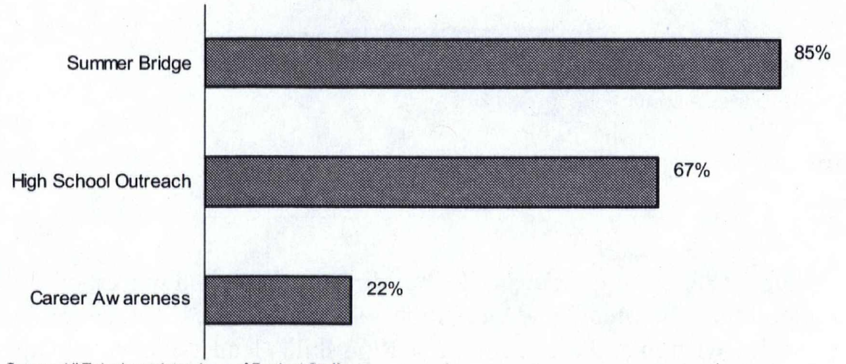
LSAMP Project Components

LSAMP projects collectively offer a wide range of activities and services. Data collected on the project components of the 27 Alliances can be organized under the broad categories of precollege development, student academic development, student professional development, faculty development, curriculum development, graduate studies development, and linkages with community colleges.

Precollege Development

Most LSAMP projects include at least some campuses that offer a summer bridge program to student participants (see figure 4). Of the 85 percent of Alliances that offer summer bridge, most offer it to all Level 1 participants. The proportion of partner campuses within an Alliance that offer a summer bridge program to LSAMP students varies widely, from all to less than half. Summer bridge typically involves such activities as college courses, workshops and seminars, career counseling, and social activities. Summer bridge programs tend to be residential in nature, run from 4 to 13 weeks, and usually include a stipend for students. While some of the summer bridge programs exclusively serve LSAMP students, others are shared with other intervention programs. Some of the LSAMP summer bridge programs involve community college transfers.

Figure 4. PreCollege Development
Percent of Alliances Offering (N=27)

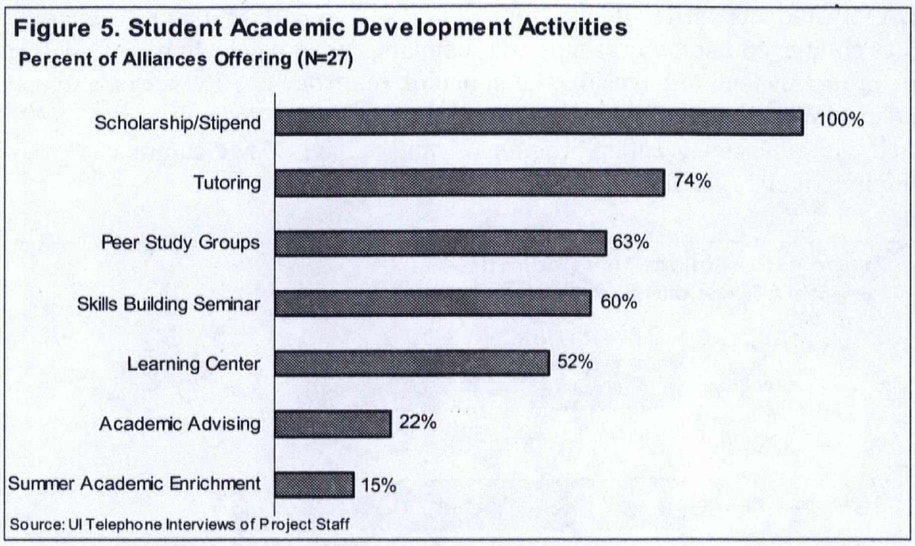


Source: UI Telephone Interviews of Project Staff

More than half of the Alliances also offer high school outreach activities. This includes LSAMP students visiting local high schools to give a science demonstration, tutoring high school students in STEM subjects, helping out at high school science fairs, and disseminating LSAMP recruitment material to high school staff members and students. In some instances, LSAMP collaborates in the outreach efforts of other STEM intervention programs that specifically target high school students who are interested in science or engineering. A handful of LSAMP projects reported carrying out STEM career awareness activities with high school students. Examples include female LSAMP students visiting high schools to talk to girls about math, LSAMP students participating in a precollege initiative where high school students are invited onto the college campus to learn about science disciplines, and science faculty visiting high schools on Saturdays to expose students to science professions and activities.

Student Academic Development

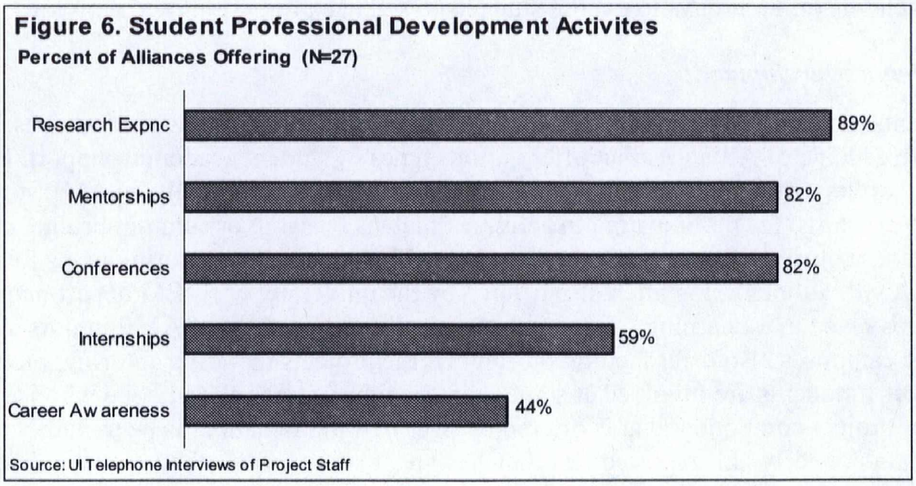
LSAMP students are exposed to an array of academic development activities and services. Figure 5 displays the percentage of Alliances that offer various types of student academic support. For instance, every Alliance offers a stipend to Level 1 (not Level 2) participants. Typically LSAMP students receive this stipend in exchange for participating in activities such as research or summer bridge, or for serving as a tutor or mentor. Tutoring is usually available to LSAMP students. This tutoring tends to be directly offered by LSAMP, although it is often also offered by the university or STEM departments. Tutoring commonly takes place in a Learning Center and is typically provided by LSAMP juniors and seniors, although some campuses also offer faculty tutoring. Of the projects that offer tutoring, most reported that almost all Level 1 students are involved at some point as either a tutor or someone who is tutored (or both). Another project component that is offered by over half the Alliances is peer study groups. Among the projects that do, nearly half reported that they have peer study groups that are formalized and structured and that tend to be tied to a specific course, while the remainder reported informal peer study groups forming among LSAMP students.



More than half the Alliances reported offering skills building seminars and workshops. Typically, almost all Level 1 students attend these seminars and workshops. Common topics include research skills, research presentation skills, written and oral communication skills, leadership, community building, interview and resume writing skills, and graduate school admissions. Some of these workshops are jointly sponsored by other related intervention programs. Just over half the Alliances also reported offering a Drop In or Learning Center where LSAMP students can meet and study together. A handful of Alliances also reported offering formalized academic advising to LSAMP students or summer academic enrichment (e.g., students taking courses while conducting research in the summer).

Student Professional Development

In terms of professional development, most LSAMP projects offer students such opportunities in the form of research experience, mentorship, and conference attendance (see figure 6). Most projects that offer undergraduate research experiences tend to offer them during the academic year as well as the summer.



While most Alliances reported that almost all of their Level 1 students participate in research, there is still much variation in the proportion of Level 1 students that do so across Alliances. LSAMP students who are in their junior and senior year are most likely to undertake research, although some projects offer such opportunities to freshmen and sophomores as well.

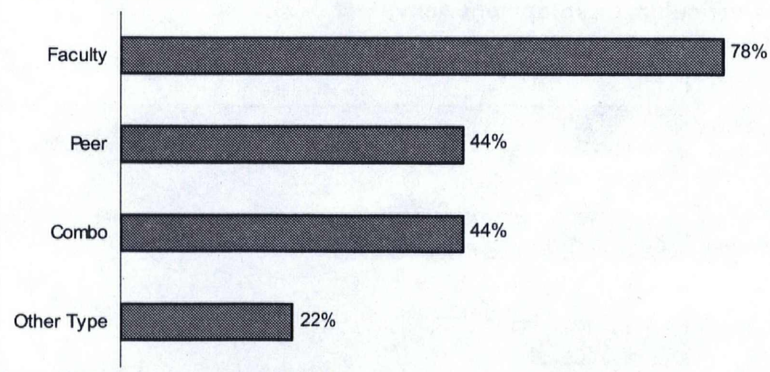
Most Alliances sponsor conference attendance by LSAMP students. Many projects organize their own Alliance-wide LSAMP conference, or cosponsor a conference with some other STEM intervention program(s). In some instances, LSAMP students attend not only their own Alliance conference, but other regional or national STEM conferences as well. At these conferences, LSAMP students may present papers or poster sessions, attend workshops, and network with representatives from industry and graduate schools. LSAMP projects commonly offer financial assistance to students who travel to present at a research conference. The estimated number of LSAMP students who attend such conferences varies widely across Alliances, with some reporting student numbers in the low hundreds.

Over half the Alliances also reported internships as a component of their project. Of those that did, over half reported that almost all their Level 1 students have internships. LSAMP students participate in internships with industry, colleges and universities, and government agencies and laboratories. Most are paid internships. LSAMP students who are interns tend to be juniors or seniors, although there are some opportunities for freshmen and sophomores. LSAMP offices coordinate internship opportunities by establishing contacts, disseminating information on internships, and assisting students in applying. In addition, nearly half of the Alliances conduct career awareness activities. Of those that do, the overwhelming majority reported that almost all Level 1 students attend such activities. These activities include career fairs, guest speakers, and field trips to research sites and industry.

Projects tend to provide mentoring to all or almost all Level 1 LSAMP students. LSAMP mentors are typically faculty members, although nearly half the projects reported providing both faculty mentors and peer mentors (see figure 7). Faculty mentoring is commonly provided through the context of faculty-mentored research. A small number of projects also recruits mentors who are industry professionals. About half the Alliances that offer mentoring reported providing some form of training to mentors.

Figure 7. Types of Mentoring Programs

Percent of Alliances Offering (N=27)

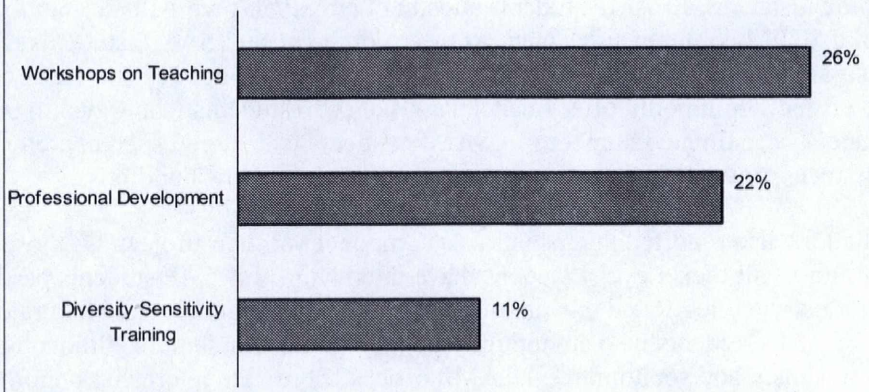


Source: UI Telephone Interviews of Project Staff

Faculty Development

About a quarter of the Alliances have offered faculty workshops on teaching (see figure 8). Topics covered included cooperative learning, critical thinking skills, application of graphing calculators to teaching calculus, and hands-on instruction. Nearly a quarter of the Alliances reported offering some other form of professional development to faculty members. Faculty professional development activities include financial support for faculty-mentored student research projects and faculty enrichment workshops. In addition, a few Alliances have employed diversity sensitivity training for staff members and/or faculty members, usually through either a workshop or conference attendance.

Figure 8. Faculty Development
Percent of Alliances Offering (N=27)

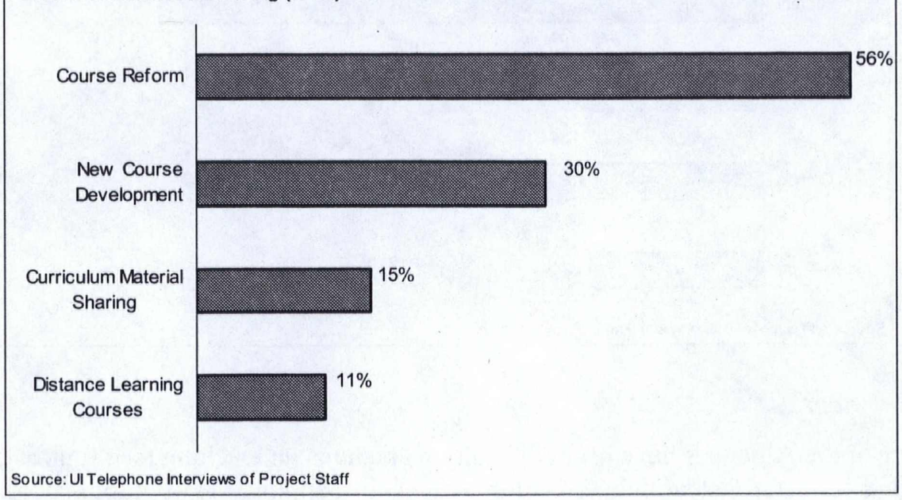


Source: UI Telephone Interviews of Project Staff

Curriculum Development

A substantial portion of the Alliances are engaged in curriculum development efforts (see figure 9). More than half of the Alliances reported work on course reform. The nature of the course reform varies, but most of these efforts involve STEM gatekeeping courses. Specific changes made to courses include increasing the use of technology, adding supplemental instruction (e.g., small group study), emphasizing collaborative learning, and integrating research. Nearly a third of the Alliances reported that LSAMP has played a role in helping to bring about new courses at some partner institutions. In addition, a few projects have engaged in other curriculum development activities, such as the sharing of curriculum materials across institutions or developing distance learning courses.

Figure 9. Curriculum Development Activities
Percent of Alliances Offering (N=27)



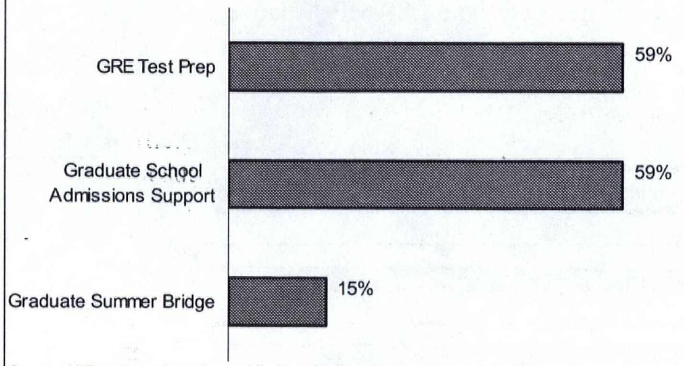
Source: UI Telephone Interviews of Project Staff

Graduate Studies Development

More than half the Alliances reported that some of their partner institutions offer GRE test preparation or assistance with the graduate school admission process (see figure 10). Graduate school admission support includes such things as workshops on the application process, individual advice and assistance from LSAMP coordinators in filling out forms and providing a recommendation letter, a databank on graduate programs and graduate peer mentors, and a graduate school fair. A few Alliances reported offering a graduate summer bridge, which commonly takes the form of students taking a graduate course while conducting research during the summer between graduating from college and beginning graduate school.

Figure 10. Graduate Studies Development

Percent of Alliances Offering (N=27)



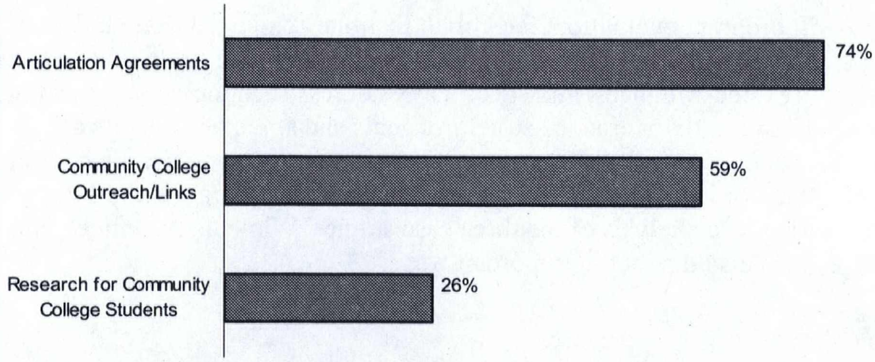
Source: UI Telephone Interviews of Project Staff

Linkages with Community Colleges

The LSAMP Alliances are working toward greater linkage with community colleges. Figure 11 displays the percentages of Alliances that have articulation agreements among partner schools, engage in community college outreach, and offer some research opportunities to community college students.

Figure 11. Community College Components

Percent of Alliances Offering (N=27)



Source: UI Telephone Interviews of Project Staff

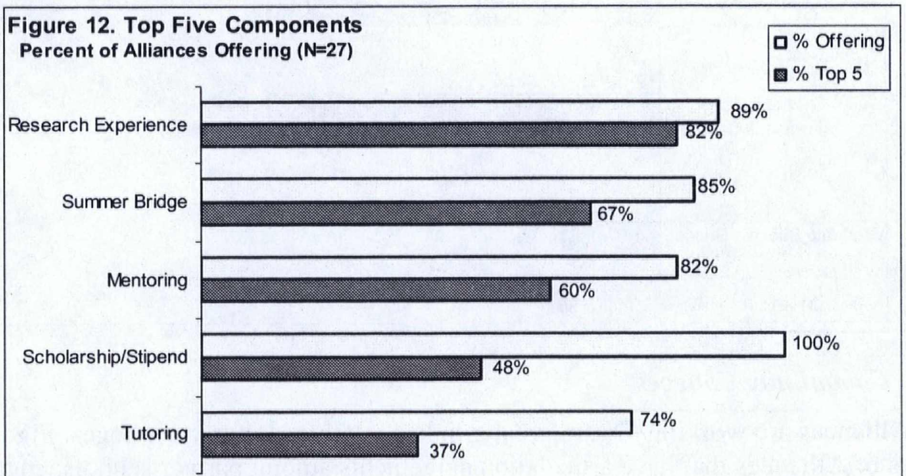
Most of the projects reported the existence of articulation agreements among partner institutions and community colleges. While in many instances there were already existing articulation agreements, nearly half of the Alliances reported that LSAMP has been at least partially responsible for helping in the development or the enhancements of more effective agreements.

Over half the LSAMP projects reported engaging in various community college outreach efforts. These include using data to identify prospective LSAMP students from community colleges, inviting community college students to STEM and LSAMP events, disseminating information to community college staff members and students about LSAMP and transfer to four-year institutions, and supporting collaborative research projects between faculty members at community colleges and four-year institutions. In addition, about a quarter of the projects reported that there are opportunities within their Alliance for community college students to engage in summer research.

The Top Five Project Components

Finally, Alliances were asked to identify their top five most important project components. A summary of the results is displayed in figure 12. The mostly commonly cited project components were research experience, summer bridge, mentoring, stipend, and tutoring.[10] The chart below also shows the frequency at which these project components are offered by the LSAMP Alliances.

Figure 12. Top Five Components
Percent of Alliances Offering (N=27)



Source: UI Telephone Interviews of Project Staff

Critical Issues Emerging from the Case Studies

As part of the LSAMP program evaluation, the Urban Institute conducted case studies of three Alliances. Detailed write-ups of each case study appear in appendix E. These case study write-ups provide an overview of each of the three Alliances, and specifically address such topics as project history and background, administrative and governance structure, goals and strategies, factors affecting implementation, lessons learned, collaboration among partner institutions, profile of student participants, participant experiences with LSAMP, and project impact. In this section, we highlight some critical issues that emerge from a cross-case analysis of the three case studies. While there is much commonality among the three projects, each is also distinct in important ways.

An Integrated Approach

An integrated intervention approach was found across the three case studies. All three case study Alliances provide student participants with financial, academic, social, and professional support. Though

[10] These can be compared to the "keys to success" identified in an earlier report on LSAMP (Sharp, Kleiner, and Frechtling 2000): summer bridge program, research experience, mentoring, drop-in center, caring staff, and Alliance structure.

the exact nature of the project activities and services tend to vary somewhat across Alliances, and even across partner institutions within an Alliance, all three projects do offer support in these four critical areas. This extended assortment of offerings is important because it provides a broad net of services and opportunities with which to assist students, and targets those particular areas in which barriers are known to be especially problematic for underrepresented minority students (refer to the literature review in appendix A). For example, data collected from the 27 Alliances reveal that approximately 60 percent of the projects involve summer bridge, stipends, and tutoring, in addition to faculty-mentored research. As demonstrated by results from focus groups conducted with LSAMP students, the needs of these students vary. There is variation in what draws students to the project as well as the services they consider most helpful.

A True Collaborative Effort

All three case study Alliances display a high level of collaboration on multiple levels. There appears to be much shared governance and collective decisionmaking taking place within the three projects. Although the central office of an Alliance is generally responsible for coordinating and overseeing the overall project, much in terms of how each of these three projects is carried out is determined by representatives from partner institutions. Two of the three case study Alliances have co-PIs who are not at the lead institution. In addition, each of the three projects includes several committees with membership drawn from institutions across the Alliance. Meetings of the steering committees, management teams, and so on enable high-level institutional administrators, faculty members, and project coordinators from across the Alliance to meet regularly to chart the course of their LSAMP project. Case study data reveal that participants perceive these meetings as a vital mechanism of collaboration, and as an important avenue to facilitate the mutual exchange of ideas and experiences from which they gain a great deal.

Connections Made Outside of the Institution

The LSAMP projects tend to differ from other intervention projects in that they not only foster student connections within the institution, but facilitate connections made outside of the institution as well.[11] Like other similar campus-based programs, LSAMP promotes students' integration with the institution by facilitating student interaction with peers and faculty and involvement in institutionally sponsored activities and events. LSAMP, however, goes a step beyond by assisting students to form relationships outside of their institutions. LSAMP is able to do this because its Alliance structure is premised on institutional partnership. Partner institutions work together in bringing about shared events like Alliance- or region-wide conferences that allow students to network with peers and faculty from partner institutions, and representatives from industry and graduate schools. By emphasizing the involvement of community colleges, LSAMP facilitates contact between LSAMP staff and students at two-year and four-year partner institutions. Some Alliances pursue community college outreach efforts and have revitalized or refined community college articulation agreements. For example, some partner institutions within COAMP and NYC LSAMP are currently developing better course coordination to smooth the transition between schools. Resource sharing also helps students to make connections across institutions as some partner schools have extended opportunities (e.g., summer research experience) to LSAMP students attending other partner institutions. Nonetheless, some LSAMP participants at community colleges indicated that they would like more opportunities to interact and network with four-year institutions.

[11] A few other programs such as NIH's Minority Access Research Career (MARC) and Minority Biomedical Research Support (MBRS) programs also adopt this approach.

Institutional Support as Key to Project Implementation

Spokespersons from all three projects noted the importance of receiving support from top institutional leaders at partner institutions. The push to pursue NSF funding for NYC LSAMP came about because the previous chancellor wanted to pull the various STEM intervention programs together into one coordinated effort. In the case of FGAMP, institutional support is perceived as a key factor in facilitating project implementation. Interviewees explained that endorsement by the president and other top officials often involves financial support, and eases the way to securing faculty involvement. Similarly, in the case of COAMP, the support and commitment of top officials were cited as being critical to the project's success. The former president at the lead institution (who served concomitantly as a chancellor of the Colorado State University system) was described as being "extremely committed" to the project and it is reported that people were very aware of this support from the top. The notable support that LSAMP projects receive from their host institutions likely results, in part, from shared goals. In the telephone interviews with all project directors or managers, the overwhelming majority reported that the goals of the project coincide with or complement those of their institution. This is because many of the participating institutions already had ongoing efforts to enhance institutional diversity (through enrolling and retaining minority students) and to increase the retention and graduation of STEM majors. Moreover, the lead institutions of several Alliances are minority-serving institutions.

Importance of Project Staffing

Evidence from the case studies suggests an important relationship between project staffing and project success. Many LSAMP participants praised their project director for his or her strong leadership, and the central office staff for (1) its efficiency in running a smooth project and (2) its effectiveness in fostering teamwork among Alliance partners. Some interviewees spoke specifically about the importance of having a site/institutional coordinator with a high-level position and clout, who can readily access resources and elicit the assistance of others. Such individuals, however, would also need to be very committed to the project given their busy schedule and other responsibilities. As the project director and manager of one Alliance noted, institutions need to recruit enthusiastic people who are already "working toward that end" rather than "just figureheads or people with big titles." They explained that it is integral to start with "a small group of key people" who have "passion" and who really want to be involved, and then build from that. Academic/activity coordinators are commonly perceived as key staff members who work at the front lines with students. In many instances, these individuals know their LSAMP students intimately as they are approached with academic and nonacademic problems. In the case of NYC LSAMP, several of the academic/activity coordinators are former LSAMP participants. These people know the program well and have developed a deep loyalty toward it, and can readily relate to the struggles of LSAMP students while serving as role models. One drawback, however, is the issue of continuous turnover as such individuals are apt to leave for graduate studies.

Reported Effects on Students

Project staff members, professors, institutional administrators, and students spoke about the many ways that LSAMP positively affects students. A common perception is that LSAMP participation leads to increased student interest, commitment, and confidence in STEM; provides valuable academic support and professional development; fosters supportive relationships with faculty and peers; and facilitates academic progress and preparation for graduate studies. These effects are likely to be due to the myriad strategies that LSAMP projects employ within its integrated approach. Interestingly, case studies and telephone interview data reveal that while individual projects differ slightly in the assortment of programmatic strategies undertaken in the pursuit of essentially the same goals, there appears to be a great amount of commonality in the perceived project effects on students.

Reported Effects on Institutions

LSAMP has affected institutions in multiple ways. Interviewees report that LSAMP has enhanced institutional capacity for student talent development, and brought about changes in institutional culture as well as in institutional policies and practices. Through LSAMP services and support, institutions assist students in their efforts to continue through the STEM pipeline. All three case study Alliances, along with other Alliances, report increases in minority and nonminority STEM enrollment and STEM degree attainment. In all three of the case studies, interviewees observed a change in institutional culture. For example, some COAMP interviewees spoke about greater faculty awareness, understanding, and responsibility for diversity. In the case of FGAMP, some credited the project with increasing dialogue among faculty about effective teaching and learning strategies, and the opening up of research labs to undergraduates. Similarly, some of the NYC LSAMP interviewees spoke about how more professors are now seeing research as an integral part of the undergraduate experience, and how institutions are placing a greater focus on affirming the equal opportunity clause.

In addition, across the three case study sites, significant changes in practice and policies are attributed to LSAMP. For instance, projects such as the NYC LSAMP are heavily pursuing course restructuring; over 18,000 students are reported to have enrolled in LSAMP restructured courses. Data drawn from the telephone interviews show that over half of the LSAMP projects are engaged in course reform efforts. The case study data reveal the varying nature of LSAMP-inspired changes taking place across various partner sites, including new emphasis on student participation in research grant proposals, the pursuit of research expositions by individual schools, development of a schoolwide research opportunity database, improvements in advisement procedures, creation of a standardized campus scholarship/funding procedure, and enhancement of community outreach and recruitment. Some participants noted that LSAMP serves as a "great recruitment tool" for schools and that the prestige and recognition it brings help participating institutions to secure funding to bring other intervention programs to campus.

Building on Past Experiences

All three case study Alliances are similar in that their projects build on a range of past experiences with minority STEM programs at individual partner sites. Alliance leadership tends to be composed of individuals who have years of experience in working with pipeline programs. For example, in the case of NYC LSAMP, the PIs involved in writing the original proposal were individuals who knew one another because of a shared interest and experience with administering minority STEM programs. Moreover, across Alliances it is reported that many of the participating institutions were invited to join the partnership precisely because of their track record in implementing similar initiatives and programs, though most of these were narrower in subject scope and at the campus level. In some cases, like that of FGAMP, the project came about as a natural next step following involvement with such a "forerunner" as NSF's Comprehensive Research Centers (CRC) program. Similarly, efforts to establish COAMP stem in part from the project director's own experience with NSF's Research Careers for Minority Scholars (RCMS) grant. For all three case study Alliances, the LSAMP program was a means to combine and scale up participating institutions' past and current STEM intervention efforts and to become part of either a system- or a statewide pipeline program. The LSAMP program has benefited from the accumulated experiences that various leaders and staff members bring to the projects. Telephone interview data reveal that the selection of project strategies is primarily determined by what is deemed effective based on past experience as well as the research literature.

Leveraging Resources

The three case study Alliances appear to be engaged in a significant degree of resource leveraging. Across sites there are various instances of institutional resources being used to support LSAMP, including the institutionalization of coordinator positions, office space, support services of institutional personnel, and release time for some faculty members to work with the project. In some cases, tutoring for LSAMP students is now institutionalized—adopted and paid for by the institution rather than the project. Resource leveraging also takes the form of collaborating and sharing resources with other minority or STEM-based programs. For example, on the campuses of partner institutions, LSAMP will commonly cosponsor activities such as workshops, tutoring, and student research conferences (or travel to conferences). LSAMP staff and coordinators of cosponsoring groups believe that this is a mutually beneficial relationship that strengthens both parties and that results in more student opportunities. In addition, this leads to greater efficiency for institutions as it minimizes redundancy in effort. Moreover, some Alliances (or individual sites) are able to leverage their record of success and the LSAMP Program's prestige to secure additional funding from external sources. Concomitantly, partner schools can leverage the prestige and success of the LSAMP project in seeking funding for other related programs. As explained by the project director of NYC LSAMP, "in the case of some institutions, some of the funding that they achieved could not have been possible without AMP," because "unless you have some research activities going on, there's no kernel of growth." The project director of FGAMP noted that data on LSAMP student performance, retention, and graduation rates were a "big factor" in their successful bid to secure yearly appropriations from the state legislature.

Tracking and Involving LSAMP Graduates

In all three case study Alliances, there were indications that LSAMP graduates are a rich resource with great potential for continuously engaging with, and contributing to, the projects. On our site visits we had an opportunity to speak with some LSAMP graduates, who were generally very appreciative of LSAMP. A few of them are employed as activities coordinators for the NYC LSAMP, and seemed happy to be able to give something back to the project through their own work. In addition, we heard about cases in which graduates return to campus as company recruiters to specifically interview LSAMP students, or those who attend LSAMP functions to show their support and to interact with students. Alliances such as COAMP recognize that their graduates constitute an important group that needs to be tracked and hence are currently setting up a system to maintain regular communication. Such contact with LSAMP graduates can enable projects to collect data on long-term participant outcomes, develop a network of graduate mentors, and tap into a potential source for fundraising. As results from the graduate survey illustrate, LSAMP graduates are satisfied with their LSAMP experience (over 90 percent of respondents said they would recommend the program to others), and many remain in contact with a LSAMP peer, faculty member, or project coordinator (52 percent).

Section IV. The LSAMP Model
Research and Theory Underlying Approaches and Strategies

This section seeks to define the LSAMP model and to discuss the model's empirical research and theoretical bases. It attempts to answer the questions: Is there a recognizable LSAMP model? If so, what research and theoretical bases have informed its approaches and strategies? What empirical evidence exists that these approaches and strategies are indeed effective for underrepresented minorities (URMs),[12] who are the program's targeted participants?

Before we begin to answer these questions, it is important to understand that the LSAMP model addresses dual goals: retention of participants through graduation with a baccalaureate degree *and* retention of participants in the STEM pipeline (which implies graduation with a STEM major and enrollment in a graduate STEM program). In terms of ensuring the retention of participants through a baccalaureate degree, the LSAMP approach can be best explained by the Tinto Theory of Student Retention. To explain the LSAMP approach to addressing the second goal—retaining students in the STEM pipeline through graduation and subsequent enrollment in graduate school—we draw on the concept of disciplinary socialization, the familiarization of novices with the process of "professional performance and discourse in the academic sciences" (Bowman and Stage 2002, p. 123).

Academic and Social Integration: The Tinto Model of Student Retention

In attempting to determine the reasons why students leave undergraduate institutions, Tinto developed a theory of departure to explain the process that leads students to withdraw from college (Tinto 1993). In so doing, he drew on the work of Arnold Van Gennep, a social anthropologist, and Emile Durkheim, a sociologist, and their theories of rites of passage and suicide, respectively. Van Gennep theorized that persons (or groups) moved from one situation (or group) to another, with the process occurring in three stages: separation (from the old), transition (to the new), and incorporation (of the values and mores of the new). Tinto sees college students as moving from one community (family, high school) to another (college), with all the adjustment problems that these entail until the student is successfully integrated into the new community. Tinto draws on Durkheim's theory of suicide to explain the process whereby students withdraw from college. According to Durkheim, one type of suicide occurs when an individual is unable to become integrated socially or intellectually into communities of society. Similarly, according to Tinto, withdrawal from college results partly from an individual's lack of integration into the academic community.

Tinto's model, which is longitudinal and interactional in character, concerns the process of departure as it occurs within an institution of higher education and focuses primarily on a student's experiences within the institution immediately after entry and up to departure. This model describes the progression of an individual towards departure from the institution as arising from a longitudinal process of interactions between the individual and other members of the academic and social systems of the institution. Tinto argues that an individual's level of academic and social integration, which is the result of accumulated experiences and interactions within the institution, will determine whether or not that individual leaves the institution prematurely or remains to complete a degree.

The institution can, through its formal and informal structures, assist the social and academic integration of the student and thus encourage persistence in the system. The function of these structures should be to smooth the transition of the student into his or her new environment encourage the building of learning communities with peers, foster interaction between students and faculty and staff, identify student needs and provide adequate support, and foster academic involvement and learning, among other activities. In

[12] See note 1.

outlining his model, Tinto saw the need for retention programs specifically tailored to the needs of different groups of students, such as older students, honor students, students of color, transfer students, and academically at-risk students. He also recognized the value of what he termed "breaking down the campus into smaller parts" (p. 199), by which he meant forming smaller communities that are more manageable and less intimidating to students.

Much of the research on college student attrition has drawn on the Tinto model, particularly through examining the effects of academic and social integration on students' college persistence or withdrawal. A significant body of studies by various researchers offers support to the validity and usefulness of the theoretical model (Bers and Smith 1991; Braxton, Brier, and Hossler 1988; Cabrera, Castaneda, Nora, and Hengstler 1992; Cabrera, Nora, and Castaneda 1992; Nora, Attinasi, and Matonak 1990; Pascarella, Smart, and Ethington 1986; Pascarella, Terenzini, and Wolfe 1986; Stage 1989; Stoecker, Pascarella, and Wolfe 1988; Williamson and Creamer 1988). Among the few studies in this area that have conducted analyses on minority student populations, Stoecker, Pascarella, and Wolfe (1988) found academic and social integration to be important determinants of persistence, while Nora (1987) found that these factors did not significantly affect retention among Chicano community college students.

Tinto's model is related to the work of Astin's college impact model ("input-environment-output"), and his theory of student involvement. Simply put, Astin postulates that the degree and nature of collegiate impact on students results from the quality of effort or involvement students experience through opportunities provided by the institutional environment to interact with other people and ideas. Research on the undergraduate student experience by Pace (1984) also has as a basic tenet that student learning and development require investment of time and effort. The theoretical emphasis on "integration" by Tinto, "involvement" by Astin (1984, 1985), and "quality of effort" by Pace (1984) are all very similar and have greatly influenced the manner in which we view the college student growth process.

The LSAMP model utilizes strategies and approaches that focus on helping students achieve academic and social integration and, ultimately, graduation from college. These are summer bridge, scholarships/stipends, peer study groups, skills building seminars, learning centers, academic advising, summer academic enrichment, faculty workshops on teaching, diversity sensitivity training for faculty, new course development, and others listed in figure 14. As we can see, several of these strategies serve the purpose of academic and social integration with an emphasis on *integration in their science or engineering majors.*

Socialization into Science: The Professionalization of Scientists

In writing about the scientific community, Gaston (1989) states:

> Scientists go through a process that socializes them to the conventional perspectives of their disciplines and specialties. In that indoctrination they learn the logic of inquiry and how to evaluate evidence. They become scientists during, and as a result of, this experience. (p. 132)

In spite of a general acceptance of the fact that scientists *do* undergo a socialization process, very little has been written about this process. Delamont (1987), in reviewing literature on the sociology of science over a 15-year period, identified research on the socialization of scientists as one of the three areas that had been neglected in this field. She comments on the "need for sociologists of science to examine normal science, the paradigms inscribed in curricula, and the ways that scientists' tacit knowledge is reproduced through 'craft' apprenticeship" (p.165). A review of the sociology of science literature since Delamont's article did not reveal more recent studies of the type called for in her article.

Disciplinary socialization is the term used by Bowman and Stage (2002) to characterize the process "by which a student becomes familiar with the process of professional performance and discourse in the academic sciences" (p. 123). These researchers cite the need for students of science to participate actively in their fields in order to understand more easily the conventions of science. They recommend participation in undergraduate research as a means to prepare students for graduate programs in the sciences. Writing about professionalization, Dryburgh (1999) describes three aspects of this process as (1) adapting to the professional culture, (2) internalizing the professional identity, and (3) demonstrating solidarity with others in the profession.

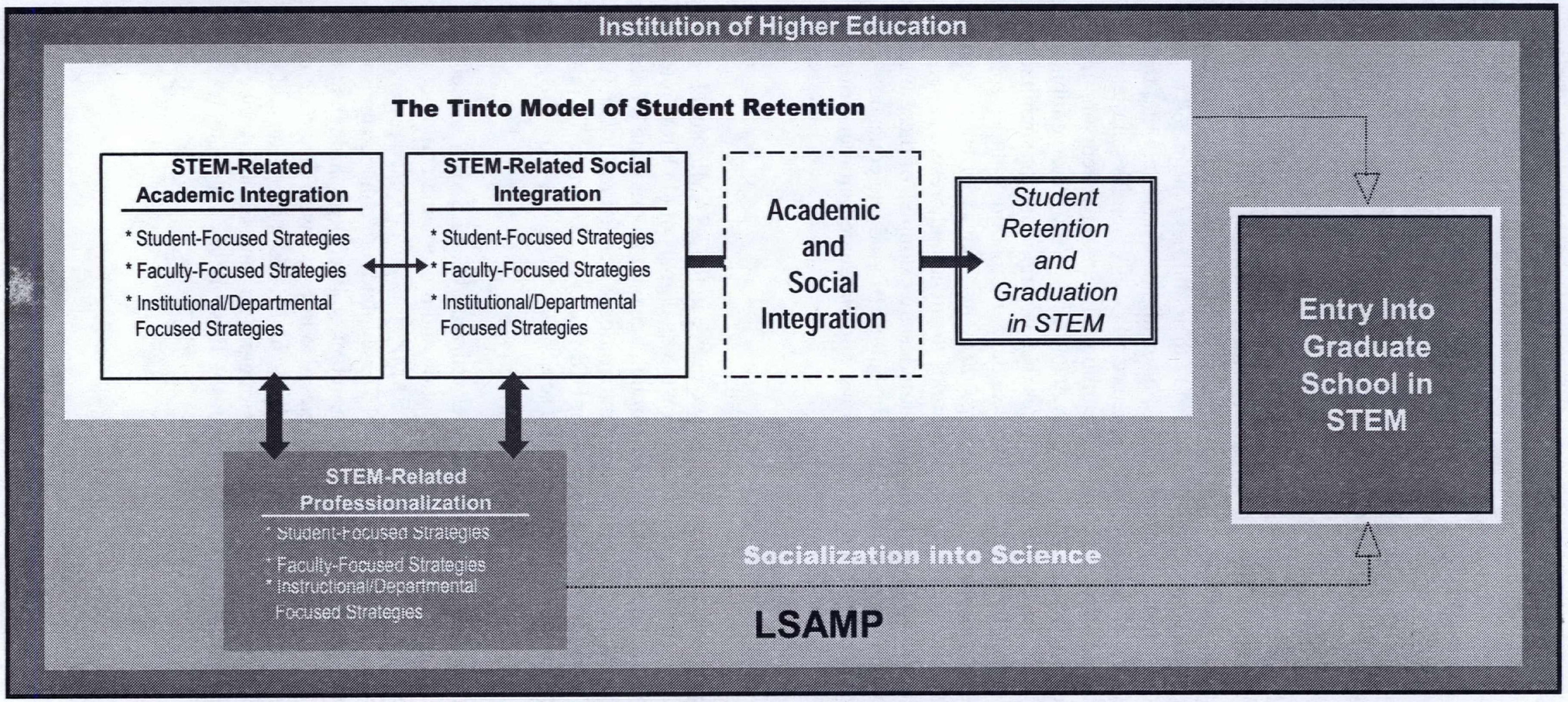
What is the process through which novices become socialized into scientific disciplines? Are opportunities to become socialized accessible to all individuals with an interest in science? It has been argued that some groups accumulate advantages important for socialization into science while others do not, with access for certain groups denied for reasons unrelated to their abilities but related to ascribed characteristics, such as race/ethnicity and sex (Merton 1973). For example, researchers find that African American, Hispanic, and American Indian students and women of all races/ethnicities are less likely than white or Asian males to be exposed to experiences and opportunities that are the precursors to membership in a scientific community (Dryburgh 1999; Mulkey and Ellis 1990). Interventions to expose these underrepresented groups to experiences and opportunities that are important for socialization into science must be provided by programs whose goal is to increase the participation of underrepresented groups in STEM fields. Strategies such as provision of undergraduate research experiences, mentoring, professional internships, career awareness activities, opportunities to attend and present papers at scientific conferences, and opportunities to publish scientific articles are examples of these interventions. Included are efforts to prepare program participants to enter the culture of graduate education: GRE test preparation workshops, support with graduate school admissions, and Graduate Summer Bridge programs.

The LSAMP Model

Figure 13 shows how the two research streams described above merge in the LSAMP model. The figure depicts a program, nested within the institution, that focuses on the dual goals of (1) URM retention through graduation and (2) retention in the STEM pipeline through entry into a graduate STEM program. Strategies, therefore, to foster students' academic and social integration, as called for in the Tinto model, have been developed around what is known to be effective for URMs *in STEM majors.* To fulfill the program's second focus—induction and socialization into the scientific professions—the program has crafted a third set of strategies: STEM-related professionalization.

Found on the following page, figure 13 lists the main strategies utilized by the LSAMP model and identifies their contributions to the academic and social integration and professionalization of program participants. The graph depicts the relationship of the set of LSAMP strategies focused primarily on academic integration with those focused on social integration. These interact to enhance the social and academic integration of LSAMP participants, resulting in their retention in college through attainment of a *baccalaureate* degree. The set of professionalization strategies also interacts with the academic and social integration strategies, contributing to the student's academic and social integration and, ultimately, to his or her graduation with a *STEM* degree. This last set of strategies has an additional, independent effect on student entry into a STEM graduate program. Obviously, these individual strategies may serve more than one purpose, as is shown in figure 14.

Figure 13. LSAMP Model



Strategies and Approaches: Elements of the LSAMP Model

Strategies in figure 14 are the major approaches undertaken by the LSAMP Alliances as described earlier. These have been characterized as being student-, faculty-, and institutional-/department-centered. According to respondents (to the telephone interviews), these activities or approaches were chosen based on Alliance members' own experiences of what works, effective strategies identified in the research literature, and current or past efforts of partner institutions. A comprehensive review of the literature on strategies and approaches that increase the participation and persistence of URMs in STEM, conducted as part of this study and found in appendix A of this report, cites the support provided by empirical research for most of the LSAMP approaches and strategies that comprise the model. The brief discussion presented below of each of the strategies for which there is evidence of effectiveness draws on this more complete and detailed literature review (references to publications cited in the following section can be found in appendix A as well).

Figure 14. Strategies and Approaches: Elements of the LSAMP Model

Focus/Activity	STEM Academic Integration	STEM Social Integration	STEM Professionalization
Student			
Summer Bridge	✓	✓	
Scholarship/Stipend	✓		
Peer Study Group	✓	✓	
Skills Building Seminar	✓	✓	
Learning Centers	✓	✓	
Academic Advising	✓		
Summer Academic Enrichment	✓		
Tutoring	✓		
Research Experience	✓	✓	✓
Mentorships	✓	✓	✓
Conferences	✓		✓
Internships	✓	✓	✓
Career Awareness			✓
GRE Test Preparation	✓		✓
Graduate School Admissions Support			✓
Graduate Summer Bridge	✓	✓	✓
Faculty			
Workshop on Teaching	✓		
Diversity Sensitivity Training	✓	✓	
Faculty Research Program	✓		
Institutional/Departmental			
New Course Development	✓		
Curriculum Material Sharing	✓		
Distance Learning Courses	✓		
Changes in Institutional/Departmental Policies and Practices	✓	✓	✓

Summer Bridge. While research on the effects of these programs is limited, a number of studies have documented positive effects in terms of persistence (Ackermann 1991; Garcia 1991; Gold, Deming, and Stone 1992; Penick and Morning 1983), academic skills test scores, first-year retention, and graduation rates (Evans 1999).

Scholarships/Stipends. In general, national studies have consistently found student aid to be a positive influence on student persistence (Murdock 1987; St. John 1991; St. John, Kirschstein, and Noell 1991). For example, a report by the U.S. Department of Education found that degree completion in science and engineering was positively related to receiving financial aid (2000). Among studies that have found differences among forms of financial aid on persistence, the preponderance of evidence suggests that the most beneficial forms are scholarships and grants (Pascarella and Terenzini 1991).

Peer Study Groups. Peer study groups are a fundamental component of several successful programs to increase the achievement and retention of URMs in STEM. Program evaluation results of both the Mathematics Workshop Program (MWP) and replication programs have shown that workshop participants who work in peer study groups are more likely to persist in SME, graduate, and earn high grades in the study subject (Alexander, Burda, and Millar 1997; Bonsangue and Drew 1995; Fullilove and Treisman 1990; Moreno and Muller 1999; Murphy, Stafford, and McCreary 1998; Treisman 1992). A meta-analysis of the effects of small-group learning on undergraduate STEM students found that various forms of small-group learning are effective in increasing academic achievement, persistence in STEM, and developing more favorable attitudes toward learning (Springer, Stanne, and Donovan 1999).

Skills Building Seminars. The effectiveness of seminars and workshops to build study skills, test-taking strategies, time-management, and other skills that are useful to college success has been rarely studied (Gándara 1999), although limited evidence that they are effective has been found (Novels and Ender 1988).

Learning Centers. While there is not much research on the effects of learning centers, observations linking their presence on campus to student learning have been documented (Holton and Horton 1996).

Academic Advising. There have been several studies of academic advising as a strategy used in retention programs. Of these, some studies have established their positive effect on student retention or satisfaction with their institutions (Backhus 1989; Forrest, cited in Pascarella and Terenzini 1991; Lowe and Toney 2001; Trippi and Cheatham 1991).

Tutoring. Tutoring has been shown to be effective in increasing student persistence, positive attitudes toward subjects, and student performance (Carman 1975; Gahan-Rech, Stephens, and Buchalter 1989). No differences in achievement outcomes have been found for peer tutoring versus staff tutoring (Moust and Schmidt 1994). Benefits of tutoring have been established not only for those receiving tutoring, but also for the tutors themselves (Bargh and Schul 1980; Good, Halpin, and Halpin 1998).

Research Experiences/Internships. The benefits of research experiences with faculty and internships with industry are well established. Several studies have found that research experiences and internships result in retention in a STEM major, heightened interest in science and engineering, graduate school attendance, choice of a STEM career, and social integration (Hackett, Croissant, and Schneider 1992; Highsmith, Denes, and Pierre 1998; Nagda, Gregerman, Jonides, von Hippel, and Lerner 1998; Pascarella and Staver 1985; Walters 1997). Some of these studies have shown that the effect may be stronger for URM students.

Research experiences and internships have additional benefits for students. For example, these types of experiences may result in opportunities for informal mentorship due to close contact with faculty. If research work is paid, this has an added effect of helping students financially; for URMs, this is especially useful because many of these students are more likely to need financial support and, as a result, to seek employment. While a job unrelated to students' academic program may detract from academic pursuits, one that is related can enrich and complement students' academic work through experiential learning. Studies have shown that holding a part-time job off-campus may be negatively related to persistence in college (Astin 1993), especially for URMs (Nora, Cabrera, Hagedorn, and Pascarella 1996). Pascarella and Terenzini (1991), in their review of the research on this topic, concluded that the evidence suggested that working during college, especially in a job that was related to one's major or career goals, had a positive impact on career choice, attainment, and level of professional responsibility attained early in a career.

Mentorships. Although mentoring has become an important element of most intervention programs for URMs, research evidence on its effectiveness continues to be mostly qualitative. What evidence does exist, however, suggests that for minority students, mentoring results in such positive outcomes as higher GPAs, lower attrition, increased self-efficacy, and better defined academic goals (Santos and Reigadas 2002; Schwitzer and Thomas 1998; Thile and Matt 1995). Mentoring has been said to facilitate students' academic and social integration (Redmond 1990).

Career Counseling/Career Awareness. There is a great deal of research to establish a strong relationship between career development and student background, particularly socioeconomic status (Hill, Pettus, and Hedin 1990; Mestre and Robinson 1983; Rolle 1977). Scientists tend to come from well-educated white families (Grandy 1994; Pearson 1986). Lack of knowledge and familiarity on the part of URMs in terms of what constitutes careers in STEM may contribute to their limited presence in these fields (Hill, Pettus, and Hedin 1990). Knowledge about STEM careers and exposure to scientists and engineers have been found to increase minority students' commitment to a STEM major, degree aspirations, and commitment to a STEM career (Good, Halpin, and Halpin 2001; Rolle 1977; Wyer 2001).

GRE Test Preparation. Research on test preparation for the Graduate Record Examination (GRE) has found positive effects on test scores (Evans 1977; Powers 1987; Swinton and Powers 1983). These effects may be linked to test familiarization and test anxiety reduction.

Faculty Workshops on Teaching. While this review uncovered no research showing the effect of faculty workshops on pedagogical skills, there is ample research to document the deleterious effects of poor teaching on STEM majors, including URM students (Brown and Clewell 1998; Hagedorn, Siadat, Nora, and Pascarella 1997; Hilton, Hsia, Solorzano, and Benton 1989; Seymour and Hewitt 1994). Researchers have reported that the poor quality of instruction in science, mathematics and engineering courses is one of the most frequently cited factors contributing to students switching out of STEM majors.

Curriculum Reform. Much concern has been expressed about the quality of STEM courses, particularly introductory courses. In tandem with pedagogical reform, curricular reform has been prominently cited as one of the major problems in science and mathematics education. Laws (1999) has identified over 500 reports published since 1983 that address the problems of science and mathematics education.

This description of the LSAMP model traces its theoretical background as well as its roots in empirical research. As can be seen from the discussion above, the development of the model rests upon well-established literature on intervention strategies and approaches, and represents an advance in the knowledge base concerning what works to increase the participation and success of URMs in science and engineering fields.

Section V. Summative Evaluation

The second major component of this evaluation assesses the extent to which LSAMP has achieved its goals. As mentioned in the introduction, the LSAMP program was designed as a comprehensive strategy intended to increase the quality and quantity of minority students who successfully complete baccalaureate degrees in science, technology, engineering, and mathematics (STEM) and who continue on to graduate studies in these fields. As it aims to make a positive impact on STEM fields, LSAMP's success may be measured by the program's ability to bring about a significant change in those areas targeted, such as the number of underrepresented minorities graduating with baccalaureate STEM degrees and persisting through to graduate study in STEM. This section of the report evaluates the success of LSAMP in achieving these student-focused goals, and also reports on the program's impact on the diversity of the STEM workforce, on the knowledge base about effective models of programs to increase the participation of underrepresented minorities in STEM, and on participating institutions of higher education (IHEs).

1. Impact on Student Participants

The conclusions presented herein are based mainly on a quantitative analysis of data collected via a survey of LSAMP participants who graduated between 1992 and 1997, and an NSF longitudinal survey of BA recipients. As a specific set of questions guided the design of the LSAMP survey used to collect outcomes data, short answers to these questions guide the presentation of findings. These are organized according to the three main outcomes of interest—undergraduate performance, graduate school enrollment, and graduate school completion.

When appropriate, findings are compared to a nationally representative sample of STEM bachelor degree recipients. This national sample was divided into a "white and Asian" sample and an "underrepresented minority" sample in order to provide two important comparisons—namely, LSAMP (all underrepresented minority) participants versus a national sample of underrepresented minorities, and LSAMP versus a national sample of white and Asian graduates. For more details regarding the analyses or the data used for comparison see section II of this report (Methodology). The tables referenced throughout this section are found in appendix F.

Undergraduate Performance: Improving the Academic Success of Students in STEM

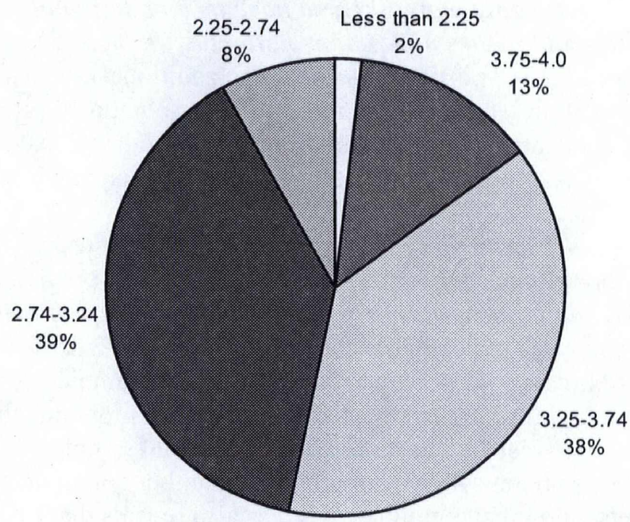
This section of the report explores the performance of LSAMP graduates relative to that of other underrepresented minorities and whites and Asians.[13]

As measured by undergraduate GPA, LSAMP participants outperformed, on average, national comparative samples of underrepresented minority and (to a lesser extent) white and Asian students (table F-1). A review of the distribution of GPA among LSAMP students reveals that *half* of the LSAMP participants graduated with a high GPA (3.25 or above), and only a small percentage (< 10 percent) graduated with a rather low GPA (2.25 or below)(figure 15). There are no significant gender differences in GPA for LSAMP graduates. There are, however, some differences in GPA related to parental education. Not surprisingly, the data reveal that the highest performing students are more likely to come

[13] The data set compiled for analysis does not contain information on LSAMP students that did not graduate. Hence, we cannot assess whether the retention rate (in undergraduate school or in STEM) is somehow greater among LSAMP participants than among the general student population.

from higher socioeconomic status (SES) households (as proxied by the parents' education), while the lowest performing students are more likely to come from low-SES households.[14]

Figure 15. Undergraduate GPA: LSAMP Participants



Note: Data for those pursuing graduate degrees only.
Source: UI LSAMP Graduate Survey, 2002. See Table F-1 for full data.

Comparing the GPA of LSAMP participants to that of a national sample of underrepresented minorities shows that LSAMP participants are significantly more likely to perform in the highest GPA categories, and significantly less likely to perform in the lower GPA categories. The analyses also show that LSAMP participants are as likely as whites and Asians (the two ethnicities that comprise the non-underrepresented-minority comparison group) to perform in the highest (3.75 and above) and lowest (2.24 or below) GPA categories, but more likely to perform in the second-highest category (3.25–3.74) and less likely to find themselves in the second-lowest performance stratum (2.25–3.24). *These findings suggest that, as measured by GPA, the average overall performance of LSAMP awardees, versus that of nationally representative samples of underrepresented minority and white and Asian students, is significantly higher.* It is important to note that some Alliances indicated that many (but not all) of their partner schools use GPA as a selection criterion, which would suggest that at those LSAMP schools the GPA of participants would be above-average. But this only applies to a limited number of institutions. More important is the fact that, across all institutions, participants are expected to maintain a minimum GPA level (which varies across institutions) in order to remain in the program. This requirement likely helps to encourage participants to perform well.

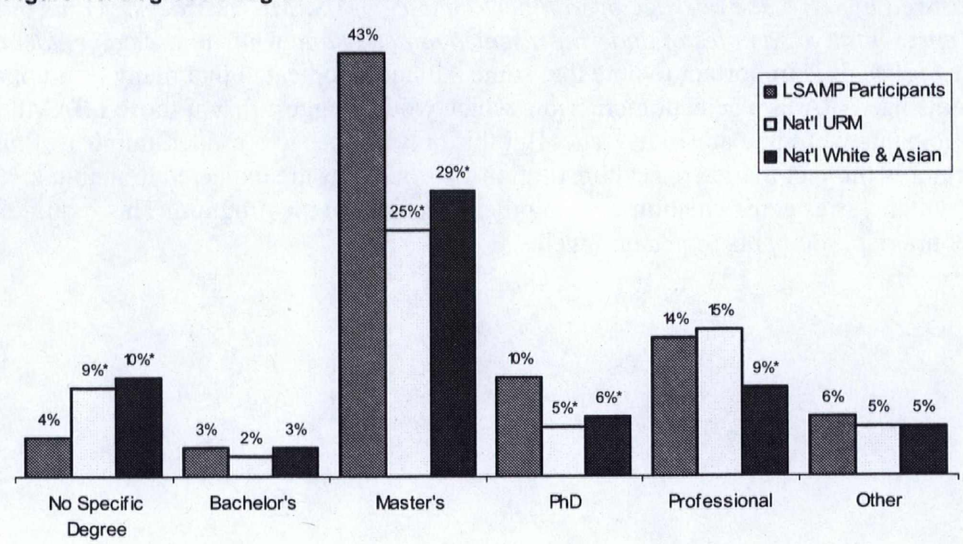
---

[14] Socioeconomic status was proxied by the highest educational level achieved by a respondent's mother or father. This analysis was originally conducted using different measures of family SES: mother's educational level, father's, or the highest of the two. Results were constant (or "robust") across these different specifications of family SES. Results are not included here but are available upon request.

LSAMP participants are significantly more likely to have taken additional post-BA coursework than underrepresented minorities and whites and Asians nationally *(table F-2A).* At the time of the survey, almost 80 percent of former LSAMP participants had taken additional courses, compared to about 62 percent of a national sample of underrepresented minorities and a national sample of whites and Asians. On average, then, LSAMP students are significantly more likely to have taken additional coursework after obtaining a bachelor's degree than either URMs (non-LSAMP participants) or non-URM students.

LSAMP participants are significantly more likely to enroll in graduate programs and to pursue master's and doctorates than either comparison group. As is true in the national population, LSAMP participants are most likely to pursue a master's degree, followed by professional degrees and doctorates. *(table F-2A).* Analyses indicate that about 65 percent of LSAMP students pursued graduate degrees, compared to approximately 45 percent of the comparison samples. In addition, a significantly larger share of LSAMP participants pursued master's and doctoral programs than either comparison group. Specifically, the data suggest that, as a share of the national samples, LSAMP participants are about 50 percent more likely to pursue an MA or a PhD than either comparison group. Restricting this analysis only to participants who pursue graduate degrees also reveals that LSAMP graduates are more likely enroll in academic (master's and doctorates) over professional programs than their national URM peers. In so doing, their enrollment patterns mirror those of the white and Asian sample. Finally, as a percentage of all LSAMP students, those seeking degrees were most likely to pursue a master's degree (43 percent), followed by professional degrees (14 percent) and doctorates (10 percent) (figure 16). This pattern is also true of the two national comparison groups. It is interesting to note that national URM and non-URM sample members were twice as likely as LSAMP participants to state that their post-bachelor's coursework was not in pursuit of a specific degree. This would suggest that LSAMP students are more focused or directed on their studies, or have clearer goals.

Figure 16. Degrees Sought: Post-Bachelor's Coursework

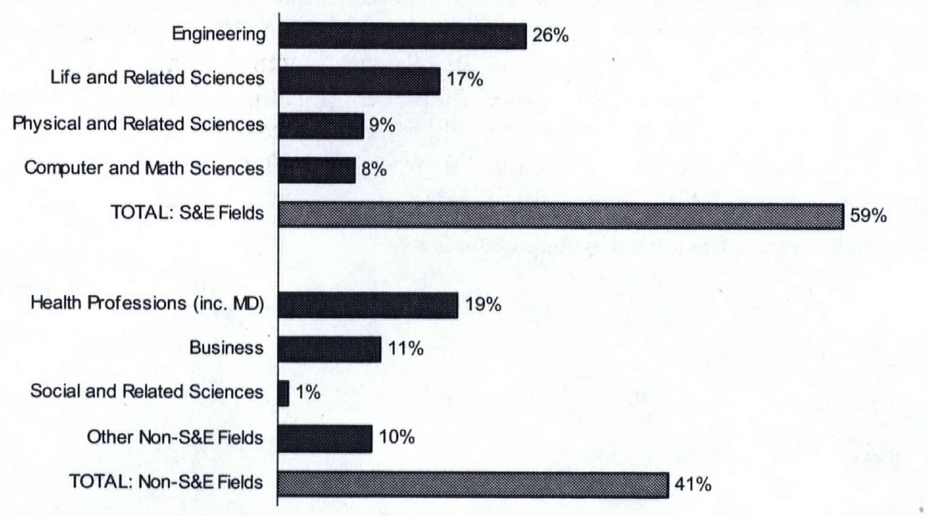


* National comparison group statistic is significantly different from LSAMP
Sources: UI LSAMP Graduate Survey, 2002. NSF NSRCG Longitudinal File 1993/95/97. See Table F-2A for full data.

LSAMP students are more likely to pursue graduate degrees in STEM *(table F-2B).* Thirty-eight percent of all LSAMP students pursued graduate degrees in STEM, compared to 20 percent and 22 percent among the comparison groups (URM and white and Asian, respectively). This difference declines when restricting the comparison only to those who pursued graduate degrees, but LSAMP students who go on to graduate studies are still more likely to enroll in STEM than either comparison group (58 percent LSAMP versus 44 percent and 50 percent in the comparison groups). These results indicate that higher percentages of LSAMP participants have pursued graduate degrees—regardless of the STEM/non-STEM distinction—than have the national comparison groups and are also more likely to remain in STEM. These findings suggest that LSAMP had the desired effect of increasing minority representation in STEM graduate programs.

LSAMP students continuing in STEM tended to enroll in engineering or in life and related sciences, while the majority of those not enrolling in STEM fields (as defined by NSF) were in health *(tables F-2B, F-2C).* The majority of students who remained in STEM at the graduate level pursued degrees in engineering (44 percent) or in life and related sciences (29 percent), while the majority in non-STEM fields pursued degrees in health, including medicine (47 percent) (table F-2C, figure 17). Combining health studies with STEM yields a STEM and health rate of graduate school enrollment of 78 percent (among those pursuing post-BA studies), *which means that 50 percent of all LSAMP participants go on to graduate studies in STEM or health.*

Figure 17. Field of Study Pursued at Graduate Level: LSAMP Participants



Note: Data for those pursuing graduate degrees only.
Source: UI LSAMP Graduate Survey, 2002. See Table F-2C for full data.

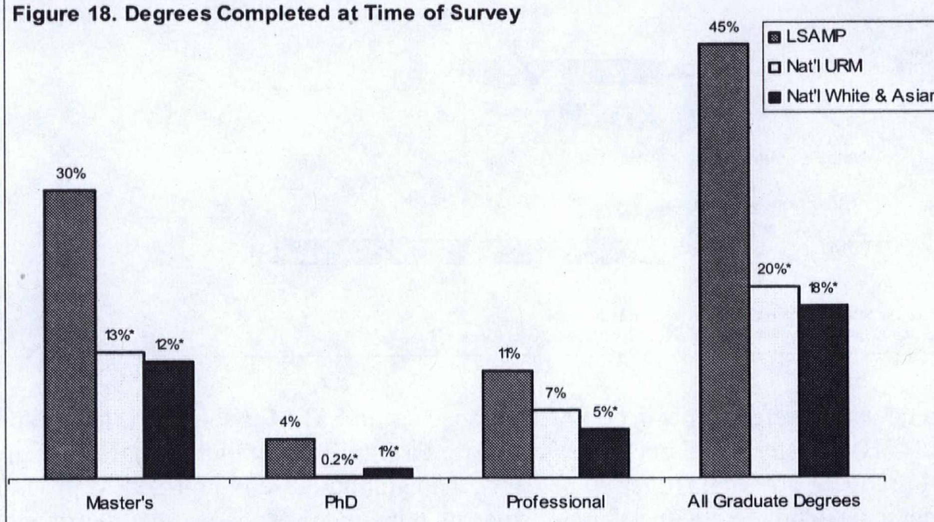
Another difference between students in STEM and those not in STEM is reflected in the type of degree pursued (table F-2B). Master's and doctorates comprised a significantly higher share of degrees among those in STEM graduate programs (over 90 percent), than among those in non-STEM programs (44 percent to 60 percent). Conversely, the share of students pursuing professional degrees is much higher among those in non-STEM (40 percent or more) than in STEM (3 percent to 8 percent) fields of studies. This finding is not unusual given the exclusion of health-related fields from the definition of STEM (medical degrees are considered non-STEM professional degrees by NSF definitions).

Regardless of academic undergraduate performance, LSAMP participants were more likely than comparison minorities (URMs) and whites and Asians to pursue graduate studies *(table F-2D).* LSAMP participants were significantly more likely than national URMs and non-URMs to pursue graduate degrees, regardless of GPA. Across nearly all GPA categories, LSAMP participants display higher rates of graduate school attendance than those in the two comparison groups (table F-2D).[15] This is important insofar as it suggests that LSAMP succeeds in encouraging not just high achievers, but also more average students, to pursue graduate studies and to seek to succeed in science. In other words, LSAMP is not biased toward promoting *only* those at the top of the achievement distribution, but instead appears to promote graduate studies among participants at all achievement levels.

Graduate School Completion: Promoting Completion of STEM Graduate Degrees

LSAMP participants exceeded the national rate of graduate degree completion for both URM and non-URM national samples, and are more likely to complete a graduate degree in a STEM than in a non-STEM field *(tables F-3A, F-3B).* At the time of the survey, over 40 percent of LSAMP participants had completed a graduate degree,[16] compared to approximately 20 percent of individuals in the national comparison groups.[17] *LSAMP participants have thus far exceeded the national rate of graduate degree completion for both URMs and whites and Asians (figure 18).* In addition, as a percentage of all respondents, LSAMP participants were more likely to complete a degree in STEM (25 percent did) than is true among either comparison group (9 percent of URMs and white and Asian graduates). Restricting this comparison to those respondents who completed a degree shows that LSAMP students are still more likely to have completed a graduate degree in STEM (57 percent) than comparison URMs (43 percent) or whites and Asians (51 percent). Also important is the finding that LSAMP students were slightly more likely to complete a degree in STEM (25 percent of all LSAMP participants) than in a non-STEM field (19 percent of all LSAMP) (see table F-3A). Almost 70 percent of completed master's degrees were in a STEM field, as were nearly 90 percent of completed PhDs. As expected, given the NSF definition of STEM,[18] the exception to this trend was professional degrees; over 80 percent of completed professional degrees were awarded in a non-STEM field (table F-3B).

Figure 18. Degrees Completed at Time of Survey



* National comparison group statistic is significantly different from LSAMP.
Sources: UI LSAMP Graduate Survey, 2002. NSF NSRCG Longitudinal File 1993/95/97. See Table F-3A for full data.

[15] The only exception is the lowest GPA category (less than 2.24), where no differences across groups are found.
[16] Graduate degree is defined as a doctorate, master's, or professional degree.
[17] There was no significant gender difference in the completion of graduate degrees for LSAMP graduates.

Former LSAMP participants are more likely to complete doctorates than national underrepresented minorities *(table F-3C).* Further investigation of the types of degrees completed by former LSAMP students reveals, unsurprisingly given earlier findings, that the vast majority of completed graduate degrees were at the master's level (66 percent, table F-3C). The second most common type of degree was professional (25 percent). These findings also hold for both comparison groups, URM and non-URM. In addition, 9 percent of degrees completed by LSAMP participants are PhDs, which is significantly higher than the percentage of doctorates in relation to other completed degrees for national URMs (1 percent), and (though higher) is not significantly different from the completion rate of white and Asian respondents.

Engineering, followed by health and life sciences, was the most common field of study among LSAMP participants who completed graduate degrees *(table F-3D).* Overall, the top three fields of completed graduate degrees for LSAMP participants were engineering (25 percent), health professions (23 percent), and life and related sciences (17 percent). These were followed by business (9 percent), physical and related sciences (9 percent), and computer and math sciences (7 percent). Degrees in non-STEM fields other than medicine or business make up only 10 percent of the graduate degrees completed by LSAMP participants.

A very large share of LSAMP participants seeking post-BA degrees are in the graduate school pipeline, either as graduates (60 percent) or enrolled students (20 percent) *(table F-3E).* The status of those who indicated they were seeking—but had not yet completed—a graduate degree at the time of the survey is an important complement to this discussion, as it relates to URM persistence in higher education. As reported above, about 60 percent of those LSAMP participants pursuing master's degrees, 75 percent of those pursuing professional degrees, and 36 percent of those pursuing doctorates had completed them at the time of the survey, between 5 and 10 years after participants' graduation with a BA in STEM. These figures rise significantly, however, if we add those who have not yet completed their graduate studies, but are still taking courses—i.e., are still in the pipeline. This is particularly true for doctoral students, which is natural given that doctoral programs take longer to complete than either master's or professional ones.

The issue of "time elapsed" discussed earlier is critical here, and helps explain both the greater rate of completion of master's and professional degrees, as well as the greater share of doctoral students (compared to master's and professional students) who are still taking courses. For the majority of LSAMP survey respondents, between five and six years passed between the time of undergraduate graduation and the survey, which is plenty of time to complete a short program, but is generally not long enough to apply to, enroll in, and complete a doctoral program. Overall, 60 percent of LSAMP participants seeking graduate degrees had completed the highest degree they were seeking and about 20 percent continued to take courses at the time of the survey. The remaining 20 percent indicated that they were not enrolled in or taking courses at the time of the survey, which might be an overestimate of those *not* in the pipeline, as doctoral candidates could be working toward completion of their dissertation. It should be noted, moreover, that the survey does not specifically ask about post-BA degree attrition, so it is not possible to confirm whether these students have officially dropped their pursuit of a graduate degree or not. To summarize, this analysis suggests that a very large share of LSAMP participants have gone on to graduate school, with at least 80 percent of them likely still in the graduate-level pipeline, either as graduates or enrolled students.

Among the LSAMP participants who have not yet taken additional post-BA courses (and who comprise about 20 percent of all LSAMP), the majority (55 percent) expressed that they are "very likely" to enroll in university courses in the future *(table F-4).* As reported earlier, almost 80 percent of LSAMP

---

[18] Recall that the NSF definition of STEM excludes medicine and technicians in various fields, including computer and information technology. These degrees make up the largest part of the non-STEM professional degrees attained by LSAMP students.

participants took additional coursework or enrolled in graduate studies (see table F-2A). The remaining participants who did not pursue post-BA coursework (21 percent) were asked to indicate how likely they were to do so in the future. For this purpose, they were provided with a three-level scale (very likely, somewhat likely, very unlikely). Responses to this question indicate that the majority of LSAMP participants who had not taken any post-bachelor's coursework at time of the survey were very likely to do so in the future (55 percent). On the other hand, less than 10 percent of respondents indicated that they were very unlikely to take additional courses in the future.

The most frequently cited reasons by LSAMP participants for not taking post-BA courses align with those cited in national samples. LSAMP graduates are, however, more likely than the national comparison groups to cite financial burdens *(table F-5).* At the time of the survey, only 20 percent of the LSAMP sample had taken no courses since their STEM bachelor's degree, compared with nearly 40 percent of the national comparison groups (table F-2A).[19] The main reasons cited by LSAMP graduates who had not taken courses were that they had a job or needed to work (76 percent); they had achieved their educational goals, at least for the time being (58 percent); other financial burdens (48 percent); and that they needed a break or were tired of going to school (45 percent). This ranking of most-frequently cited reasons is largely the same of a national group of STEM graduates who had also *not* taken courses since obtaining a BA.[20] Nonetheless, LSAMP graduates are significantly more likely than either comparison group (underrepresented minorities and whites and Asians) to report financial concerns as a reason preventing them from returning to school. More specifically, over 75 percent of LSAMP graduates not taking additional courses, versus about 60 percent of comparison group students, cited the need to work, while almost 50 percent of LSAMP graduates (versus about 30 percent of national URMs and whites and Asians) mentioned "other financial burdens." Also possibly alluding to financial burdens, LSAMP respondents were significantly more likely than national whites and Asians to cite family responsibilities as a reason for failing to pursue additional studies.

LSAMP participants were also significantly more likely than either national comparison group (minority and nonminority) to indicate that they "needed a break" from school, or that they could no longer attend school because they had "moved" away from the school they were attending. Finally, both underrepresented minority groups (LSAMP graduates and national URM sample) were about equally likely to state that they were no longer certain of the field they wished to study. White and Asian respondents, however, were less likely than LSAMP graduates to list this response among the reasons for not returning to school (approximately 22 percent URMs versus 13 percent whites and Asians, respectively).

Summary of Key Student Outcomes: Graduate School Enrollment and Completion

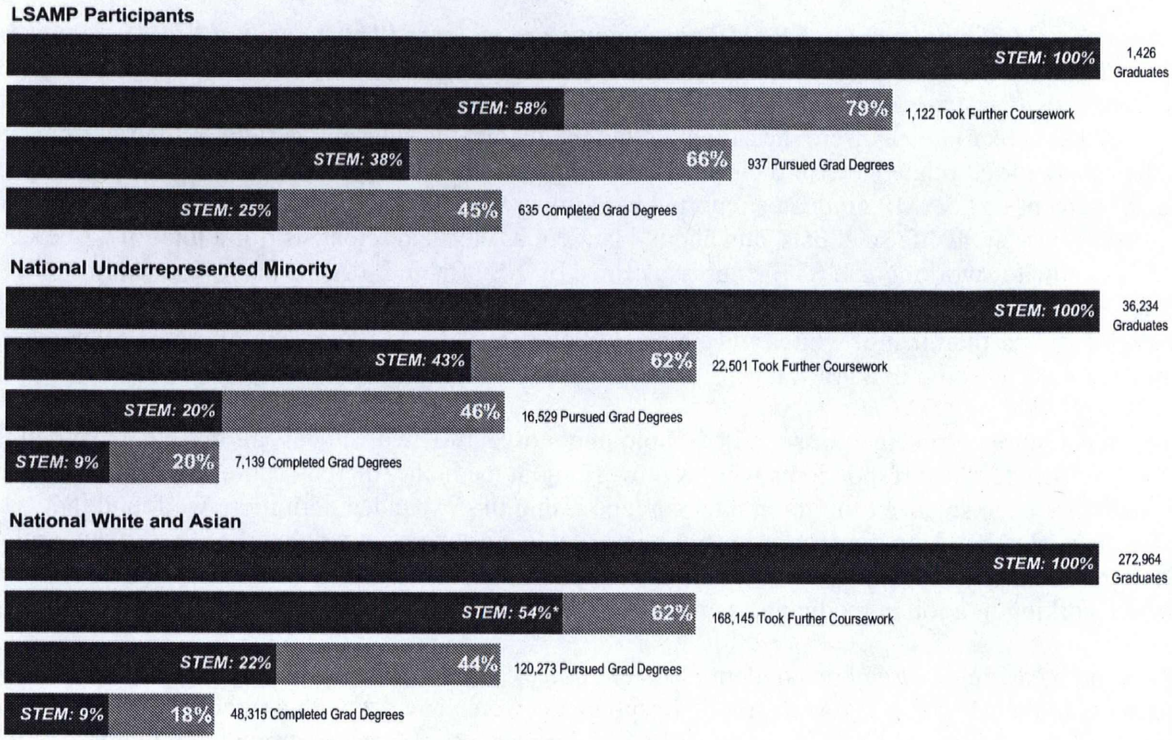
Figure 19 presents the most critical student-level outcomes measured, and clearly conveys the differences in the "pipeline" progression of LSAMP participants versus comparative URM and white and Asian samples.

---

[19] The original proposal question asked about those who had not "gone on to graduate school." Because of different skip patterns used in all three NSCRCG surveys, relevant data were collected only from those who had taken *no courses at all.* It should be kept in mind, therefore, that this analysis does not include information for the 13 percent of LSAMP, 27 percent of national URMs, and 28 percent of national whites and Asians who had taken additional coursework since graduation, but were *not* working toward a master's degree, professional degree, or doctorate.

[20] The one exception is that white and Asian graduates were more likely than either minority group to indicate, as a reason for not taking additional courses after obtaining a B.A., that they had achieved their educational goals, at least temporarily.

Figure 19. Graduate Coursework, Degrees Pursued and Degrees Completed



Sources: LSAMP Graduate Survey (UI) and NSRCG longitudinal file (NSF).
*National comparison group statistic is not significantly different from LSAMP.

The data show that about 80 percent of LSAMP students took further coursework after completing their bachelor's degree, compared to about 60 percent of comparison URM and white and Asian students. Similarly, a larger proportion of LSAMP participants pursued graduate degrees (66 percent) than is true among the comparison groups (45 percent). Finally, about 45 percent of LSAMP students completed graduate degrees, while this was true of about 20 percent of national URM and white and Asian bachelor's degree holders.

Analyses of these same data by field of studies shows that LSAMP participants, while as likely as whites and Asians to pursue further coursework in STEM, outperform this comparison group as well as URMs in terms of graduate degree enrollment and completion in STEM. Thirty-eight percent of LSAMP participants enrolled in STEM graduate degrees, compared to about 20 percent of comparison groups. In addition, 25 percent of former LSAMP students completed graduate degrees in STEM, versus about 9 percent of comparison groups.

These results reveal a striking difference in the progression of LSAMP participants versus national URMs and whites and Asians going through the STEM pipeline. This difference, in favor of LSAMP, is perceived at each step—in pursuit of post-BA coursework, in enrollment in graduate programs, and in completion of graduate degrees, overall and in STEM fields.

2. Impact on the STEM Workforce: Diversifying and Expanding the STEM Workforce[21]

In terms of field of employment, LSAMP participants are no more likely to be in a STEM-related job than national comparison URMs. They are, however, somewhat less likely to indicate that their jobs are "not related" to their education than either national comparison group (tables F-6A, F-6C). Respondents' career choices were measured by two indicators: the substantive field of their current job and the self-reported relatedness of their job to their highest STEM degree. In terms of the specific job field, 27 percent of LSAMP graduates reported working as engineers, 11 percent as computer and math scientists, 6 percent as life scientists, and about 4 percent as physical scientists, for a total of 47 percent of LSAMP graduates working in a STEM job as defined by NSF (table F-6A).[22] When compared to the national samples, the percentage of LSAMP participants in STEM jobs is similar to that of other URMs and slightly lower than that of whites and Asians (47 percent of LSAMP versus 52 percent of whites and Asians reported working in STEM, table F-6B).

To provide a more complete assessment of employment in STEM-related occupations, we expanded this analysis to include those respondents who were working in medicine, thereby capturing those who use their undergraduate science training in their careers. Using this expanded definition, we found that *no difference* existed between the proportions of respondents in each group who worked in a science-related field. Approximately 62 percent of LSAMP participants, national URMs, and national whites and Asians reported working in a job in medicine or an NSF-defined STEM field (table F-6B).

The second measure of survey respondents' career choices was a self-reported assessment of job relatedness to their highest STEM degree.[23] Respondents were provided with a three-point scale: "closely related," "somewhat related," and "not related." Similar proportions of each group were likely to report that their job was "closely" or "somewhat related" to their education (about 60 percent and 25 percent of each group, respectively, table F-6C). Positive and significant findings for LSAMP participants are revealed in the final answer category: LSAMP participants were less likely to indicate that their jobs were "not related" than either national comparison group.[24]

LSAMP graduates are less likely than comparisons to exit the STEM labor market citing unavailability of jobs in their field (table F-6C). To better understand attrition from the STEM pipeline, survey respondents indicating that their job was "not related" to their highest STEM degree were asked to provide the reasons for pursuing non-STEM employment. As a result, 10 percent of LSAMP participants and about 15 percent of both national URMs and whites and Asians provided the employment information analyzed herein. On average, all three groups (LSAMP and both national comparison groups) had similar distributions of responses, with one exception. LSAMP participants were significantly less likely than national whites and Asians to report that a job in their highest degree field was unavailable (30

---

[21] A small percentage of LSAMP participants (5%) had never held a full-time job by the time of the survey, and is therefore excluded from the analyses presented in this section.

[22] The NSF definition of STEM is somewhat restrictive—as it excludes jobs in medicine and technicians in any of the STEM fields, including computer science—focusing instead on those in research and teaching jobs in these fields.

[23] A clarification is warranted here. The wording of this survey question was slightly different on the LSAMP and NSRCG survey instruments. The LSAMP version asked about job relatedness to "most recent STEM degree," while the NSRCG question simply asked about the "most recent degree." Since we restricted the comparison to STEM degree recipients, we assume that answers are comparable. However, if NSRCG respondents had completed additional, non-STEM degrees since their bachelor's degree, their answer to this question would refer to that non-STEM degree.

[24] No gender difference in job relatedness to STEM degree was found for LSAMP participants (analysis available upon request).

percent versus 49 percent). This finding may align with the attention paid to STEM-related professionalization and research experience in the LSAMP program.

LSAMP participants are more likely to belong to professional associations than either comparison group, but are no more likely to participate actively in them (as measured by the available measure of meeting attendance) *(table F-7).* As table F-7 shows, LSAMP participants were likely to have more professional society memberships than either comparison group, with a significantly lower percentage having zero memberships and significantly higher percentage belonging to two or more professional associations than the national comparison groups. LSAMP participants were, however, as likely as whites and Asians and URMs nationally to have attended a professional association meeting in the year prior to being surveyed. Between 43 and 45 percent of each group had attended at least one meeting in the previous year.

The available evidence is insufficient to discern whether LSAMP participants have entered, or will enter, academia. Unfortunately, not enough time had elapsed since LSAMP participants' STEM bachelor's degrees to provide generalizable information about their presence in faculty positions. At the time of the survey—between five and six years after the majority had earned their STEM bachelor's degrees—about 4 percent of LSAMP participants had completed a PhD, accounting for 36 percent of those who indicated that they sought a doctorate (table F-3E). Nearly half of those who were seeking a doctorate were still taking coursework at the time of the survey, and at least some of those no longer taking courses (17 percent) may have been working on their dissertations.

3. Impact on the Knowledge Base: the LSAMP Model

The main goal of this evaluation, as required by NSF, was to evaluate the success of the LSAMP program in increasing the quality and quantity of minority students who successfully complete baccalaureate degrees in science, technology, engineering, and mathematics and who continue on to graduate studies in these fields. In carrying out the work necessary to conduct this assessment, we identified a set of practices that converge to form a distinct model or theory. We have discussed this model, and its links to the existing literature in STEM, extensively in section IV. In this section we take this work further and explore the model's effects empirically. Using the data collected through the survey of LSAMP participants, and national data from the NSRCG, we study the relative success of different components of the LSAMP model, and of the model as a whole, in producing the outcomes presented in earlier sections of this report.

An important caveat is warranted here. The LSAMP model as defined in this work is not one that can easily be teased apart into discrete components to see the relative impact of each element. Instead, it is a model whose success is likely dependent on the presence of all the factors (in statistical terms, there are both fixed and interaction effects associated with the model components). While one could envision setting out to test these factors in a multivariate model, such an exercise would not provide useful information because the categories are too interrelated, making the construction of discrete variables measuring similar constructs impossible (see figures 13 and 14). To the extent that we felt we could reasonably tease out components that could be interpreted in a standard way throughout institutions, we did so. The findings from these analyses are presented below, under LSAMP model components. Before presenting those findings, however, we provide a summary of results to assess the degree to which the LSAMP program, and hence the LSAMP model, was successful.

The LSAMP Model

Two sources provide evidence to assess the success of the LSAMP program as a whole. One is the analysis of outcomes (performance, enrollment, graduation and employment) carried out earlier in this section; the other is participants' opinions about the LSAMP program.

The analyses discussed in the previous section present evidence to assess the success of the LSAMP program. Four broad outcomes were analyzed—performance in undergraduate studies, enrollment in graduate studies, attainment of graduate degrees, and employment in STEM.[25] Key findings show that, on average, compared with nationally representative samples of URMs and whites and Asians, LSAMP students (1) performed better academically (as measured by GPA), (2) are more likely to pursue further education (post-BA), and (3) are more likely to pursue and to complete graduate studies, particularly in STEM. These and other results provide support for the LSAMP program and suggest that LSAMP succeeded in its goals of retaining and encouraging minorities in the STEM pipeline.

Additional evidence is provided by LSAMP participants, who were asked their opinions as to the program's usefulness for several key segments of the STEM pipeline. More specifically, they were asked to rate the program (on a scale of 1 to 5) with respect to outcomes of interest. According to these ratings, participants felt that the program was most helpful in terms of earning a bachelor's degree in STEM and completing college; 68 percent and 61 percent, respectively, responded that LSAMP was extremely or very helpful in this regard (see table F-8A). In addition, 48 percent believed that the program was extremely or very helpful in attending graduate school and 36 percent reported as much regarding finding a postcollege job.

LSAMP Model Components

The goal of the analyses presented herein is to identify whether, within the LSAMP model, it is possible to identify activities that are most strongly related to desired outcomes. In the introductory remarks of this report, we noted that students from underrepresented minority groups face obstacles at different points in the STEM pipeline that make it difficult for them to progress through that pipeline. A key focus of the LSAMP program was to devise strategies to address or remove those obstacles in order to facilitate the continued presence and the advancement of minorities through the STEM pipeline. These strategies are at the core of the LSAMP model.

Table F-8B presents an analysis, by targeted outcome, of a comprehensive set of LSAMP strategies or activities. The goal of this analysis is to find out if there is a positive relationship between participation in different activities and desired outcomes. For this purpose, and for each outcome of interest, we divided the LSAMP sample according to whether respondents achieved the desired outcome or not, and proceeded to compare the rates of participation in different activities.

***There are three activities or program components that stand out as having a positive relationship with desired outcomes (such as graduate studies and graduation)—namely, research with faculty, internships (i.e., research activities), and summer bridge (i.e., academic preparation)** (table F-8B).*[26] The results show that LSAMP participants who participated in research with faculty were more likely to pursue and complete graduate degrees, both overall and in STEM. In addition, students who participated in research internships were more likely to have enrolled in graduate degrees (in general and in STEM) and complete a STEM graduate degree. Participants pursuing graduate degrees, and completing graduate degrees (both in general and in STEM) were also more likely to have attended "summer bridge"

[25] The LSAMP model extends to entry into graduate school only.
[26] Findings regarding graduate school support, although significant, are not reported due to the low number of records on which they are based and concerns over selection bias.

activities. Interestingly, these findings align nicely with those obtained through interviews with the Alliances. As reported in the formative component of this evaluation, the top three project components cited by Alliances as being most important were, in order of importance, research experience, summer bridge, and mentoring. The first two are the same listed by survey respondents (all LSAMP participants), the last one is likely associated with doing research with faculty. To summarize, this analysis suggests that there are three activities or program components that stand out as having a significant positive relationship with desired outcomes—namely, research with faculty, internships, and summer bridge. These components represent research and academic preparation, which correspond, respectively, to the professionalization and academic elements of the model.

LSAMP students who pursued graduate degrees and who completed graduate degrees (in general and in STEM in particular) tended, on average, to participate in more activities and to spend more time in the program (table F-8B). Two other factors studied were number of LSAMP activities in which students participated and number of years of participation in LSAMP. The mean of each was constructed for two groups—students who achieved the targeted outcome (e.g., enrollment in graduate school, enrollment in STEM, etc.) and those who did not. The results, also found in table F-8B, show that LSAMP students who pursued graduate degrees and who completed graduate degrees (in general and in STEM in particular) tended, on average, to participate in more activities and to spend more time in the program.

Finally, students who claimed not to have participated in any LSAMP activities were analyzed separately to see if their exclusion had somehow biased results. They account for 8 percent of the LSAMP sample. We discovered a significant difference only with respect to completion of graduate degrees in STEM. Those students claiming not to have participated in any LSAMP activities were twice as likely *not* to have completed a STEM degree. It is difficult to interpret these findings, since it is unlikely that these students did not participate in any activities (they probably do not recall). But it is clear that, even if they did participate in some activities that they do not remember, they were not very active LSAMP participants. Hence, it is not surprising, if we hypothesize that LSAMP does have an effect on outcomes such as graduate school graduation, that these participants are less likely to complete a STEM graduate degree than those who were more active in LSAMP.

Although there are some demographic differences between LSAMP participants who began their studies at a community college and those who did not, no differences between these two groups are found in program outcomes (table F-9). Another distinguishing component of the LSAMP program was its initial emphasis on community college students. As mentioned in the introduction, community colleges enroll close to half of all students from groups traditionally underrepresented in STEM disciplines. Only 26 percent of all students at two-year colleges, however, transfer to four-year institutions. By targeting these students, LSAMP may have aided in the transition to a four-year college and helped preserve students already in the STEM pipeline.

Close to 10 percent of LSAMP participants began their studies at a community college (table F-9). Community college starters were demographically different from those who did not attend community college across three dimensions: gender, race and socio-economic status. They were significantly more likely than students who did not begin at community college to be male (63 percent versus 49 percent), Hispanic (54 percent versus 36 percent), and to have a mother who had not completed high school (25 percent versus 15 percent).

Despite these demographic differences, program outcomes for community college starters mirrored those of students whose entire degree was completed at a four-year institution. There were no significant differences in distribution of undergraduate grade point average, the percent that enrolled in STEM graduate studies, or the percent completing a STEM graduate degree between these two groups. Based upon these data, we conclude that regardless of initial demographic differences, participation in LSAMP is associated with similar outcomes for both groups of students.

4. Impact on Participating IHEs

Greater retention of students in STEM. Evidence gathered from the telephone interviews with project staff and the case study site visits provides insight into the range of ways that the LSAMP program has affected participating colleges and universities. Foremost is the belief that involvement in LSAMP has enabled institutions to retain and graduate more STEM students by substantially expanding their capabilities to develop and support STEM student talent. The overwhelming majority of LSAMP projects reported that the major outcome of their project is a positive impact on student STEM retention and STEM degree attainment (in particular underrepresented minority students). The process evaluation data show how institutional capability to boost STEM student productivity is seemingly enhanced by LSAMP's work in providing a wider and more targeted array of services and supports that often includes enhanced access to undergraduate research, participation in summer bridge, STEM tutoring and peer study groups, attendance and presentation at scientific conferences, and internships. While each of these services and supports may be effective in themselves, the fact that they form components of an integrated and comprehensive program seems to strengthen their collective efficacy. Furthermore, as pointed out by some, this enhanced institutional ability, coupled with a growing reputation of the LSAMP program, bestows indirect benefits and advantages to the schools, such as greater institutional prestige, enhanced ability to recruit URM STEM prospective undergraduates, and an improved chance to procure subsequent funding for other STEM-related intervention programs.

Change in institutional culture. LSAMP is also said to have affected participating institutions by effecting a change in institutional culture. For example, STEM faculty members are reported to be developing greater awareness, understanding, and responsibility for diversity; becoming more open-minded about how undergraduates can contribute in the laboratory; becoming more engaged in advising at various levels including in more informal ways; and, reflecting more about effective teaching and learning strategies. Moreover, some schools reported that the LSAMP minority retention approach is inspiring non-STEM disciplinary fields on campus to follow suit (e.g., by expanding undergraduate research opportunities, providing students with more personal attention). In addition, LSAMP's emphasis on connecting students to institutional services is reportedly helping to bring together faculty and student support staff. LSAMP is also said to be impacting student culture at participating schools through community building, which enables LSAMP students to become part of a supportive social network. For example, senior LSAMP participants commonly tutor and mentor junior participants, and serve as role models. LSAMP helps to fend off student isolation by promoting student interaction and camaraderie through such vehicles as student clubs, LSAMP learning centers, and a range of activities and events (which take place at the school and Alliance level).

Changes in policies and practices. LSAMP has also affected policies, procedures, and practices at participating schools. Examples include the influence of LSAMP on various campuses in changing aspects of academic advisement, institutional admissions recruitment, scholarship application, advertisement of science research internships and assistantships, course registration, and faculty research proposals. Some schools have experienced infrastructure change through the enhancement of diversity support systems such as the addition of LSAMP-sponsored advising and tutoring services, and the creation of learning centers or LSAMP space for students to come together. Over half of the Alliances reported that some of their partner schools have undertaken efforts in the area of STEM curriculum development (often involving gatekeeping courses), which includes reforming existing courses, developing new ones, sharing of course materials with partner schools, and introducing distance learning courses. Finally, LSAMP participation has also enabled institutions to engage in greater collaboration, networking, and resource and information sharing with other schools. This occurs among the four-year institutions as well as between the four-year institutions and the two-year institutions (e.g., refinement or development of articulation agreements, assistance with the transfer and adjustment of LSAMP community college students to four-year institutions). Collaborations within the Alliance take place at multiple levels as LSAMP expands opportunities for institutional leaders, project staff, students, and faculty on one campus to work with and form supportive relationships with counterparts at partner schools.

VI. Conclusions and Recommendations

This section summarizes the main conclusions that emerge from our evaluation of the LSAMP Program and provides a set of recommendations for its future implementation and replication.

Conclusions

1. The LSAMP program has met its stated goals of (a) "increasing the quality and quantity of students successfully completing" LSAMP-supported STEM baccalaureate programs and (b) increasing the number of students matriculating into programs of graduate study in STEM.[27]

LSAMP graduates make up a growing percentage of underrepresented minorities (URMs) who obtain baccalaureate degrees in STEM fields. From 1995 to 1997, the LSAMP share of URM undergraduate STEM degrees increased fourfold as LSAMP participants progressed to graduation and the number of LSAMP Alliances increased (NSF 2002).[28] This increase coincided with a steady rise in the number of underrepresented minorities obtaining bachelor's degrees in STEM nationwide (NSF 2002). Most importantly, former LSAMP participants are significantly more likely to enroll in graduate programs in general, and in STEM in particular, than are members of national samples of whites and Asians, and underrepresented minorities.

Our comparison of LSAMP participants' graduating GPAs with those of national samples of underrepresented minority and Asian and white student baccalaureate recipients in STEM majors reveals that LSAMP students are significantly more likely to perform in the highest GPA categories and significantly less likely to be in the lowest GPA categories. This suggests that, as measured by GPA, the overall performance of LSAMP graduates is significantly higher than that of nationally representative samples of minority and non-minority students.

Interestingly, the study also found that a *higher* percentage of lower-achieving LSAMP graduates (in terms of GPA) are pursuing graduate degrees than is true among similarly achieving graduates in the comparison groups. This suggests that LSAMP has been also effective in encouraging lower performing students to pursue graduate studies, and that these students have successfully gained admission to graduate programs.

2. The LSAMP program has exceeded its goals by producing underrepresented minority students who attain graduate degrees in STEM at a rate not only higher than that of the national population of underrepresented minorities but also than that of white and Asian STEM baccalaureate degree recipients.

LSAMP students have attained STEM graduate degrees at significantly higher rates than either the URM or the white and Asian comparison samples. Moreover, former LSAMP participants are also more likely to complete a graduate degree in STEM than in a non-STEM field than are the other two comparison groups.

---

[27] LSAMP participants, graduates, or students referred to include only Level I participants, since these were the focus of our study. (Level I students are those who are funded by the program and who typically participate in a basic set of LSAMP sponsored activities.) LSAMP might have shown a larger impact on the numbers of URMs graduating in STEM if *all* students who participated in the program had been included.

[28] Data from NSF show that degrees awarded to URMs from 1994 to 1997 increased steadily, with LSAMP graduates representing an increasing share (1% in 1994/95, rising to 4% in 1997/98).

3. LSAMP's strategies and approaches constitute a discrete, identifiable program model, grounded in research and theory, that can be tested and replicated.

The mixed-methods approach used in this evaluation enabled us to study the LSAMP model in a number of settings. This allowed us to observe the program playing out in Alliances and institutional sites across the country, with common strategies and approaches forming an identifiable intervention model to increase access to, and success in, STEM fields for URMs. The model represents an integrated approach to increasing minority student success in STEM. More important, the LSAMP model, grounded in theory as well as empirical research, has been tested and demonstrated to be successful based on data collected as part of this evaluation. The identification, description, and empirical investigation of this successful model signifies a critical advance in the existing knowledge base of intervention program models.

Recommendations

1. *Increase data collection efforts.* LSAMP Alliances should collect the following additional data on Level I participants :

- Undergraduate retention and attrition information about participants so that the program's success in retaining participants may be assessed.
- Tracking information that may be used to follow up on participants in order to ascertain whether or not they remain in the STEM career track by enrolling in a STEM graduate program and/or entering the S&E workforce.

2. *Strengthen the focus on community college students.* In light of the program's success in retaining in the STEM pipeline underrepresented minority students who begin their college education in community colleges, LSAMP should place added emphasis on strengthening and expanding the community college component of the program. Community colleges enroll more than half of all underrepresented minority students in postsecondary education and thus provide a promising source of potential STEM students.

3. *Expand the program to offer graduate school tuition and support to LSAMP graduates.* LSAMP graduates who did not continue taking courses after completing a bachelor's degree cited financially-related factors as reasons for not doing so. The need to work and other financial burdens figured prominently among the most important barriers to LSAMP students' enrollment in graduate education, and these factors were cited by a significantly higher percentage of LSAMP graduates than their peers in both comparison groups. Given LSAMP's success in preparing participants to enter and complete graduate degrees, extending the program's offerings to include financial incentives to encourage these students to enter graduate STEM programs seems a worthwhile investment.[29]

4. *Emphasize successful factors in selecting sites to receive LSAMP awards.* In awarding LSAMP grants, the program should continue to consider three criteria of utmost importance in identifying potentially successful applicants: (1) evidence of institutional and faculty support;[30] (2) history of, or plans for, a

[29] See note 2.

[30] Institutions where institutional goals are aligned with LSAMP goals and that have a history of prior involvement in diversity-focused efforts are more likely to be supportive.

strong collaborative relationship among partners;[31] and (3) well-defined plan and the capacity to provide the integrative services that comprise the LSAMP model.[32]

5. *Replicate and expand the LSAMP program.* Given LSAMP's proven success, it is important that efforts to replicate and disseminate the model be increased. The LSAMP model, unlike most intervention efforts for increasing URM participation in STEM, lays the foundation for systemic institutional change. It does so, in large part, by synergistic efforts of institutional partners who can collaborate and share resources, information, and experiences.

[31] Proposed partnerships should have a plan for facilitating collaboration among partners and choose a structure and rationale that encourage collaboration.
[32] This plan should include provisions for advancing the knowledge base by tracking effectiveness of efforts.

References

Ackermann, S. P. (1991). The benefits of Summer Bridge programs for underrepresented and low-income students. *College and University,* 66(4), 201-08.

Alexander, B. B., Burda, A. C., and Millar, S. B. (1997). A community approach to learning calculus: Fostering success for underrepresented ethnic minorities an emerging scholars program. *Journal of Women and Minorities in Science and Engineering,* 3(3), 145-59.

Astin, A. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Personnel,* 25, 297-308.

Astin, A. (1985). *Achieving educational excellence: A critical assessment of priorities and practices in higher education.* San Francisco, CA: Jossey-Bass Publishers.

Astin, A. (1993). *What matters in college: Four critical years revisited.* San Francisco, CA: Jossey-Bass Publishers.

Backhus, D. (1989). Centralized intrusive advising and undergraduate retention. *NACADA Journal,* 9(1), 39-45.

Bargh, J. A., and Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology,* 72(5), 593-604.

Bers, T.H., and Smith, K.E. (1991). Persistence of community college students: The influence of student intent and academic and social integration. *Research in Higher Education,* 32, 539-56.

Bonsangue, M.V., and Drew, D.I. (1995). Increasing minority students' success in calculus. *New Directions for Teaching and Learning,* 61, 23-33.

Bowman, M.H., and Stage, F.K. (2002). Personalizing the goals of undergraduate research. *Journal of College Science Teaching,* 32(2), 120-25.

Braxton, J.M., Brier, E.M., and Hossler, D. (1988). The influence of student problems on student withdrawal decisions: An autopsy on 'autopsy' studies. *Research in Higher Education,* 28, 241-53.

Brown, S. V., and Clewell, B. C. (1998). *Project Talent Flow: The non-STEM field choices of black and Latino undergraduates with the aptitude for science, engineering, and mathematics careers.* Washington, DC: The Urban Institute.

Cabrera, A.F., Castaneda, M.B., Nora, A., and Hengstler, D. (1992). The convergence between two theories of college persistence. *Journal of Higher Education,* 63, 143-64.

Cabrera, A.F., Nora, A., and Castaneda, M.B. (1992). The role of finances in the persistence process: A structural model. *Research in Higher Education,* 33, 571-93.

Carman, R. A. (1975). Long-term study of effects of tutoring in developmental mathematics. (ERIC Document Reproduction Service No. ED112983).

Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology. (2000). *Land of Plenty—Diversity as America's Competitive Edge in Science, Engineering and Technology*. Washington, DC: Author

Delamont, S. (1987). Three blind spots? A comment on the sociology of science by a puzzled outsider. *Social Studies of Science,* 17(1), 163-70.

Dryburgh, H. (1999). Work hard, play hard: Women and professionalization in engineering—adapting to the culture. *Gender and Society,* 13(5), 664-82.

Evans, F.R. (1977). *The GRE-Q coaching/instruction study.* (GRE Board Professional Report GREB No. 71-5aP). Princeton, NJ: Educational Testing Service

Evans, R. (1999). A comparison of success indicators for program and non-program participants in a community college summer bridge program for minority students. *Visions: The Journal of Applied Research for the Florida Association of Community Colleges,* 2(2), 6-14.

Fullilove, R. E., and Treisman, P. U. (1990). Mathematics achievement among African-American undergraduates at the University of California, Berkeley: An evaluation of the Mathematics Workshop program. *Journal of Negro Education,* 59(3), 463-78.

Gahan-Rech, J., Stephens, L., and Buchalter, B. (1989). The effects of tutoring on college students' mathematical achievement in a mathematics laboratory. *Journal of Research and Development in Education,* 22(2), 18-21.

Gándara, P. (with Maxwell-Jolly, J.) (1999). *Priming the pump: Strategies for increasing the achievement of underrepresented minority undergraduates.* New York: College Board.

Garcia, P. (1991). Summer bridge: Improving retention rates for underprepared students. *Journal of the Freshman Year Experience,* 3(2), 91-105.

Gaston, J. (1989). The benefits of black participation in science. In W. Pearson and H.K. Bechtel (Eds.), *Blacks, science, and American education* (pp. 123-36). New Brunswick: Rutgers University Press.

Gold, M. V., Deming, M. P., and Stone, K. (1992). The bridge: A summer academic enrichment program to retain African-American collegians. *Journal of the Freshman Year Experience,* 4(2), 101-17.

Good, J., Halpin, G., and Halpin. G. (1998). The affective and academic benefits for mentors in a minority engineering program. (ERIC Document Reproduction Service No. ED429488).

Grandy, J. (1994, June). *Gender and ethnic differences among science and engineering majors: Experiences, achievements, and expectations.* (GRE Board Research Project No. 92-03R and ETS Research Report 94-30). Washington, DC: Educational Testing Service.

Hackett, E., Croissant, J., and Schneider, B. (1992). Industry, academe, and the values of undergraduate engineers. *Research in Higher Education,* 33(3), 275-95.

Hagedorn, L.S., Siadat, M.V., Nora, A., and Pascarella, E.T. (1997). Factors leading to gains in mathematics during the first year of college: An analysis by gender and ethnicity. *Journal of Women and Minorities in Science and Engineering,* 3(3), 185-202.

Highsmith, R.J., Denes, R., and Pierre, M.M. (1998). Mentoring Matters. (ERIC Document Reproduction Service No. ED430909)

Hill, O.W., Pettus, W.C., and Hedin, B.A. (1990). Three studies of factors affecting the attitudes of blacks and females toward the pursuit of science and science-related careers. *Journal of Research in Science Teaching,* 27(4), 289-314.

Hill, S.T. (2002). *Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1991-2000.* (Report No. NSF 02-329). Arlington, VA: National Science Foundation, Division of Science Resources Statistics.

Hilton, T.L., Hsia, J., Solorzano D.G., and Benton, N.L. (1989). *Persistence in science of high-ability minority students.* (National Science Foundation Grant No. MDR-8652096). Princeton, NJ: Educational Testing Service.

Holton, B.E., and Horton, G.K. (1996). The Rutgers Physics Learning Center: Reforming the physics course for first-year engineering and science students. *Physics Teacher,* 34(3), 138-43.

Laws, P.W. (1999). New approaches to science and mathematics teaching at liberal arts colleges. *Daedalus,* 128(1), 217-40.

Lowe, A., and Toney, M. (2001). Academic advising: Views of the givers and takers. *Journal of College Student Retention,* 2(2), 93-108.

Merton, R. (1973). *The sociology of science.* Chicago: The University of Chicago Press.

Mestre, J.P., and Robinson, H. (1983). Academic, socioeconomic, and motivational characteristics of Hispanic college students enrolled in technical programs. *Vocational Guidance Quarterly,* 31, 187-194.

Moreno, S.E.. and Muller, C. (1999). Success and diversity: The transition through first-year calculus in the university. *American Journal of Education,* 108(1), 30-57.

Moust, J.C., and Schmidt, H.G. (1994). Effects of staff and students tutors on student achievement. *Higher Education,* 28(4), 471-82.

Mulkey, L.M., and Ellis, R.S. (1990). Social stratification and science education: A longitudinal analysis, 1981-1986, of minorities' integration into the scientific talent pool. *Journal of Research in Science and Teaching,* 27(3), 205-17.

Murphy, T.J., Stafford, K.L., and McCreary, P. (1998). Subsequent course and degree paths of students in a Treisman-style workshop calculus program. *Journal of Women and Minorities in Science and Engineering,* 4(4), 381-96.

Murdock, T.A. (1987). It isn't just money: The effects of financial aid on student persistence. *Review of Higher Education,* 11(1), 75-101.

Nagda, B.A., Gregerman, S.R., Jonides, J., von Hippel, W., and Lerner, J.S. (1998). Undergraduate student-faculty research partnerships affect student retention. *Review of Higher Education,* 22(1), 55-72.

National Science Board. (2003). *The science and engineering workforce: Realizing America's potential.* (No. NSB 03-69) Arlington, VA: Author.

National Science Foundation. (2002). *Science and engineering degrees, By race/ethnicity of recipients.* (No. NSF 02-329). Arlington, VA: Author.

National Science Foundation. (2001). "National survey of recent college graduates (NSRCG) longitudinal data file (1993, 1995, 1997)." Prepared by WESTAT for the National Science Foundation.

Nora, A. (1987). Determinants of retention among Chicano college students: A structural model. *Research in Higher Education,* 26, 31-59.

Nora, A., Attinasi, L.C., and Matonak, A. (1990). Testing qualitative indicators of pre-college factors in Tinto's attrition model: A community college student population. *Review of Higher Education,* 13, 337-56.

Nora, A., Cabrera, A., Hagedorn, L.S., and Pascarella, E. (1996) Differential impacts of academic and social experiences on college-related behavioral outcomes across different ethnic and gender groups at four-year institutions. *Research in Higher Education,* 37(4), 427-51.

Novels, A.N., and Ender, S.C. (1988). The impact of developmental advising for high-achieving minority students. *NACADA Journal,* 8(2), 23-26.

Pace, C. (1984). *Measuring the quality of college student experiences.* Los Angeles, CA: University of California, Higher Education Research Institute.

Pascarella, E.T., Smart, J.C., and Ethington, C.A. (1986). Long term persistence of two-year college students. *Research in Higher Education,* 24, 47-71.

Pascarella, E.T.. and Staver, J.R. (1985). The influence of on-campus work on science career choice during college: A causal modeling approach. *Review of Higher Education,* 8(3), 229-45.

Pascarella, E.T., and Terenzini, P.T. (1991). *How college affects students.* San Francisco, CA: Jossey-Bass Publishers.

Pascarella, E.T., Terenzini, P.T., and Wolfe, L.M. (1986). Orientation to college and freshman year persistence/withdrawal decisions. *Journal of Higher Education, 57,* 155-75.

Pierce, D. (1999, July). Testimony: Commission on the Advancement of Women and Minorities in Science, Engineering and Technology. Available: http://www.nsf.gov/od/cawmset/meetings/hearing-990720/drpierce/drpierce.htm

Pearson, W.J., Jr. (1986). Black American participation in American science: Winning some battles but losing the war. *Journal of Educational Equity and Leadership,* 6(1), 45-59.

Penick, B.E., and Morning, C. (1983). The retention of minority engineering students. Report on the 1981-82 NACME retention research program. (ERIC Document Reproduction Service No. ED247325).

Powers, D.E. (1987). Who benefits most from preparing for a "coachable" admissions test? *Journal of Educational Measurement,* 24(3), 247-62

Redmond, S.P. (1990). Mentoring and cultural diversity in academic settings. *American Behavioral Scientist,* 34(2), 188-200.

Rolle Sr., G.F. (1977). Facilitating career development of minority students. (ERIC Document Reproduction Service No. ED189280).

Santos, S.J., and Reigadas, E. T. (2002). Latinos in higher education: An evaluation of a university faculty mentoring program. *Journal of Hispanic Higher Education,* 1, 40-50.

Schwitzer, A.M., and Thomas, C. (1998). Implementation, utilization, and outcomes of a minority freshman peer mentor program at a predominantly white university. *Journal of the Freshman Year Experience and Students in Transition,* 10(1), 31-50.

Seymour, E., and Hewitt, N. (1994). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview.

Sharp, L., Kleiner, B., and Frechtling, J. (2000). *A description and analysis of best practice findings of programs promoting participation of underrepresented undergraduate students in science, mathematics, engineering, and technology fields.* (Report No. NSF 01-31). Arlington, VA: National Science Foundation.

Springer, L., Stanne, M.E., and Donovan, S.S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research,* 69(1), 21-51.

St. John, E.P. (1991). The impact of student financial aid: A review of recent research. *Journal of Student Financial Aid,* 21(1), 18-32.

St. John, E.P., Kirshstein R.J., and Noell, J. (1991). The effects of students aid on persistence: A sequential analysis. *Review of Higher Education,* 14(3), 383-406.

Stage, F.K. (1989). Motivation, academic and social integration, and the early dropout. *American Educational Research Journal,* 26, 385-402.

Stoecker, J., Pascarella, E.T., and Wolfe, L.M. (1988). Persistence in higher education: A 9-year test of a theoretical model. *Journal of College Student Development,* 29, 196-209.

Swinton, S.S., and Powers, D.E. (1983). A study of the effects of special preparation on GRE analytical scores and item types. *Journal of Educational Psychology,* 75(1), 104-115.

Thile, E.L., and Matt, G.E. (1995). The ethnic mentor undergraduate program: A brief description and preliminary findings. *Journal of Multicultural Counseling and Development,* 23(2), 116-126.

Tinto, V. (1993). *Leaving college: Rethinking causes and cures of student attrition* (2nd ed.). Chicago, IL: University of Chicago Press.

Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *College Mathematics Journal,* 23(5), 362-72.

Trippi, J., and Cheatham, H.E. (1991). Counseling effects on African American college student graduation. *Journal of College Student Development,* 32(4), 342-49.

Urban Institute. (2002). "Urban Institute's Louis Stokes Alliances for Minority Participation (LSAMP) Graduate Survey." Washington, DC: The Urban Institute.

Walters, N.B. (1997). Retaining aspiring scholars: Recruitment and retention of students of color in graduate and professional science degree programs. ASHE Annual Meeting Paper. (ERIC Document Reproduction Service No. ED415816).

Williamson, D.R., and Creamer, D.G. (1988). Student attrition in 2- and 4-year colleges: Application of a theoretical model. *Journal of College Student Development,* 29, 210-17.

Wyer, M.B. (2001). Intending to stay: Positive images, attitudes, and classroom experiences as influences on students' intentions to persist in science and engineering majors (Doctoral dissertation, North Carolina State University, 2000). *Dissertation Abstracts International,* 62, 1063.

APPENDIX A. Literature Review on Effective Strategies to Increase Diversity in STEM Fields

Literature Review on Effective Strategies to Increase Diversity in STEM Fields

Introduction

The disproportionately low participation of African Americans, Native Americans, and Latinos in the fields of science, technology, engineering, and mathematics (STEM) is widely recognized as a serious and persistent concern for this country because it impedes our national ability to compete in an increasingly scientific and technologically based world. To avoid future potential shortfalls of scientists and engineers we must do more to recruit and retain minority students, a group that constitutes the fastest growing portion of the school-age population (Clark, 1999). Currently, fewer than half of the students who enter college with the intention to major in mathematics, science, and engineering actually end up doing so (Laws, 1999). Compared with student withdrawal rates in the humanities, social sciences, and education, those in mathematics, science, and engineering are high, and they are especially so for underrepresented minorities (Seymour & Hewitt, 1994). In comparison to their white peers, underrepresented minority freshmen are just as likely if not more likely to enroll in science and engineering studies (Elliott et al., 1996; Green, 1989; U. S. Department of Education, 2000). Yet, underrepresented minorities are more likely to switch to non-science majors and are less likely to complete a science, mathematics, and engineering degree (Culotta, 1992; Elliott et al., 1996; Morrison & Williams, 1993; U.S. Department of Education, 2000).

To redress the race/ethnic disparity in STEM participation, a number of programs have been created to operate on various colleges and universities. These programs typically entail a range of services and activities designed to address factors affecting underrepresented minority students' interest, motivation, and skills in STEM. The origins of some of these intervention programs can be traced back to the 1960s (Matyas, 1991b). While there is a considerable amount of material of a descriptive nature published on these efforts, there is relatively little research on program outcomes and effectiveness of specific strategies. And while evaluations of programs are becoming more commonplace, evaluation results are not always published and thus difficult to access (Ginorio & Grignon, 2000). Nonetheless, a synthesis of existing research findings on intervention approaches can yield valuable insight, which can inform policymaking and future initiatives. Thus, a review of the scholarly literature was conducted on effective strategies to increase minority participation in STEM fields. While much of the research presented here examines specific effects on underrepresented minority groups, in many cases the effects may be comparable for nonminority students. Conversely, while research on some strategies fails to examine particular effects on minority students, it is quite possible that benefits found for the overall group also hold true for minority group members.

This review of the literature begins with an examination of findings on major strategies for which there is a considerable amount of research, followed by a presentation of other approaches for which there is some supporting evidence. Next, findings on three notable intervention programs are presented. These programs were chosen because they are well-known, have empirical data to substantiate their effectiveness, and have been either widely replicated or influential to the development of other programs. Finally, this review concludes with a discussion of the need for institutional collaboration and partnership in efforts to boost the national production of qualified individuals in STEM fields.

Specific Strategies

Summer Bridge

Precollege summer bridge programs or transitional programs for low-income and minority students have become "an established part of the effort to recruit, retain, and graduate a population of students underrepresented in higher education" (Ackermann, 1991). In a study of 20 prototypical programs to promote the high achievement of underrepresented minority college students, Gándara (1999) noted that the great majority of programs are focused on the sciences, mathematics, and engineering, and what's more, that nearly half of these programs include pre-freshman bridge in their approach. Though bridge programs vary, they typically entail intensive academic enrichment and other strategies designed to facilitate students' transition and adjustment to college life. Attention to the juncture from high school to college is imperative given the high degree of student attrition that occurs between freshmen and sophomore year (Tinto, 1987). Supplemental instruction through pre-freshman bridge can effectively narrow a preparation gap that is often caused by attendance of impoverished schools with inadequate instruction, poor facilities and equipment, and few positive role models. Minorities tend to be less prepared for a rigorous academic program in college because they are much less likely than whites or Asian Americans to pursue an academic course of study or to take advanced mathematics and science courses during high school (Wilson, 2000). A 1990 study by the Rand Corporation found that schools with high minority enrollments generally offer students fewer challenging courses in mathematics and science (Culotta, 1992). Moreover, we know that the higher the SAT-math score the more likely that person will major in science. Investigating the role of ethnicity in science persistence, Elliott et al. (1996) found that preadmission variables accounted for a significant amount of the variance of science persistence while ethnicity did not.

While research on the effects of summer bridge program participation is limited, a number of studies have documented positive effects. In trying to improve minority student admissions and retention, the four-week bridge program at Georgia State University offers participants (African American developmental studies students) classes in mathematics, reading, composition, study skills, and word processing, and provides free tutoring, academic and career counseling, mentoring, and other follow-up services during the academic year. Program evaluation results show high ratings of program effectiveness by students as well as faculty members. Moreover, participants have achieved "a remarkably high retention rate" that exceeds that of all developmental studies students of other races and which matches that of African American students who do not require developmental courses (Gold, Deming, & Stone, 1992). Study findings of one community college's six-week summer bridge program for minority students, offering academic enrichment and training in "college survival skills," indicate that program participants, in comparison to nonparticipants, had lower grade point averages but achieved comparable or higher levels in terms of performance on an academic skills test, first-year retention, and graduation rate (Evans, 1999). An evaluation of the summer bridge program of the California State University System, a four to six week on-campus residential experience that focuses on improving basic skills and familiarizing new students with the university experience, found an increase in freshmen and sophomore retention rates. Moreover, participants were more likely to use campus services, meet more frequently with faculty outside of class, join study groups, and be satisfied with their college friendships (Garcia, 1991). An evaluation of a summer program for incoming freshmen and transfer students at the University of California, Los Angeles found a modest increase in the college persistence rate of participants (Ackermann, 1991).

Summer orientation is recognized as a common component of successful minority programs (Torres, 2000). Data collected from directors of programs that aim to recruit and retain underrepresented students in science and engineering showed that overnight, residential, and/or summer programs were most frequently cited as being most integral to program success (Matyas, 1991b). Moreover, research on the Meyerhoff Program and the Minority Engineering Program (MEP), two highly regarded intervention programs, have also identified summer bridge to be an important factor in their effectiveness (Maton, Hrabowski, & Schmitt, 2000; Morrison & Williams, 1993). In a retention research study conducted by NACME, in which data were analyzed for 51 projects, a positive relationship was found between successful minority engineering student retention and the offering of a summer pre-freshman program (Penick & Morning, 1983).

Mentoring

Mentoring programs have become prevalent, and appear to be a widely utilized approach in intervention programs for minorities. In designing intervention programs to increase interest and sustain persistence in STEM fields Ginorio and Grignon (2000) recommend consideration of the principle that "each student needs at least one person to serve as a mentor, someone who has faith in them and will provide necessary information or support at key junctures involving choice" (p.167). Despite the growing popularity of mentoring, research evidence on its effectiveness continues to be primarily anecdotal and qualitative with there being few studies attempting to measure effects through the use a control group that has not been mentored (Romero cited in Gándara, 1999). According to Gándara, researching the effects of mentoring poses a special challenge because mentoring relationships can vary greatly; a program may show greater within group differences than between group differences.

On the whole the existing research evidence seems to support the importance of mentoring in undergraduate education (Jacobi, 1991). Frequency of student-mentor contact has been found to positively correlate with students' college adjustment and perceived mentor supportiveness (Santos & Reigadas, 2002). Minority students have reported on the critical role that mentors play in their adjustment to college, and progress towards graduate studies and a career (Freeman, 1999; Lee 1999). Minority students who participated in mentoring programs have demonstrated such positive outcomes as higher grade point averages, lower attrition, increased self-efficacy, and better defined academic goals (Santos & Reigadas, 2002; Schwitzer & Thomas, 1998; Thile & Matt, 1995). Mentoring is said to address several causes of college attrition and delayed graduation by facilitating aspects of students' academic and social integration (Redmond, 1990).

The literature on mentoring recognizes a critical distinction between formal or planned mentoring, and informal or natural mentoring. According to Gándara (1999), naturally forming relationships are more likely to be successful. Some intervention programs attempt to foster informal mentoring relationships through cohort or community building among peers and program staff. Unfortunately, without intervening circumstances, mentoring appears to be relatively uncommon at the postsecondary education level, and this appears to be especially so for minority students (Blackwell, 1987; Jacobi, 1991). A longitudinal study involving minority high school valedictorians and salutatorians shows how without proper role models and supporters to guide them through college, promising students can easily fail to live up to their potential (Arnold, 1993). Arnold observed that "ignored by faculty and outside the central college academic and social structures, the valedictorians at predominantly white institutions never had the opportunity to develop the subtle skills of translating intrinsic academic interests into clearly formulated career goals and effectively managed educational and professional activities" (p. 277-278).

Jacobi (1991) points out that while minority and female students may feel a greater need for mentors they are more likely to encounter obstacles in attaining mentoring because of the shortage of female and minority faculty members. This shortage is especially acute in science and engineering. Yet, race or gender consistency between mentor and protege may not be as important as some other factors of the mentoring relationship (Clewell & Ginorio, 1996). Examining student views about race in the mentoring relationship, Lee (1999) found that African American students attending a predominantly white college felt that having an African American faculty mentor was less important than having a mentor in their career field. Martinez (cited in Gándara, 1999), however, found that minority undergraduates in a university mentorship program were more likely to form strong relationships with faculty of color that influenced them to pursue graduate study than with nonminority faculty.

Mentoring programs can also be classified by who provides the mentoring. Within the higher education context mentors are most typically faculty members or upperclass students. Cosgrove (1986), in one of the few studies using a control group, found that students participating in a program that recruited mentors from faculty members, professional staff members, and university administrators, experienced a greater satisfaction with the overall campus environment, and increased confidence in their ability to set and achieve goals, solve problems, and make decisions. Beyond studies that involve faculty as formal mentors, there is a substantial body of research documenting positive effects of student-faculty interaction outside of the classroom, especially when such contact involves discussion of intellectual matters (Pascarella & Terenzini, 1991). Some view this association between student-faculty contact and academic success as indirect support for the link between mentoring and academic success (Jacobi, 1991).

The critical role that mentoring plays in the educational progress of underrepresented minority students is clearly substantiated in a study by Solorzano (1993) in which he interviewed 66 Chicano and Chicana Ford Foundation Minority Fellowship recipients about their educational experiences. The single most important factor identified in students' degree attainment was a positive mentoring experience. In a study of nonpresistence decisions among American Indian undergraduates, Gloria and Kurpius (2001) found that having a socially supportive network is central to academic persistence, particularly strong is the effect that faculty/staff mentors exert.

Because of the very limited availability of Chicano or Chicana faculty role models and mentors on college campuses, students more frequently reported receiving mentoring from peers. In a study on the mentoring experiences of Mexican American undergraduates at one institution, Romero (1996) found that these students were most likely to be mentored by a family member (54.4%), followed by a peer/roommate (16.3%), and university personnel (13.6%). A study by Rice and Brown (1990) shows that while some students may prefer a peer mentor over a faculty mentor, peer mentors may not be adequately equipped to provide all the mentor services that students desire. Hence, it is likely that a combination of both faculty and peer mentors can best fulfill the needs of those students seeking mentorship.

Research Experience

Engaging in hands-on research, whether within an academic setting or off-campus in a position with industry, appears to be an effective strategy in increasing the number who pursue degrees and careers in STEM fields. Using a national sample of students, Pascarella and Staver (1985) controlled for differences in family background, aptitude, secondary school experiences, precollege career choice, academic major, and college achievement, and found that on-campus employment in science exerted a positive effect on post-sophomore year science career choice. Hackett, Croissant, and Schneider (1992) found that controlling for social background and academic experiences, undergraduate research and cooperative education programs (paid industry internships) strongly influenced participating engineering students' skills, job values, and life objectives. Those who participated in an industry internship position reported this work experience to be very influential to their career choice, far more so than their classroom experience. Post internship data collected from National Action Council for Minorities in Engineering (NACME) scholars who participated in the Corporate Scholars Program found that mentoring matters. Successful mentoring, either by individuals formally assigned the role or by supervisors who informally carried out the duties of mentors, resulted in substantial increased interest by interns to return to their host companies and more favorable evaluation of workplace experiences (Highsmith, Denes, & Pierre; 1998). In a survey study of computing majors who were completing an internship, Schambach and Kephart (1997) found students generally expressed a very favorable response to the experience, and reported perceived benefits that included "recruitment advantages, an excellent method of learning, better understanding of organizations and career focus, as well as reinforcement of course learned skills and enhanced confidence in their own professional capabilities" (p. 214). In a study of the persistence in science of high-ability minority students, those who persisted tended to report that scientists and engineers they knew, knew about, or met in summer jobs or part-time work, especially minority scientists and engineers, influenced them to a greater degree than did parents, friends, and teachers although these individuals were important (Hilton, Hsia, Solorzano, & Benton, 1989).

In Solorzano's (1993) study of Ford Foundation Minority Fellows, many students, especially those in the sciences, reported that engaging in hands-on research experience with faculty to be one of their most important academic experiences and as being particularly influential to their finishing college and attending graduate school. A program on undergraduate student-faculty research partnership at the University of Michigan, which targets underrepresented minority and female students interested in science, has produced positive effects on retention. Using an experimental design in which student applicants to the program were randomly assigned to either the control or experimental group, the researchers found that program participation had positively affected retention for each of the race/ethnic groups examined (Hispanic, African American, and white). Particularly strong effects were found for the low-achieving African-American group (Nagda, Gregerman, Jonides, von Hippel, & Learner, 1998).

A 1990 study by the National Science Foundation (NSF) showed that participants of NSF's Research Experiences for Undergraduates Program demonstrated a heightened interest in science and engineering, pursuing a graduate degree, and attending graduate school immediately after college completion. While participants choose to be involved with the program for various reasons, underrepresented students (African Americans, Native Americans, Alaskan Natives, and females) were more likely than others to be motivated by wanting to know if science or engineering, or research, was appropriate for them. Participation in a summer science research program can also enhance students' social integration. In a study involving past participants of one such program, minority students tended to stress the importance of positive relationships with peers and faculty and how this impacted their decision to continue on to graduate school (Walters, 1997).

Involvement with faculty research at the undergraduate level can help clarify educational and career plans, and enhance students' sense of self-efficacy. Proactive steps to heighten students' self-efficacy is recommended in efforts to expand diversity in science and engineering (Hackett, Casas, Betz, Rocha-Singh, 1992). This is because beyond the effects of academic ability and achievement, self-efficacy has been found to be predictive of grades and persistence in technical/scientific majors, as well as perceived career options in a range of science and engineering fields (Lent, Brown, & Larkin, 1986). Research with faculty may entail such professional development experiences as conference attendance, presentation of one's work, and publication submissions—all of which socializes one to a career in research while strengthening self-efficacy. In an interesting experimental study on mathematics/science self-efficacy enhancing interventions, undergraduates with at least a moderate level of mathematics ability and who were undecided about career plans were randomly assigned to one of four treatment conditions. Four weeks after treatment, those who underwent the performance accomplishment treatment (successful completion of a number series task), continued to show higher levels in mathematics/science course self-efficacy, mathematics/science related career interests, mathematics/science relatedness in courses they plan to enroll in the next quarter, and mathematics/science relatedness of their choice of major (Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999).

Undergraduate participation in research also entails the added benefits of informal mentorship through close contact with faculty. Interactions with faculty that combine student's classroom and nonclassroom experiences have been found particularly important to student retention (Pascarella & Terenzini, 1991). For both minority and nonminority groups a positive relationship has been found between students' self-reported progress in mathematics and science, and students' satisfaction with student-faculty relations (Eimers, 2000). Analyzing data collected from a national sample of undergraduates and faculty, Drew (1996) found that faculty orientation toward working with students is very strongly related to students' satisfaction with their college science experiences (this measure had a greater effect than all other background and college environmental variables in the regression). Unfortunately, the level of student satisfaction with science faculty relations appears low. In a study involving upperclass African American students at 11 public research universities, more students viewed faculty members as discouraging than supportive (Blockus, 2000/2001). Aside from building students' knowledge and skills, research work with faculty can be beneficial by providing students with an opportunity to interact meaningfully with faculty outside of the classroom and to develop a basis for a true mentor-protégé relationship.

Paid research work also has the added benefit of helping students to defray college expenses. This is especially salient in the case of minority students, who typically are in greater need of financial support, and consequently may be more likely to seek employment during college. Hispanic students, for example, are more likely to leave college to support family (Celis cited in Nagda et. al, 1998). Meanwhile, Native American science and engineering majors have been found to average more hours of paid work than their peers (Grandy, 1994). While a job that is unrelated to students' academic program can detract time from study and academic pursuits, a job that is related can complement and enrich students' studies through experiential learning. National data reveal that bachelor's degree attainment, along with a host of other positive outcomes, is positively associated with holding a part-time job on campus but negatively associated with holding a part-time job off campus (Astin, 1993). In another study involving a national sample of college students, working off-campus was found to have a significant negative effect on persistence for minorities (reducing the chance of persisting by 36%) but not for nonminorities (Nora, Cabrera, Hagedorn & Pascarella, 1996). Quality work experience can socialize students to professional norms and may result in long-term professional advantages. In their review of the research in this area, Pascarella and Terenzini (1991) concluded that most of the evidence suggests that working during college, particularly in a job related to one's major or initial career aspirations, has a positive net impact on career choice, career attainment, and level of professional responsibility attained early in one's career.

Tutoring

Tutoring has been a long-standing aid in student learning, and is widely used today as an intervention measure to enhance student performance and persistence. College-level tutoring programs can vary greatly in approach, substance, and degree of structure. Those in the tutor role are often upper division students, staff members, or faculty members. Most studies that compare achievement outcomes of students tutored by either peers or staff members have found no differences (Moust & Schmidt, 1994). In his review of peer tutoring, Topping (1996) notes that tutoring is being widely utilized in varying forms at several hundred institutions, and that student subjective feedback is generally very positive.

In a study involving academically underprepared college freshmen, length of exposure to tutoring had a consistent effect on course credits earned (House & Wohlt, 1990). In an early study on tutoring by Carman (1975), students enrolled in a remedial course were randomly divided into one of three groups (one group receiving no tutoring, and two groups receiving varying degrees of tutoring). Study results indicated that course grade and overall GPA did not differ among the three groups. However, course withdrawal was significantly lower for the tutored groups than the non-tutored group. Moreover, interview results revealed that members of the tutored groups held more positive views about mathematics and other courses. This pattern of increased persistence and positive attitude continued during the two years following the tutoring experience. In a study by Gahan-Rech, Stephens, and Buchalter (1989) positive effects of tutoring were found for mathematics students. Controlling for initial mathematics ability, no difference in mathematics performance was found between the group that received no tutoring and the group that attended five or fewer tutoring sessions. The group of students who attended six or more tutoring sessions, however, performed better than the other two groups despite the superior initial mathematics ability of the non-tutored group.

Benefits of tutoring have been demonstrated for not only those receiving the tutoring, but also for those performing the tutoring. In some cases tutors experience greater achievement gains than those who are tutored (Bargh & Schul, 1980). In one study using survey data collected from nontraditional college students at multiple institutions, the strongest predictor of understanding science was teaching science (Lundberg, 2003). Evidence of affective and academic benefits were found for advanced student mentors involved in a minority engineering program in which they interacted with mentees regularly through tutoring and involvement in problem-solving workshops (Good, Halpin, & Halpin, 1998). In an experimental study on the cognitive benefits of teaching, Bargh and Schul (1980) compared performance between a group of undergraduates who studied verbal material to learn for themselves (the control group) and another group who studied the same material to teach it to another person. The group that was preparing to teach scored significantly higher than the control group on a subsequent retention test of the material. In another study in which students were randomly assigned to one of two groups, Benware and Deci (1984) investigated whether students who learned with an active orientation (learning material that they expected to teach another student) would perform better than those who learned with a passive orientation (learning the same material and expecting to be tested on it). Results revealed that the two groups scored equally on rote learning, but the group that learned expecting to teach scored higher on conceptual learning. Similar results emerged from a study by Annis (cited in Topping, 1996) in which students were randomly assigned to one of three groups. The group that showed the greatest gain on test score was the group that read and taught, followed by the group that read and expected to teach (but who actually did not carry out the task), which in turn was followed by the group which read to study only. Hence, the implication here is that the act of teaching facilitates or reinforces the learning process.

Career Counseling and Awareness

There is much research to suggest a strong connection between career development and student background, particularly with regard to socioeconomic status (Hill, Pettus, & Hedin, 1990; Mestre & Robinson, 1983; Rolle, 1977). For example, those majoring in natural science tend to be from a higher social class than those pursuing a social science or nonscience major (Clark, 1986). Scientists come disproportionately from well-educated families, with fathers engaged in professional or managerial occupations (Pearson, 1986). In a study of undergraduate science and engineering majors conducted by Grandy (1994), a greater proportion of white students than minority students had parents employed in technical, mechanical, and scientific positions. In another study Hispanic science and engineering students were found to have received less career counseling from high school teachers and counselors, owned fewer technical toys, and had lower family income levels than did their nonminority peers (Mestre & Robinson, 1983). Given the historical underrepresentation of minorities in higher education, and in prestigious and lucrative careers in mathematics- and science-based fields, career counseling and career awareness have become common intervening strategies used in efforts to recruit and retain minorities in STEM. In a study involving African American and Latino high school valedictorians and salutatorians, Arnold (1993) noted that even with this select group of academic achievers there appears to be a "critical lack of tacit knowledge about higher education and careers" (p. 277). Moreover, research suggests that in comparison to their white peers, minority students tend to possess lower career aspirations and expectations (Fleming, 1982), demonstrate lower career decision-making self-efficacy (Gloria & Hird, 1999), and perceive greater ethnic identity barriers in their career development (Luzzo, 1993).

In a study involving middle and high school students, and students from a historically black university, personal contact with a scientist was identified as the major factor affecting students' science-related career decisions. Students who personally knew a scientist, mathematician, or engineer scored a higher mean than did those lacking this type of acquaintance on such variables as participation in science-related hobbies and activities, academic self-image, science-related career interest, parental encouragement and support, perceived relevance of mathematics and science, and ability in mathematics and science (Hill, Pettus, & Hedin, 1990).

A recent study of African-American engineering students found that prior knowledge of the profession and opportunities to talk with engineers was a factor that differentiated between those who remained in the major and those who switched (Good, Halpin, & Halpin, 2002). Wyer (2000/2001) found that positive images of scientists and engineers is positively related to students' commitment to a science or engineering major, degree aspirations, and commitment to a science or engineering career. While accurate information on science careers and personal contact with professional scientists can facilitate one's career exploration and decision-making, poor understanding of the nature of scientific careers may be contributing to the loss of student interest in science. According to Grandy (1998), the perceived compatibility between students' values and the aspired to career impacts persistence towards that career. Sadly, a significant number of individuals have a poor appreciation of the contributions of science professionals as some reportedly transfer out of science and engineering because they would rather do something that will benefit society.

In the Seymour and Hewitt study, inadequate advising, counseling, and tutoring were responsible in part for about one quarter of all student decisions to switch out of math, science, and engineering majors, and was cited by three-quarters of the switchers as a source of frustration. About half of those who persisted in math, science, and engineering studies expressed dissatisfaction with deficiencies in advising, counseling, and tutoring, as this was the second most frequently mentioned concern for this group. Students tended to describe their advising and counseling experiences as "confusing," "unreliable," "inadequate," and "impersonal." They desired current information and advice about career options, graduate schools, scholarships, and interaction with professionals who could share their experiences about work (Seymour, 1995; Seymour & Hewitt, 1994). Dissatisfaction with career counseling services, however, is not confined to math, science, and engineering majors. Assessing student satisfaction on 21 dimensions of the undergraduate experience, Astin, Korn, and, Green (1987) found that career counseling and advising received the lowest rating by a national sample of undergraduates. Only forty-five percent of respondents were either "very satisfied" or "satisfied" with career counseling and advising at their institution; more than half were "neutral" or "dissatisfied."

In a study involving 610 undergraduates, a high proportion of the participants (75%) indicated that they needed assistance in career planning before selecting a major (Beatty, Davis, & White, 1983). Students advised by professional advisors tended to be more satisfied than those advised by faculty advisors. The most often cited reasons for dissatisfaction with advising were that advisors did not care about the student personally, advisors knew little about college courses and procedures, and advisors knew little about courses outside of their own departments. The researchers also analyzed pre- and post-test scores on a student developmental task inventory (with the three scales of "appropriate educational plans," "mature life-style plans," and "mature career plans") for a group that took a career planning/orientation course and for two comparison groups that had not. The group which took the career course scored lowest on the pre-test, scored the highest on the post-test on two of the three scales, and achieved the greatest gains on all three scales. The most highly-rated course items were the career interview, departmental fair, textbook, and career day.

While faculty members usually assume some degree of responsibility in advising their students on academic matters, they tend to be more reluctant with career matters as many are unaware or not up to date on career information. Venglar, Goldberg, Cavanaugh, and Whiteneck (1982) reported on the result of one institution's efforts to involve faculty in career education programs. This project included career brochures, career modules, interdisciplinary courses focused on careers for specific disciplinary majors, curriculum reform, and career workshops. An evaluation of the project found that students exposed to career education materials and activities, in comparison to those not exposed, could list more career options for graduates in their major and could identify more skills they were learning that are relevant to the careers they aspired to; were more confident about acquiring a good job; and, more frequently communicated with faculty, alumni, and fellow students about career decisions. Rolle (1977), in a study involving African American students from low socioeconomic backgrounds, found that career planning experiences and occupational explorations led to an increase in career maturity as measured by the Career Maturity Inventory.

Finally, a study involving 1,229 beginning engineering students from 17 institutions nationwide shows that while more than half of the students had not understood the nature of engineering until after high school, the overwhelming majority of these students had made their decision to pursue an engineering degree prior to college entry (Shell, LeBold, Linden, & Jagacinski, 1983). This latter finding is not surprising given that success in attaining a mathematics-based or science-based college degree seems to depend greatly on a strong foundation of mathematics and science preparation. This suggests that while intervening strategies at the college level can enhance the retention of STEM majors, they are not likely to be very effective in the recruitment of new students into STEM fields. Instead, in order to increase substantially the number who earn STEM baccalaureate degrees, especially those who have been traditionally underrepresented, there needs to be greater intervention at the precollege level. Unfortunately, those from disadvantaged backgrounds do not realize, until it is too late, that those who do not acquire sufficient mathematics background prior to college entry are essentially "eliminated from an inordinate number of careers ranging from those from physical sciences and engineering to those in the social sciences and psychology" (Anderson, 1990, p. 264).

The lack of early encouragement and motivation has been identified as one of the main reasons for the underrepresentation of African Americans in the natural sciences (Pearson cited in Grandy, 1994). Precollege summer seminar and career information have been shown to exert a greater influence on the choice of an engineering career for African American and Hispanic students than for white students. In a review of research on career development counseling for African Americans, Murry and Mosidi (1993) point to evidence suggesting that parental influence more heavily impacts the career choice attitudes of African American and Native American high school students than that of their white peers. Similarly, in a study on the influences of parental career behavior on adolescent children's career development, Dillard and Campbell (1981) found that Anglo parents' career values and aspirations for their children are less associated with their children's career aspirations and expectations than in the cases of Puerto Ricans and African Americans. Thus, along with the use of role models and mentoring, early outreach career guidance programs for minority adolescents and their parents are recommended as an effective means of familiarizing students with a wider spectrum of college majors and career fields.

Other Strategies

Curriculum Reform

Much concern and criticism have been raised over the fact that despite the relatively strong academic backgrounds of freshmen with interest in math, science, and engineering (Green, 1989; Seymour, 1992; Seymour & Hewitt, 1994), there continues to be high attrition in these areas of study. While some may perceive the deficit in STEM majors as the natural outcome of a "weeding out" process of those who are incapable of handling a highly quantitative curriculum, more are coming to recognize that the heavy flow of talented students from these fields signals a systemic problem in STEM undergraduate education in this country. In an ethnographic study to investigate why college science fails to retain or attract students with the potential to become future scientists, Sheila Tobias (1990) recruited seven able postgraduates from the humanities and social sciences to "seriously audit" introductory science courses and to keep a journal of their experiences and observations. Encountering competition, a "tyranny of technique," and a lack of community in their science course, the auditors yearned for greater attention, support, and excitement. The main finding, according to Tobias (1993), is that "the physical sciences are presented in too narrow a teaching and learning mode and that students with other strengths find little opportunity to use the skills they learn elsewhere, particularly their verbal skills, in making sense of the material" (p. 43).

Many have advocated curriculum reform as every year a large number of students are diverted out of the STEM pipeline through failure in gateway courses. There has been particularly great concern expressed over the quality of calculus education. An estimated third of all freshmen who take calculus fail the course (Treisman, 1992). The nature of the "curricular structural impediments is complex," explained Treisman, and in cases like pre-calculus the "problems are essentially ones of coherence of the curriculum and its link or disconnectedness with what comes next" (Garland, 1993, p. 15). The calculus reform movement is said to have impacted nearly every institution of higher education in America (Bonsague & Drew, 1995), and typically involves the "use of technology," "real-life applications of the material," and "innovative teaching" (Alexander, Burda, & Millar, 1997). In a review of files on the 127 projects funded by the National Science Foundation's calculus initiative (1988-94), Ganter (1997) found that the development of original curricular materials was the major goal of most projects, and that computer laboratory experiences, discovery learning, and technical writing were the most commonly employed instructional strategies. Acknowledging that curriculum reform is needed, John White of the National Science Foundation proposed integrating courses and combating the perception that mathematics and science are "sterile" and removed from the real world (Sheahan & White, 1990). In his model of institutional adaptation, developed from case studies of effective institutions to explain why some colleges and universities are more successful than others in improving minority participation, retention, and graduation, Richardson (2000) identified the most advanced response as that which includes significant curricular and pedagogical reform.

According to Laws (1999), since 1983 over 500 reports have been published addressing the problems of science and mathematics education. These reports are so similar in their calls for reform that they can be easily summarized as including the following principles: "learn science and mathematics actively by doing them in collaboration with peers and instructors; engage in extended research projects with faculty mentors; explore fewer topics in more depth; achieve scientific literacy by being able to ask and answer questions such as "How do we know...?" and "What is the evidence for...?"; relate scientific and mathematical understandings to contemporary social issues; and develop written and oral communication skills (p. 218-219). In their study Keynes and Olson (2000) described the redesign of the calculus sequence at one research university as involving such key features as active learning, creative use of lecturing and other pedagogical methods, increase student/faculty contact, and increased use of group projects and workshop sessions. Participants of the calculus initiative achieved a higher average course grade and rate of course retention than did a comparison group enrolled in the standard calculus course. The researchers caution that curricular reform efforts that are purely content-based and which do not produce a more engaging environment tend not to yield as successful student outcomes. In an experimental study investigating the effectiveness of a revised undergraduate biology course, students enrolled in the experimental course (one which integrated lecture and laboratory sections, and adopted a learner-centered instructional model) scored higher on the attitude toward science survey and equally well on content knowledge acquisition when compared with students enrolled in the traditional course (McCormick, 2000/2001).

The need to target pedagogical effectiveness in the reform movement is clear. In their ethnographic inquiry into science, math, and engineering attrition, Seymour and Hewitt (1994) interviewed 335 undergraduates at seven institutions about their educational experiences, including those who stayed and those who transferred out of these fields. Of the range of concerns expressed by defectors and persisters, poor teaching by science, math, and engineering faculty was the most often cited by both groups (90.2% and 73.7%, respectively). Furthermore, dissatisfaction with instruction was the third most frequently mentioned factor in switching decisions, and had contributed to over one-third of such decisions. Students lamented the "counterproductive" effects of faculty's emphasis on "weeding out" rather than on "support and encouragement." In a study involving a nationally representative sample of college freshmen, Hagedorn et. al. (1997) found that perceived teaching quality by students significantly and positively predicts mathematics gain. The importance of quality of instruction is also emphasized in a national study by Hilton et. al. (1989) on the persistence of high-ability minority students in college science. This study found that persisters, in comparison to nonpersisters, view science, math, and engineering study to be more enjoyable, interesting, and rewarding. In a 1992 study involving a national sample of undergraduates at 388 institutions, Astin and Astin (cited in Drew, 1996), found that a strong research-oriented faculty negatively impacted persistence among physical science majors; the authors surmised that this was due in part to the heavy reliance on teaching assistants in undergraduate science coursework. In contrast, a strong student-oriented faculty positively impacted students' aspirations for research careers and persistence in the biological sciences.

Investigating why high ability minority students are choosing not to pursue science, mathematics, and engineering (SME) fields, Brown and Clewell (1998) interviewed 135 African-American and Latino nonscience majors (most of whom had SAT I mathematics scores of 600 or above). Using a critical incident technique in this study, the researchers found that the top three most influential factors pertain to teachers' attitudes and behaviors (non-SME teachers were perceived as being more caring and encouraging, whereas SME teachers tended to be seen as being "arrogant, unavailable, or unapproachable"); teaching practices (non-SME teachers were considered to be more effective in presenting the subject matter); and, course or curriculum issues (students were turned off by the longer time-to-degree, restrictive curriculum, time-consuming workload, and intense competitiveness associated with SME).

To battle structural and psychosocial factors impeding greater and more diverse participation in STEM, a number of support services have been offered. While there is little formal research on many of these strategies, their wide usage would suggest that they have been judged effective through informal study or casual observation. The availability of academic and psychosocial support services is critical in light of the finding that what seems to distinguish those who persist from those who transfer out of STEM has less to do with ability, and more to do with the manner in which students respond to barriers encountered. Interviewing a large number of undergraduates who persisted and those who switched out of math, science, and engineering majors, Seymour and Hewitt found the two groups to be similar in ability and character, but that "nonswitchers were more likely to make effective use of situational resources, to employ a variety of other strategies, and to find ways to tolerate or surmount the same types of difficulties reported by switchers" (Seymour, 1992, p. 232).

Learning Centers

A growing number of campuses have seen the contributions that a learning center can make towards student achievement. Studying the growth and influence of learning centers, Sullivan (1980) notes that since the late 1960s and early 1970s there has been a growing movement in higher education institutions to create a unit, program, or facility specifically to assist students in strengthening those learning skills needed to achieve academically. A survey of 2,713 two-year and four-year institutions in North America revealed that approximately half operated at least one learning center program or unit. While learning centers can vary in name as well as function, they typically strive to facilitate student retention and performance, and often include elements related to instructional resources and media, learning skills enhancement, tutoring services, and pedagogical development. While there is scarcely any research on the effects of learning centers, observations of a relationship between their presence on campus and student learning have been documented. An article by Holton and Horton (1996) describes the development and impact of the Physics Learning Center (PLC) at Rutgers University, later renamed the Mathematics and Science Learning Center. The Center offers lecture demonstrations that have been modified as permanent interactive exhibits, a study area, a physics library, tutors, test materials and course handouts, computers, and instructional videotapes on problem solving and review sessions. Drawing in over 140,000 student visits a year, the Center became a place where faculty and teaching assistants hold office hours, study groups meet, workshops are presented, and undergraduate clubs are housed. The authors noted that the facility became the setting where student performance and persistence were enhanced, and where "innovative, student-active, course development and experimentation" occurred. In her review of intervention programs, Gándara (1999) noted that those which use learning centers as a major strategy emphasize them as a place in which students gather to form supportive networks involving peers and program staff, where learning tools are imparted, and where students can find sanctuary for study. The presence of a student study center was identified as a program component common to model minority engineering programs in a study by NACME (Matyas, 1991b).

Workshops and Seminars

Academic enhancement activities designed to impart knowledge and to refine skills that are instrumental to college success have become prevalent on many campuses. The effectiveness of such seminars and workshops, however, has been little studied (Gándara, 1999). Yet, given a clear demand for such offerings, this type of academic support is often included in college-level intervention programs. A high proportion of minority students, including some with strong precollegiate educational records, struggle once in college in part because of feelings of isolation, and poor awareness of school policy, procedures, and support programs. African American students have self-reported poorer study skills in comparison to their white peers (Nettles, Thoeny & Gosman,1986). Gallagher, Golin, and Kelleher (1992) found that African American college students, when compared with their white counterparts, expressed a greater need for assistance with study skills, reading skills, test-taking strategies, test anxiety, mathematics anxiety, and time-management skills. African Americans also displayed more concern with self-confidence, fear of failure, and relationships with faculty. African American males showed the most concern over career choice. Overall, African American college students appeared to be under a greater degree of stress than their white peers. A study by Novels and Ender (1988) found that minority students who participated in a series of three developmental modules with the themes of "University Awareness," "Strategies for Successful College Study," and "Career Exploration/Validation," achieved higher college grades than did a historical comparison group.

Efforts to increase STEM graduate degree attainment often involve assisting students with test-taking skills as graduate school admissions tend to place much emphasis on entrance exam scores. Research on test preparation for the Graduate Record Examination (GRE) has yielded evidence of positive effects that may be linked to test familiarization and test anxiety reduction (Evans, 1977; Powers, 1987; Swinton & Powers, 1983). Information about graduate programs, admission process, financial aid opportunities, and the like can greatly assist traditionally underrepresented students in their progress towards graduate school entry. In his study of Ford Foundation Minority Fellows, Solorzano (1993) found that many of these scholars experienced the lack of information and encouragement to continue on to graduate school as an obstacle that hindered their advancement from undergraduate to graduate studies.

Academic Advising

Quality academic advising has been described as the "cornerstone" of student retention (Dannells, Rivera, & Knall-Clark, 1992), and is a common strategy used in intervention programs that strive to reduce student attrition. Research suggests that quality academic advising positively impacts student retention as well as satisfaction with the institution (Backhus, 1989; Lowe & Toney, 2001). There is evidence to suggest that institutions with strong orientation programs and advising services have higher graduation rates than institutions without such emphasis (Forrest cited in Pascarella & Terenzini, 1991). Because overall student satisfaction with academic advising is low (Astin, Korn, & Green, 1987), and minority students are at a greater risk of dropping out of STEM majors, some have advocated the use of "intrusive" or "aggressive" advising with underrepresented populations (Matyas, 1991a; Velez, 2000). Intrusive advisement programs are based on the principle that students should be called in for advising numerous times during the school year instead of the standard once-a-semester meeting between a student and his or her advisor, or until a student displays serious academic difficulties. In one study the implementation of an intrusive advising program coincided with such positive outcomes as reduced freshmen attrition, higher mean student grade point average, and more course hours attempted and completed by students. Because of a lack of controls, however, it is not clear what is attributable to the advisement program, and what resulted from other intervening programs (Glennen & Baxley, 1985).

Close contact with faculty and counselors has been identified as a key element of successful mathematics and science intervention models for underrepresented students (Rendon, 1985). According to Seymour and Hewitt (1994), the failure to elicit reassurance from faculty members that they are performing well, and have made a proper choice of science, has a disproportionately negative effect on both females and minority students because their confidence tends to be "neither strong, nor internalized, and is often tied to particular high school teachers who encouraged them" (Seymour, 1995, p. 201). Those students in the study who persisted in SME majors expressed a strong appreciation for "faculty, professional advisors, departmental assistants, and teaching assistants who showed an active long-term interest in their learning, their problems and their progress" (Seymour, 1995, p. 202).

As the higher education student body becomes more diverse, academic advisors can play an increasingly crucial role in addressing the needs of nontraditional students. Possessing less of the "cultural capital" that provides familiarity with how to negotiate successfully through a university system, traditionally underrepresented students can benefit tremendously from quality academic advisement. In a recent study of factors that affect decisions of underrepresented minorities to forego science and engineering doctoral study, Brazziel and Brazziel (2001) found that each of the highly able interviewees mentioned poor advisement as a hindrance. In a study to assess the long-term effects on a cohort of

African American students targeted for a special academic counseling program, Trippi and Cheatham (1991) found that while controlling for a range of variables, first-year, second-year, and third-year students who sought and received counselor assistance with legibility concerns (i.e., those pertaining to institutional culture, norms, and procedures) were consistently more likely to graduate than those who did not receive such assistance. In a study on academic advising, Lowe and Toney (2001) found no difference in the retention rates of those who were advised by faculty and those who were advised by staff advisors.. A study on the personal, career, and learning skills needs of college students found that in terms of mode of receiving help, individual counseling was the most preferred method by the overall sample, and was more greatly preferred by African American students than by white students (Gallagher, Golin, & Kelleher, 1992).

In a review of the literature on educational advising, Creamer (1980) constructed an advising model for retention that recommended such steps as offering training programs for faculty or counselors with advising responsibilities; implementing a system for regular information flow to students which frequently updates academic progress; and, promoting the development of frequent and meaningful interactions between faculty and students. A retention study conducted by NACME yields evidence that retention success of minority engineering students is related to the monitoring of student performance and early warning of academic difficulty (Penick & Morning, 1983).

Financial Assistance

Minority intervention programs tend to recognize the importance of providing financial support to students. A recent report by the U.S. Department of Education (2000) found science and engineering degree completion to be positively related to receiving financial aid from school. Holding constant a range of factors, students with families providing reliable financial support were more likely to complete a science or engineering degree. Though institutional research on the impact of student aid has yield mixed results (with some studies concluding aid to be effective and others concluding that it is not significant), national studies have consistently found student aid to be a positive influence on persistence (St. John, 1991). In their analysis of data for a national sample of students, St. John, Kirshstein, and Noell (1991) found that with a range of background and college experience variables taken into account, financial aid exerts a positive effect on college persistence. Loans as well as grants and work significantly affected persistence.

In a meta-analysis of research studies on financial aid and persistence, Murdock (1987) found a positive albeit weak relationship. The impact of financial aid on persistence was greater for low socioeconomic status students than for middle and high socioeconomic status students; greater for students at two-year institutions than four-year institutions; greater for those attending private than public institutions; and, greater in the later years than the initial years of college. Fenske, Porter, and DuBrock (2000) found that departure rates within SME were highest for underrepresented minorities and needy students. Underrepresented minorities in both SME and non-SME majors were less likely to finance their education with gift aid only or self-help only packages; minorities tend to participate in more types of aid. For each of the five years of college in which data were analyzed, a high proportion of students with gift aid only packages persisted the following year. According to Pascarella and Terenzini (1991), among the studies that find significant differences among forms of aid on persistence, the weight of the evidence suggests that scholarships or grants are the most beneficial.

Model Programs

The Mathematics Workshop

One of the most well-known and modeled after intervention programs is the Mathematics Workshop Program (MWP) which began at the University of California, Berkeley. Positive outcomes have been documented for this particular program, and similar programs found on other campuses. Because of its success the mathematics workshop model has been modified and used at the high school level and in other disciplines at the college level (Murphy, Stafford, & McCreary, 1998). Work on the mathematics workshop model began in 1974 after Uri Treisman conducted an informal observational study of African American undergraduates and Chinese American undergraduates in an effort to explain differences in the performance of these two groups in first-year calculus (the latter group generally performed well and the former group did not). Treisman's findings challenged pervading beliefs that motivation, standardized test scores, and economic background explained success or failure. Instead, he found that group performance was linked to strategy differences in exam preparation and homework completion. African American students were more likely to study alone and to have little contact with calculus classmates outside of class. Chinese American students, in contrast, were more apt to engage in informal "study groups" and to mix their social and study time. The study groups effectively aided the exchange of academic and institutional information, and expedited mastery of subject matter as "students checked each others' work, pointed out errors in each others' solutions, and freely offered each other any insights that they had obtained...about how to manage difficult problems" (Fullilove & Treisman, 1990, pp. 466-467).

In response to these findings, the MWP, as part of the university's Professional Development Program, was purposefully designed as a honors program to combat "debilitating patterns of isolation" by emphasizing "group learning and a community life focused on a shared interest in mathematics" (Treisman, 1992, p. 368). As a complement to the calculus course, an "intensive" workshop was offered in which groups of 5-7 students collaboratively tackle challenging and carefully crafted problems for two hours twice a week. A graduate student workshop leader monitors the process and strategically guides participants through difficulties. According to Treisman, the heart of the project lies with the problem sets which fuel group interaction as students are given "plenty of opportunities for self-correction and an environment in which they could safely make public their understandings" (Garland, 1993, p. 14). Along with an emphasis on academic excellence and enrichment, the program also offers within the academic setting itself a range of support services such as counseling, monitoring of academic progress, and assistance in navigating the university system (Clewell, 1989).

Program evaluation results show that workshop participants, when compared with nonparticipants, were more likely to persist and to graduate, in addition to being two to three times more likely to earn higher mathematics grades (Fullilove & Treisman, 1990). Moreover, African American and Latino participants outperformed not only their nonworkshop minority peers, but also their nonworkshop White and Asian classmates. African American students with Mathematics SAT scores in the low-600s performed as well as White and Asian students with Mathematics SAT scores in the mid-700s (Treisman, 1992). These results are even more impressive when one considers the academic records of minority students prior to the creation of the program. African American and Latino students had grades far below the average; more than one-fourth of the minority students who attempted Mathematics IA dropped the class; and, after failing the mathematics sequence, a significant number of minorities withdrew from the institution (Clewell, 1989). Qualitative study of the program suggests that the superior outcomes of workshop participants may be due to greater time spent on mathematics study, which is shown to be a significant and positive predictor of mathematics gain (Hagedorn, Siadat, Nora, & Pascarella, 1997), as well as the more efficient manner of study that purportedly occurs in these study groups (Fullilove & Treisman, 1990).

One of the many sites inspired by the workshop model is the University of Texas at Austin which established the Emerging Scholars Program (ESP). In addition to attending the regular calculus lecture, ESP students attend a two-hour workshop three days a week while non-ESP calculus students attend a one-hour discussion section twice a week. The small-group format of ESP was established to facilitate positive experiences for students in freshmen calculus by providing a supportive environment within which they could share and exchange calculus knowledge, and build friendships with others interested in pursuing mathematics-related majors. Informal advising and counseling are said to be integral to the community building that takes place within ESP as participants are regularly monitored by teaching assistants or undergraduate peer teachers (Garland, 1993). Investigating the effects of program participation, Moreno and Muller (1999) controlled for precollege achievement (quantitative SAT score) and found that ESP students on average earned about one letter grade higher in Calculus I and were more likely to enroll in Calculus II than were non ESP students. Moreover, those participating in ESP for a full year were almost twice as likely to choose a SME major than were nonparticipating calculus students.

The mathematics workshop model also has been successfully adapted by the Academic Excellence Workshop at the California State Polytechnic University (Pomona). Here, upper-division minority SME undergraduates lead problem-solving sessions in which students work collaboratively on calculus problems devised to reinforce key concepts and to detect deficiencies in students' comprehension. Bonsangue and Drew (1995) examined data over a five-year period for those enrolled in first-quarter calculus and found that while workshop and nonworkshop minority students did not differ in initial mathematics skills and background, workshop participants earned a higher mean grade in both first and second year calculus, and had a lower rate of course repetition. Moreover, three years after college entry only 15% of workshop students had either left the institution or switched from a MSE major, compared with 52% of the nonworkshop minority students, 50% of nonworkshop white students, and 41% of nonworkshop Asian American students. Interviews with a cohort of workshop students revealed that 70% felt that without the workshop they would not have performed as well as they did in their calculus coursework. In informal interviews workshop facilitators reported that their role in the sessions helped them to master the material that allow them to do well on graduate school entrance exams. Moreover, through serving as role models, undergraduate teaching assistants are likely to gain confidence in themselves as their self-efficacy and self-image as achievers are reinforced (Kenschaft, 1990).

Other programs influenced by the Berkeley model have also documented positive effects, including the Merit Workshop Calculus Program at the University of Illinois at Urbana-Champaign which targets African-American and Hispanic students, and students from small high schools. Longitudinal data show that despite having somewhat weaker academic backgrounds than nonworkshop students, workshop participants were more likely to earn higher grades in calculus coursework, to complete the calculus sequence, and to persist in calculus-based majors (Murphy, Stafford, & McCreary, 1998). The Wisconsin Emerging Scholars Program, a nonremedial, multicultural workshop emphasizing community and collaboration in learning calculus, has also yielded positive student outcomes. Controlling for precollege achievement,
minority workshop participants, when compared with their minority classmates not participating in the workshop, achieved a higher mean course grade and a higher course completion rate. Qualitative evidence from this study suggests that through a process of solving challenging problems within a student-centered interactive environment in which students take the lead in teaching one another, students are able to derive "both external affirmation from their peers and internal affirmation that they have mastery of the material" (Alexander, Burda, & Millar, 1997, p. 154). The program did encounter barriers, however, including feelings of token representation in some white-dominated workshop sections,

as well as the surfacing of racial disharmony and competition in a bicultural section. The researchers concluded that the mathematics workshop model cannot be uniformly implemented across institutions, but rather ought to be modified to best fit local conditions, and that while the program is beneficial to participants, it may not be enough "to surmount the pervasive problems of racism and ethnic isolation that ethnic minority students face on college campuses" (Alexander, Burda, & Millar, 1997, p. 157).

Research on the mathematics workshop model, and other similar programs, has produced strong evidence that supplemental instruction in the form of cooperative learning results in positive student outcomes (Blanc, DeBuhr, & Martin, 1983; Posner & Markstein, 1994). Springer, Stanne, and Donovan in a 1999 meta-analysis study of the effects of small-group learning on undergraduates in SMET, found that "various forms of small-group learning are effective in promoting greater academic achievement, more favorable attitudes toward learning, and increased persistence through SMET courses and programs" (p.21).

Meyerhoff Program

The Meyerhoff Program is a comprehensive intervention program located at the University of Maryland Baltimore County that is designed to address four critical areas suggested by the research literature as inhibiting minority success in science: knowledge and skills, motivation and support, monitoring and advising, and academic and social integration. Top mathematics and science African American students are selected for participation and exposed to such program components as summer bridge (mathematics, science, and humanities coursework and training in analytical problem solving); scholarships (four-year comprehensive contingent upon maintaining at least a B average); academic advising and personal counseling; tutoring; study groups; summer research internships in science and engineering; mentoring by scientific professionals; and, faculty and family involvement. A strong family-like program community is fostered through regular staff-student group meetings and shared residence hall by Scholars during the freshmen year.

In a study that compares first-year academic outcomes of the first three cohorts of Meyerhoff students with a historical sample of comparably talented African American science students at the university, Hrabowski and Maton (1995) found that controlling for key background variables, Meyerhoff students achieved both a higher mean overall GPA (3.5 vs. 2.8) and a higher mean science GPA (3.4 vs. 2.4). Observational and survey questionnaire data suggest that study groups, a peer-based community, financial scholarships, summer bridge program, and the collaborative efforts of staff and faculty are particularly relevant to participant success.

Extending their previous research, Maton, Hrabowski, and Schmitt (2000) recently investigated the longer-term participant impact of the Meyerhoff Program and factors that lead to program effectiveness. Academic outcomes five years after college entry were compared for three cohorts of Meyerhoff students and multiple comparison groups (including SME students who declined the Meyerhoff scholarship, a historical cohort of comparable students, and a contemporary comparison group). Results show that Meyerhoff students generally earned higher grades in SME, graduated with SME degrees at a higher rate, and attended graduate school in SME fields at a higher rate than did the comparison groups. Furthermore, interview data indicated that as a result of the program, positive ripple effects on science education were felt at the institution, and faculty underwent a "dramatic, positive change in perceptions and expectations concerning African American student performance in science" (p. 647).

In a recent study, Fries-Britt (1998) conducted extensive interviews with twelve Meyerhoff Scholars in their senior year to learn more about their academic, social, and racial experiences. She found that like many other top African American students, those in this study had little exposure to other academically gifted African American students. According to Fries-Britt, the Meyerhoff program represented the first time that these students were "surrounded by a large number of high-achieving Blacks who were striving toward the same goal of academic excellence" (p. 564). She concluded that participation in the Meyerhoff program provided an emotionally supportive, family-like environment that facilitated peer networking, and consequently helped ward off feelings of marginalization. Student isolation and nonassimilation are of particular concern in cases where minority students attend a large, predominantly white university.

Minority Engineering Program

A well-established and widely replicated program is the Minority Engineering Program (MEP), which is the college-level extension of the MESA (Mathematics, Engineering, and Science Achievement) program that operates at the secondary school level. Founded in 1973 by Ray Landis, an engineering professor at the California State University, Northridge, MEP centers today are located on twenty campuses within the state of California, and at colleges and universities in fourteen other states (Gándara, 1999). While MEPs are located on a variety of campuses, and vary somewhat in program features, they tend to share some common elements: linkage with the engineering unit of the institution; strong precollege and community college outreach; concentrated efforts on working with freshmen and sophomores; an emphasis on coöperative learning and community building through the use of structured collaborative study groups, the clustering of MEP students in the same sections of courses, and the establishment of study centers; professional development activities such as role model speakers and industry field trips; and, the offering of such academic support services as freshmen orientation courses, tutoring, summer bridge, supplemental instruction in mathematics and science, close monitoring of student progress, and academic and personal counseling (Collea, 1990; Landis, 1988; Morrison & Williams, 1993).

Gains in student learning and retention in engineering studies have been reported for MEP participants (Rotberg, 1990). In response to a 1985 request by the California legislature to assess the impact of MEP, the California State Postsecondary Education Commission (1985) issued a report that shows MEP participants continue in engineering at a higher rate than non-participants. The results were especially encouraging for the four ethnic groups targeted by the program (African Americans, Mexican-Americans, other Hispanics, and American Indians). Examining three-year retention data for engineering students at the University of California campuses and the California State University campuses, Landis (1988) found that the retention rate for minority students who participated in the MEP exceeds not only that of minority students who did not participate in the MEP, but also that of the overall student group in engineering. Gándara (1999) cites improved retention rate data for the MEP at the California State University, Sacramento which experienced an increased 10 percent per year over four years—beginning with 50 percent in 1991 and growing to 80 percent by 1994. One recent study found that the higher retention rate of African-American MEP students, in comparison to non MEP African-American engineering students, at one institution was associated with a greater sense of connectedness to the engineering community (Good et al., 2002). The MEPs of certain universities have also been credited with their institution's success at graduating high numbers of underrepresented students. MEPs have been highlighted in a study that examines the top ten institutions that are most successful at preparing underrepresented minorities for doctoral study in science and engineering (Brazziel & Brazziel, 1997), as well as in a study of four predominately white campuses with exceptionally high minority retention rates (Clewell & Ficklen, 1987).

Since the creation of the Minority Engineering Program minority enrollment in engineering has climbed substantially, but attrition remains high (Morrison & Williams, 1993). Indeed merely having a program on campus does not guarantee success. Just as program implementation varies, so does program effectiveness (Richardson, 1994). In a study examining MEPs at 20 engineering schools, Morrison and Williams (1993) found that the eight MEPs that are the most successful in recruiting and graduating minority students tended to have strong recruitment through high school outreach, provide summer programs that strengthen content knowledge and emphasize study and critical thinking skills, be perceived as having high faculty support, offer study centers, be equipped with an adequate number of tutors, and receive relatively high levels of institutional funding.

The three programs highlighted above (Mathematics Workshop, Meyerhoff Scholars, and MEP) constitute a small sample of science related intervention programs for minorities that exist on college and university campuses across the country. Many other smaller or lesser well-known programs have also yielded evidence of success (see Chandra, Stoeklin, & Harmon, 1998; Fredericksen, 1998; Gándara, 1999; Lam, Doverspike, & Mawasha, 1997). This seems to be especially the case for multi-component programs, or those that adopt a more holistic approach to battling the impediments that hinder greater and more diverse participation in STEM. In a study that examines institutional practices that positively affect the retention of minority students on predominately white campuses, Clewell and Ficklen (1987) conducted intensive case studies of four colleges and universities with high minority retention rates. These researchers found that all four institutions had effective retention programs that were deemed comprehensive in their offering of services.

A 1985 study by NACME (see Matyas, 1991b) found that model minority engineering programs tackle both academic and attitudinal barriers, and tend to contain the following components: (1) student recruitment from high schools and two-year colleges; (2) assistance with admission procedures; (3) assistance with student matriculation (including procuring financial aid, academic advising, orientation); (4) academic support services (tutoring, study skills training, extra recitations); (5) student study center; (6) linkage of students with minority student organizations in engineering; and (7) summer engineering jobs. Renowned programs such as the National Institutes of Health's Minority Biomedical Research Support Program (MBRS), and the Minority Access to Research Career Program (MARC) offer a wide range of services including research experiences, special seminars and workshops, travel to professional science meetings, tuition and stipends, and information on graduate schools. Given that research shows that the educational persistence and achievement of minority students are impacted by a complex array of factors, it is logical that the most effective programs will be those that seek to assist students with overcoming an assortment of barriers at both the institutional and personal level. This does not mean that the same program ought to operate identically at different institutions. Treisman warns against program isomorphism, and argues that minority programs need to reflect the varying histories, missions, and goals of individual institutions (Garland, 1993).

The Case for System Wide Partnerships

Community Colleges

Institutional collaboration within the higher education system can contribute much to the effort to increase minority participation in STEM fields. Through institutional partnerships colleges and universities can work in consort to share valuable resources, and to overcome barriers or shortcomings that exist on individual campuses. Take for example the case of community colleges, which typically lack the technical resources to develop outstanding science and research programs, but which have a high concentration of Latino, American Indian, and African American students (Darden, Bagakas, & Li, 1997; Wilson, 2000), who constitute a largely untapped pool with great potential for increasing this country's scientific workforce. More than half of all minority freshmen begin their college careers in junior and community colleges (Brazziel & Brazziel, 1994; Brazziel & Brazziel, 1997); many choose to do so because of the lower cost of attending a two-year college rather than a four-year institution. Research reveals that the burdens of debt have a greater impact on the college attendance of minorities than that of whites (Rotberg, 1990).

In a national study of students on the engineering path, Adelman (1998) found that community college transfer students show strong preparation; the degree completion rates of transfer students rivaled those of 4-year college students. These community college transfer students account for 1/6th of the degrees awarded in engineering. In their study of community college students, Nora and Rendon (1990) found that two-year institutions appear to be the "primary collegiate vehicle Hispanics use to attain career, economic, and social mobility" as even the brightest of the group tend to begin their college careers in mathematics and science there (p. 37). Comparing the backgrounds of white and Hispanic community college students, the researchers found that Hispanic students had less educated parents, but superior high school grades. In Solorzano's 1993 study of Ford Foundation Fellows, a high proportion of these doctoral fellows (45 percent of the men and 41 percent of the women) began their college career at a two-year institution. While many community college students aspire to go on to attain a four-year degree, a high proportion does not successfully do so (Wilson, 2000). Those who start out at a two-year college are much less likely to complete a bachelor's degree than those who initially enter a four-year institution (Astin cited in Grandy, 1998). Clearly much more can be done to assist community college students to transition successfully from two-year to four-year institutions.

Grandy (1998) found that minority students at four-year institutions reported receiving greater minority support than did minority students at two-year colleges, and suspects that this may be because community college students "were less able to envision their futures beyond the sophomore year because there were no older students who could offer advice and support and with whom they could identify" (p. 609). In this longitudinal study of high ability minority students, minority support (minority and female role models and advisors, advice and support from advanced students of their own ethnic group, and dedicated minority relations staff) heavily impacted students' ambition and commitment to science during the sophomore year, which in turn, had the greatest effect on science and engineering status four years after college entry. Grandy recommends that two-year colleges form links with nearby four-year institutions, and create opportunities for minority students to personally interact with advanced students. Institutional partnerships may also enable qualified community college students to gain hands-on research experience in university laboratories, which is critical to preparing students for graduate study in scientific and technical fields. Richardson (2000) warns that too frequently four-year institutions choose to link with whiter and more affluent suburban community colleges over inner-city community colleges with higher minority enrollments. Collaboration between community colleges and senior institutions can also result in the important product of articulation agreements, which affects the facility by which community college students continue on to earn a bachelor's degree from a four-year institution. A study on the community college transfer function found that community college articulation with senior institutions is generally weak, in terms of there being a poor exchange of information about transfer students and comparison of curriculum and expectations (Rendon, Justiz, & Resta, cited in Rendon & Nora, 1994).

Minority Institutions

In trying to make a greater contribution to the production of scientists and engineers, minority institutions grapple with the challenge of how to reach an effective balance of research efforts at what are primarily teaching institutions (George, 1991). Institutions with a predominantly minority student enrollment such as tribal colleges, historically Black colleges and universities (HBCUs), and Hispanic-serving institutions (HSIs) tend to lack the technical resources to develop top-notched science programs.

To provide their students with richer opportunities to explore and train for careers in scientific fields, minority institutions need to utilize a range of strategies including linkage with other institutions. A prime example is the case of HBCUs, which can and have played an integral role in institutional partnerships that enhance minority participation in STEM fields.

HBCUs have historically educated the greater part of the most highly educated African Americans in the country, including many professional engineers and scientists (Malcolm, 1990). While predominately white colleges and universities today educate the majority of African American students, HBCUs continue to be credited with the training of a disproportionately high number of graduates who go on to attain a doctorate degree, or those who become scientists and engineers (Brazziel & Brazziel, 1997; Hill, Pettus, & Hedin, 1990; Pearson, 1986; Solorzano, 1995). This record is even more impressive in light of the fact that African American students at HBCUs tend to start college with weaker academic backgrounds and to come from more disadvantaged families than do African American students at majority institutions (Allen, 1988). This success of HBCUs is linked to the fact that most of the African American scientists and engineers in academe are on the faculties of historically black colleges where they visibly serve as role models with responsibilities as teachers, researchers, and administrators. According to Hill, Pettus, and Hedin (1990), "early exposure to, and interaction with, professional role models in the natural and technical sciences have been found to be critical for recruiting and retaining students' interest and participation in mathematics and science," while "the lack of role models has been suggested as yet another factor that inhibits the recruitment of young blacks and females into science" (p.294). Some researchers have suggested that African American students at HBCUs are apt to be better psychosocially adjusted, when compared with African American students at predominately white institutions, because their "critical mass" facilitates the development of a "relevant" community, since campus activities are better matched with their own interests, and they find the overall campus more nurturing (Allen, 1988; Freeman, 1999; Sedlacek, 1999).

Although tribal colleges and HSIs encounter many similar barriers that HBCUs do, there has been considerably less research attention devoted to examining the nature of and response to challenges faced by them. There has been scarcely any empirical research on HSIs and tribal colleges, much less on the effectiveness of these types of institutions in the production of scientists and engineers. Examining the baccalaureate origins of Hispanic Ph.d.s in science and engineering, Baker (2000) found that four of the top five institutions identified as most productive are HSIs. The majority of institutions on the list of top twenty producers are located in the states of Texas (six), New Mexico (four), and California (three). Moreover, a relatively small number of institutions are responsible for the baccalaureate training received by Latino science and engineering doctorates. The twenty institutions identified as most productive accounted for about a quarter of the Latinos who went on to earn doctorates in science and engineering. Similarly, Solorzano (1994) found that many Chicano/a doctorates received their baccalaureate degrees from HSIs, although slightly less so for Chicano/a science doctorates. For the Chicana group, 2 of the top 9 producers were HSIs and accounted for 20% of the eventual science doctorates. For the Chicano group, 5 of the top 30 producers were HSIs and accounted for 20% of the eventual science doctorates.

One type of special-focus serving institution that has been the subject of considerable research is women's colleges. Evidence shows that women are one and a half times as likely to earn baccalaureate degrees in the life sciences, physical sciences, and mathematics at a women's college than at a coeducational institution (Sebrechts, 1992). Moreover, graduates of women's colleges continue on to doctoral studies in math, science, and engineering in disproportionately large numbers. Elizabeth Tidball (1986) found that more than half of the most productive colleges that graduated women who went on to doctoral studies in the natural sciences were women's colleges, despite their declining numbers among institutions of higher education. A recent study shows that the greater propensity of women's colleges to produce future female doctorates remains after controlling for instructional expenditure. For African

American and Latina women, in comparison to White women, institutional resources and selectivity play a much smaller role in producing female doctorates. Both HBCUs and HSIs spend less per student on instruction, yet both are more productive and more efficient at producing African American doctorates and Latina doctorates, respectively, than other institutional types (Wolf-Wendel, Baker, & Morphew, 2000). Examining the baccalaureate origins of women of color who earn doctorates, Wolf-Wendel (1998) found that historically black women's colleges graduated higher proportions of successful African American women than did any other institutional type (including historically black coed institutions). Similarily, Hispanic-serving women's change colleges (colleges that were once single-sex but had become co-ed) outproduced all other institutional types in terms of Latina women who go on to earn doctorates. Interestingly, a recent study comparing the baccalaureate origins of male and female doctorates revealed an inverse relationship for doctoral productivity by gender at the most productive institutions; undergraduate institutions with higher male doctoral productivity tend to have lower female productivity (Tidball, Smith, Tidball, & Wolf-Wendel, 1999). The positive impact of attendance at a women's college is believed to be linked to such things as mentoring, role modeling, counseling, extensive extracurricular opportunities such as internships, and the presence of a "critical mass" of female students and scientists (Sebrechts, 1992; Tidball, 1980; Tidball, 1986; Wolf-Wendel, 2000). Moreover, recognizing that many female students underestimate their own abilities, women's colleges seek to recruit and retain students through an array of nurturing practices rather than through a "swim or sink" approach that can be commonly found in math and science departments at many institutions.

A number of effective institutional strategies can be drawn from the overall body of research involving special focus institutions, including developing dual degree and cross registration programs with other universities; centralizing science and engineering resources into centers; and, forming consortia with other higher education institutions, corporations, and national laboratories to enhance faculty development, undergraduate curriculum reform, and research opportunities (George, 1991). Collison (1999) points out that dual-degree programs involving majority institutions and minority institutions are "mutually beneficial arrangements" that enable smaller institutions to strengthen or build new programs, and majority institutions to increase the number of minority students who earn degrees from their school. Institutional collaboration between undergraduate teaching institutions and research universities can also facilitate the recruitment and admission of college graduates into graduate programs through assistance with identification of relevant programs, the application process, financial aid information, etc. Moreover, majority institutions, through institutional partnerships, can capitalize upon the high concentration of minority faculty members that is commonly found at minority institutions but absent from their own campus. Minority students attending majority institutions can benefit greatly from exposure to and personal interactions with these minority role models. The use of role models has been identified as a key element in successful mathematics and science intervention models for underrepresented minorities (Rendon, 1985).

Predominately White Institutions

The colleges and universities with the resources to build preeminent programs in STEM tend to be predominately white institutions. While these institutions have much to contribute to institutional partnerships, they are also in need of much assistance in boosting underrepresented minority student participation in STEM fields. While all students experience some degree of stress in adjusting to their new life at college, minority students on white majority campuses may be more likely to experience additional stress related to isolation and social adjustment pressures (Pounds, 1987). Examining the range of problems that African American students face on predominately white campuses, Allen (1988) found that the most serious ones pertain to isolation, alienation, and lack of support. Analyzing data gathered at a small predominately white public university, Loo and Rolison (1986) found that minority students were more apt to express feelings of isolation and alienation than were nonminority students. Data gathered from a national stratified sample of college seniors majoring in STEM revealed that Mexican-Americans, more than any other ethnic group, found their undergraduate environment stressful (Grandy, 1997). In a study investigating the relationship of role strains, life event stresses, and the adjustment of minority freshmen at a majority institution, evidence emerged to suggest that minority status is related to additional stress that results in an increased risk for negative outcomes (Smedley, Myers, & Harrell, 1993).

According to Richardson (2000), the paucity of earnest faculty engagement in tackling the challenges of minority achievement is especially severe at research universities, where much of the "brain power" in mathematics, science, and engineering is based. Majority institutions can greatly enhance minority participation in STEM by sharing their wealth of resources, and by providing more meaningfully STEM learning and working opportunities to traditionally underrepresented students on their campus, as well as those at nearby minority institutions and community colleges. Moreover, institutional partnership efforts that involve serious collaboration between faculties at the various types of institutions can lead to the creation of effective recruitment and bridge programs, expanded collaborative research opportunities for both faculty and students, and the sharing and replication of successful intervention strategies for underrepresented minority students.

References

Ackermann, S. P. (1991). The benefits of Summer Bridge programs for underrepresented and low-income students. *College and University,66* (4),201-08.

Adelman, C. (1998). *Women and men of the engineering path: A model for analyses of undergraduate careers*. Washington, DC: National Institute for Improving Science Education

Allen, W. R. (1988). Improving black student access and achievement in higher education. *Review of Higher Education, 11* (4), 403-16.

Alexander, B. B., Burda, A. C., & Millar, S. B. (1997). A community approach to learning calculus: Fostering success for underrepresented ethnic minorities in emerging scholars program. *Journal of Women and Minorities in Science and Engineering, 3* (3), 145-59.

Anderson, B. J. (1990). Minorities and mathematics: The new frontier and challenge of the nineties. *Journal of Negro Education, 59*, 260-72.

Arnold, K. D. (1993). The fulfillment of promise: Minority valedictorians and salutatorians. *Review of Higher Education, 16* (3), 257-83.

Astin, A. (1993). *What matters in college: Four critical years revisited.* San Francisco, CA: Jossey-Bass Publishers.

Astin, A., Korn, W., & Green, K. (1987). Retaining and satisfying students. *Educational Record, 68*(1), 36-42.

Backhus, D. (1989). Centralized intrusive advising and undergraduate retention. *NACADA Journal, 9* (1), 39-45.

Baker, M. Q. (2001). The baccalaureate origins of Latino doctorates in science and engineering: 1983-1997 (Doctoral dissertation, American University, 2000). *Dissertation Abstracts International, 61*, 4303.

Bargh, J. A., & Schul, Y. (1980). On the cognitive benefits of teaching. *Journal of Educational Psychology, 72* (5), 593-604.

Beatty, J. D., Davis, B., & White, B.J. (1983). Open option advising at Iowa State University: An integrated advising and career planning model. *NACADA Journal, 3* (1), 39-48.

Benware, C., & Deci, E. (1984). Quality of learning with an active versus passive motivational set. *American Educational Research Journal, 21* (4), 755-65.

Blackwell, J. E. (1987). Mentoring and networking among blacks. In A.S. Pruitt (Ed.), *In pursuit of equality in higher education* (pp.146-162). Dix Hills, NY: General Hall.

Blanc, R. A., DeBuhr L. E., & Martin, D. C. (1983). Breaking the attrition cycle: The effects of supplemental instruction on undergraduate performance and attrition. *Journal of Higher Education, 54* (1), 80-90.

Blockus, L. H. (2001). The influences and experiences of African American undergraduate science majors at predominately White universities (Doctoral dissertation, University of Missouri, 2000). *Dissertation Abstracts International, 61*, 4668.

Bonsangue, M. V., & Drew, D. I. (1995). Increasing minority students' success in calculus. *New Directions for Teaching and Learning*, (61), 23-33.

Brazziel, W. F., & Brazziel, M. E. (1994). Science and engineering doctorate recipients with junior and community college backgrounds. *Community College Journal of Research and Practice, 18* (1), 71-80.

Brazziel, W. F., & Brazziel, M. E. (1997). Distinctives of high producers of minority science and engineering doctoral starts. *Journal of Science Education and Technology, 6* (2), 143-53.

Brazziel, W. F., & Brazziel, M. E. (2001). Factors in decisions of underrepresented minorities to forego science and engineering doctoral study: A pilot study. *Journal of Science Education and Technology, 10* (3), 273-81.

Brown, S. V., & Clewell, B. C. (1998). *Project Talent Flow: The non-STEM field choices of black and Latino undergraduates with the aptitude for science, engineering, and mathematics careers* (Alfred P. Sloan Foundation Grant No. 95-12-15). Washington, D.C.: The Urban Institute.

California State Postsecondary Education Commission. (1985). etention of students in engineering: A report to the legislature in response to Senate concurrent resolution 16. (ERIC Document Reproduction Service No. ED316416).

Carman, R. A. (1975). Long-term study of effects of tutoring in developmental mathematics. (ERIC Document Reproduction Service No. ED112983).

Chandra, U., Stoeklin, S., & Harmon, M. (1998). A successful model for introducing research in an undergraduate program. *Journal of College Science Teaching, 28* (2), 113-116.

Clark, M. L. (1986). Predictors of scientific majors for black and white college students. *Adolescence, 21* (81), 205-13.

Clark, J. V. (1999). Minorities in science and math (ERIC Digest). Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. (ERIC Document Reproduction Service No. ED433216).

Clewell, B. C. (1989). Intervention programs: Three case studies. In W. Pearson Jr., & H.K. Bechtel (Eds.), *Blacks, science, and American education* (pp. 105-122). New Brunswick: Rutgers University Press.

Clewell, B. C., & Ficklen, M. S. (1987). Effective institutional practices for improving minority retention in higher education. *Journal of College Admissions, 116*, 7-13.

Clewell, B. C., & Ginorio, A. B. (1996). Examining women's progress in the sciences from the perspective of diversity. In C. Davis, A. B. Ginorio, C. S. Hollenshead, B. B. Lazarus, P. M. Rayman, & Associates (Eds.), *The Equity Equation* (pp. 163-231). San Francisco: Jossey-Bass.

Collea, F. P. (1990). Increasing minorities in science and engineering: A critical look at two programs. *Journal of College Science Teaching, 20* (2), 31-34, 41.

Collison, M. (1999). The power of partnerships. *Black Issues in Higher Education, 16* (10), 26-29.

Cosgrove, T. J. (1986). The effects of participation in a mentoring-transcript program on freshmen. *Journal of College Student Personnel, 27* (2), 119-24.

Creamer, D. (1980). Educational advising for student retention: An institutional perspective. *Community College Review, 7* (4), 11-8.

Culotta, E. (1992). Scientists of the future: Jumping high hurdles. *Science, 258*, 1209-13.

Dannells, M., Rivera, N. L., & Knall-Clark, J. E. (1992). Potentials to meet and promises to keep: Empowering women through academic and career counseling. *College Student Journal, 26* (2), 237-42.

Darden, J. T., Bagakas, J. G., & Li, C. (1997). Racial inequality of enrollment in selected U.S. institutions of higher education. *Equity and Excellence in Education, 30*, 47-55.

Dillard, J. M., & Campbell, N. J. (1981). Influences of Puerto Rican, Black, and Anglo parents' career behavior on their adolescent children's career development. *The Vocational Guidance Quarterly, 30* (2), 139-148.

Drew, D. E. (1996). *Aptitude revisited: Rethinking math and science education for America's next century.* Baltimore: The Johns Hopkins University Press.

Eimers, M. T. (2000). The impact of student experiences on progress in college: An examination of minority and nonminority differences. AIR 2000 Annual Forum Paper. (ERIC Document Reproduction Service No. ED446502).

Elliott, R. A., Strenta, C., Adair, R., Matier, M., & Scott, J. (1996). The role of ethnicity in choosing and leaving science in highly selective institutions. *Research in Higher Education, 37*, 681-709.

Evans, F. R. (1977). The GRE-Q coaching/instruction study. GRE board professional report GREB No. 71-5aP. (ERIC Document Reproduction Service No. ED163088).

Evans, R. (1999). A comparison of success indicators for program and non program participants in a community college summer bridge program for minority students. *Visions: The Journal of Applied Research for the Florida Association of Community Colleges, 2* (2), 6-14.

Fenske, R. H., Porter, J. D., & DuBrock, C. P. (2000). Tracking financial aid and persistence of women, minority, and needy students in science, engineering, and mathematics. *Research in Higher Education, 41* (1), 67- 94.

Fleming, L. (1982). Parental influence on the educational and career decisions of Hispanic youth. (ERIC Document Reproduction Service No. ED242825).

Fredericksen, E. (1998). Minority students and the learning community experience: A cluster experiment. (ERIC Document Reproduction Service No. ED423533).

Freeman, K. (1999). No services needed? The case for mentoring high-achieving African-American students. *Peabody Journal of Education, 74* (2), 15-26.

Fries-Britt, S. (1998). Moving beyond black achiever isolation: Experiences of gifted black collegians. *Journal of Higher Education, 69* (5), 556-76.

Fullilove, R. E., & Treisman, P. U. (1990). Mathematics achievement among African-American undergraduates at the University of California, Berkeley: An evaluation of the Mathematics Workshop program. *Journal of Negro Education, 59* (3), 463-78.

Gahan-Rech, J., Stephens, L., & Buchalter, B. (1989). The effects of tutoring on college students' mathematical achievement in a mathematics laboratory. *Journal of Research and Development in Education, 22* (2), 18-21.

Gallagher, R. P., Golin, A., & Kelleher, K. (1992). The personal, career, and learning skills needs of college students. *Journal of College Student Development, 33* (4), 301-10.

Gándara, P. (with Maxwell-Jolly, J.) (1999). *Priming the pump: Strategies for increasing the achievement of underrepresented minority undergraduates.* New York: College Board.

Ganter, S. (1997). Impact of calculus reform on student learning and attitudes. *AWIS, 26* (6), 10-15.

Garcia, P. (1991). Summer bridge: Improving retention rates for underprepared students. *Journal of the Freshman Year Experience, 3* (2), 91-105.

Garland, M. (1993). The Mathematics Workshop model: An interview with Uri Treisman. *Journal of Developmental Education, 16* (3), 14-16, 18, 20, 22.

George, Y. S. (1991). Nurturing talent: Reports from the field. In M.L. Matyas & S.M. Malcom (Eds.), *Investing in human potential: Science and engineering at the crossroads* (pp. 117-140). Washington, DC: American Association for the Advancement of Science.

Ginorio, A. B., & Grignon, J. (2000). The transition to and from high school of ethnic minority students. In G. Cambell, R. Denes, & C. Morrison (Eds.), *Access Denied* (151-173). New York: Oxford University Press.

Glennen, R. E., & Baxley, D. M. (1985). Reduction of attrition through intrusive advertising. *NASPA Journal, 22* (3), 10-4.

Gloria, A. M., & Hird, J. S. (1999). Influences of ethnic and nonethnic variables on the career decision-making self-efficacy of college students. *Career Development Quarterly, 48* (2), 157-74.

Gloria, A. M., & Kurpius, S. E. (2001). Influences of self-beliefs, social support, and comfort in the university environment on the academic nonpersistence decisions of American Indian undergraduates. *Cultural Diversity & Ethnic Minority Psychology, 7*, 88-102.

Gold, M. V., Deming, M. P., & Stone, K. (1992). The bridge: A summer academic enrichment program to retain African-American collegians. *Journal of the Freshman Year Experience, 4* (2), 101-17.

Good, J., Halpin, G., & Halpin. G. (1998). The affective and academic benefits for mentors in a minority engineering program. (ERIC Document Reproduction Service No. ED429488).

Good, J., Halpin, G. & Halpin, G. (2002). Retaining black students in engineering: Do minority programs have a longitudinal impact? *Journal of College Student Retention, 3*, 351-364.

Grandy, J. (1994, June). *Gender and ethnic differences among science and engineering majors: Experiences, achievements, and expectations.* (GRE Board Research Project No. 92-03R & ETS Research Report 94-30). Washington, DC: Educational Testing Service.

Grandy, J. (1997). Gender and ethnic differences in the experiences, achievements, and expectations of science and engineering majors. *Journal of Women and Minorities in Science and Engineering, 3*, 119-143.

Grandy, J. (1998). Persistence in science of high-ability minority students: Results of a longitudinal study. *Journal of Higher Education, 69* (6), 589-620.

Green, K. (1989). A profile of undergraduates in the sciences. *American Scientist, 77*, 475-480.

Hackett, G., Casas, J. M., Betz, N. E., & Rocha-Singh, I. A. (1992). Gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering. *Journal of Counseling Psychology, 39* (4), 527-38.

Hackett, E., Croissant, J., & Schneider, B. (1992). Industry, academe, and the values of undergraduate engineers. *Research in Higher Education, 33* (3), 275-95.

Hagedorn, L. S., Siadat, M. V., Nora, A., & Pascarella, E. T. (1997). Factors leading to gains in mathematics during the first year of college: An analysis by gender and ethnicity. *Journal of Women and Minorities in Science and Engineering, 3* (3), 185-202.

Highsmith, R. J., Denes, R., & Pierre, M. M. (1998). Mentoring Matters. (ERIC Document Reproduction Service No. ED430909).

Hill, O. W., Pettus, W. C., & Hedin, B. A. (1990). Three studies of factors affecting the attitudes of blacks and females toward the pursuit of science and science-related careers. *Journal of Research in Science Teaching, 27* (4), 289-314.

Hilton, T. L., Hsia, J., Solorzano D. G., & Benton, N. L. (1989). *Persistence in science of high-ability minority students.* (National Science Foundation Grant No. MDR-8652096). Princeton, NJ: Educational Testing Service.

Holton, B. E., & Horton, G. K. (1996). The Rutgers Physics Learning Center: Reforming the physics course for first-year engineering and science students. *Physics Teacher, 34* (3), 138-43.

House, J. D., & Wohlt, V. (1990). The effect of tutoring program participation on the performance of academically underprepared college freshmen. *Journal of College Student Development, 31* (4), 365-70.

Hrabowski III, F. A., & Maton, K. I. (1995). Enhancing the success of African-American students in the sciences: Freshman year outcomes. *School Science and Mathematics, 95* (1), 19-27.

Jacobi, M. (1991). Mentoring and undergraduate academic success: A literature review. *Review of Educational Research, 61* (4), 505-32.

Kenschaft, P. (1990). Recruitment and retention of students in undergraduate mathematics. *College Mathematics Journal, 21* (4), 294-301.

Keynes, H. B., & Olson, A. M. (2000). Redesigning the calculus sequence at a research university: issues, implementation, and objectives. *International Journal of Mathematical Education in Science and Technology, 31* (1), 71-82.

Lam, P., Doverspike, D., & Mawasha, P. R. (1997). Increasing diversity in engineering academics (IDEAs): Development of a program for improving African-American representation. *Journal of Career Development, 24* (1), 55-70.

Landis, R. B. (1988). The case for minority engineering programs. *Engineering Education, 78* (8), 756-61.

Laws, P. W. (1999). New approaches to science and mathematics teaching at liberal arts colleges. *Daedalus, 128* (1), 217-40.

Lee, W. Y. (1999). Striving toward effective retention: The effect of race on mentoring African American students. *Peabody Journal of Education, 74* (2), 27-43.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology, 33* (3), 265-69.

Loo, C. M., & Rolison, G. (1986). Alienation of ethnic minority students at a predominantly white university. *Journal of Higher Education, 57* (1), 58-77.

Lowe, A., & Toney, M. (2001). Academic advising: Views of the givers and takers. *Journal of College Student Retention, 2*(2), 93-108.

Lundberg, C. A. (2003). Nontraditional college students and the role of collaborative learning as a tool for science mastery. *School Science and Mathematics, 103*(1) 8-17.

Luzzo, D. A. (1993). Ethnic differences in college students' perceptions of barriers to career development. *Journal of Multicultural Counseling and Development, 21* (4), 227-36.

Luzzo, D. A., Hasper, P., Albert, K. A., Bibby, M.A., & Martinelli, Jr, E.A. (1999). Effects of self-efficacy-enhancing interventions on the math/science self-efficacy and career interest, goals, and actions of career undecided college students. *Journal of Counseling Psychology, 46* (2), 233-243.

Malcom, S. (1990). Reclaiming our past. *Journal of Negro Education, 59* (3), 246-259.

Maton, K. I., Hrabowski III, F. A., & Schmitt, C. (2000). African American college students excelling in the sciences: College and postcollege outcomes in the Meyerhoff Scholars program. *Journal of Research in Science Teaching, 37* (7), 629-54.

Matyas, M. L. (1991). Fostering diversity at higher education universities. In M. L. Matyas & S.M. Malcom (Eds.), *Investing in human potential: Science and engineering at the crossroads* (pp. 37-66). Washington, DC: American Association for the Advancement of Science.

Matyas, M. L. (1991). Programs for women and minorities: Creating a clear pathway for future scientists and engineers. In M. L. Matyas & S. M. Malcom (Eds.), *Investing in human potential: Science and engineering at the crossroads* (pp. 67-96). Washington, DC: American Association for the Advancement of Science.

McCormick, B. D. (2001). Attitude, achievement, and classroom environment in a learner-centered introductory biology course (Doctoral dissertation, University of Texas at Austin, 2000). *Dissertation Abstracts International, 61*, 4328.

Mestre, J. P., & Robinson, H. (1983). Academic, socioeconomic, and motivational characteristics of Hispanic college students enrolled in technical programs. *Vocational Guidance Quarterly, 31*, 187-194.

Moreno, S. E., & Muller, C. (1999). Success and diversity: The transition through first-year calculus in the university. *American Journal of Education, 108* (1), 30-57.

Morrison, C., & Williams, L. E. (1993). Minority engineering programs: A case for institutional support. *NACME Research Newsletter, 4* (1).

Moust, J. C., & Schmidt, H. G. (1994). Effects of staff and students tutors on student achievement. *Higher Education, 28* (4), 471-82.

Murdock, T. A. (1987). It isn't just money: The effects of financial aid on student persistence. *Review of Higher Education, 11* (1), 75-101.

Murphy, T. J., Stafford, K. L., & McCreary, P. (1998). Subsequent course and degree paths of students in a Treisman-style workshop calculus program. *Journal of Women and Minorities in Science and Engineering, 4* (4), 381-96.

Murry, E., & Mosidi, R. (1993). Career development counseling for African Americans: An appraisal of the obstacles and intervention strategies. *Journal of Negro Education, 62* (4), 441-47.

Nagda, B. A., Gregerman, S. R., Jonides, J., von Hippel, W., & Lerner, J. S. (1998). Undergraduate student-faculty research partnerships affect student retention. *Review of Higher Education, 22* (1), 55-72.

National Science Foundation. (1990, May). NSF Research Experiences for Undergraduates (REU) program: An assessment of the first three years (National Science Foundation Report 90-58). (ERIC Document Reproduction Service No. ED322850).

Nettles, M. T., Thoeny, A. R., & Gosman, E. J. (1986). Comparative and predictive analyses of black and white students' college achievement and experiences. *Journal of Higher Education, 57* (3), 289-318.

Nora, A., Cabrera, A., Hagedorn, L. S., & Pascarella, E. (1996) Differential impacts of academic and social experiences on college-related behavioral outcomes across different ethnic and gender groups at four-year institutions. *Research in Higher Education, 37* (4), 427-51.

Nora, A., & Rendon, L. (1990). Differences in mathematics and science preparation and participation among community college minority and non-minority students. *Community College Review, 18* (2), 29-40.

Novels, A. N., & Ender, S. C. (1988). The impact of developmental advising for high-achieving minority students. *NACADA Journal, 8* (2), 23-26.

Pascarella, E. T., & Staver, J. R. (1985). The influence of on-campus work on science career choice during college: A causal modeling approach. *Review of Higher Education, 8* (3), 229-45.

Pascarella, E. T., & Terenzini, P. T. (1991). *How college affects students.* San Francisco, CA: Jossey-Bass Publishers.

Pearson, W. J., Jr. (1986). Black American participation in American science: Winning some battles but losing the war. *Journal of Educational Equity and Leadership, 6* (1), 45-59.

Penick, B. E., & Morning, C. (1983). The retention of minority engineering students. Report on the 1981-82 NACME retention research program. (ERIC Document Reproduction Service No. ED247325).

Posner, H. B., & Markstein, J. A. (1994). Cooperative learning in introductory cell and molecular biology. *Journal of College Science Teaching, 23* (4), 231-33.

Powers, D. E. (1987). Who benefits most from preparing for a "coachable" admissions test? *Journal of Educational Measurement, 24* (3), 247-62

Pounds, A. W. (1987). Black students' needs on predominantly white campuses. In D. J. Wright (Ed.), *New Directions for Student Services, no.38* (pp.23-38). San Francisco: Jossey-Bass.

Redmond, S. P. (1990). Mentoring and cultural diversity in academic settings. *American Behavioral Scientist, 34* (2), 188-200.

Rendon, L. I. (1985). Elements of successful math and science models for Mexican American students. (ERIC Document Reproduction Service No. ED258777).

Rendon, L. I., & Nora, A. (1994). Clearing the pathway: Improving opportunities for minority students to transfer. In M. J. Justiz, R. Wilson, & L. G. Bjork (Eds.), *Minorities in Higher Education* (pp. 120-150). Phoenix, AZ: American Council on Education/Oryx Press.

Rice, M., & Brown, R. D. (1990). Developmental factors associated with self-perceptions of mentoring competence and mentoring needs. *Journal of College Student Development, 31* (4), 293-99.

Richardson, L. (1994). MEP: Turning long shots into successes. *Black Issues in Higher Education, 11* (8),10-11.

Richardson, R. C. (2000). The role of state and institutional policies and practices. In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 207-15). New York: Oxford University Press.

Romero, L. C. (1996). The mentoring of Mexican Americans during their baccalaureate years. In A. Hurtado, R. Figueroa, & E. E. Garcia (Eds.), *Strategic interventions in education: Expanding the Latina/Latino Pipeline* (pp. 198-213). Santa Cruz: University of California, Santa Cruz Printing Services.

Rolle Sr., G. F. (1977). Facilitating career development of minority students. (ERIC Document Reproduction Service No. ED189280).

Rotberg, I. C. (1990). Resources and reality: The participation of minorities in science and engineering education. *Phi Delta Kappan, 71* (9), 672-79.

Santos, S. J., & Reigadas, E. T. (2002). Latinos in higher education: An evaluation of a university faculty mentoring program. *Journal of Hispanic Higher Education, 1*, 40-50.

Schambach, T. P., & Kephart, D. (1997). Do I/S students value internship experiences? (ERIC Document Reproduction Service No. ED422937).

Schwitzer, A. M., & Thomas, C. (1998). Implementation, utilization, and outcomes of a minority freshman peer mentor program at a predominantly white university. *Journal of the Freshman Year Experience & Students in Transition, 10* (1), 31-50.

Sebrechts, J. S. (1992). Cultivating scientists at women's colleges. *Initiatives*, *55* (2), 45-51.

Sedlacek, W. E. (1999). Black students on white campuses: 20 years of research. *Journal of College Student Personnel, 28* (6), 484-95.

Seymour, E. (1992). "The problem iceberg" in science, mathematics, and engineering education: student explanations for high attrition rates. *Journal of College Science Teaching, 21* (4), 230-38.

Seymour, E. (1995). Guest comment: Why undergraduates leave the sciences. *American Journal of Physics, 63* (3), 199-202.

Seymour, E., & Hewitt, N. (1994). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview.

Sheahan, B.H., & White, J.A. (1990). Quo vadis, undergraduate engineering education. *Engineering Education, 80* (8), 1017-22.

Shell, K. D., LeBold, W. K., Linden, K. W., & Jagacinski, C. M. (1983). Career planning characteristics of engineering students. *Engineering Education, 74* (3), 165-70.

Smedley, B. D., Myers H. F., & Harrell S. P. (1993). Minority-status stresses and the college adjustment of ethnic minority freshmen. *Journal of Higher Education, 64* (4), 434-52.

Solorzano, D. G. (1993). The road to the doctorate for California's Chicanas and Chicanos: A study of Ford Foundation Minority Fellows. CPS report. (ERIC Document Reproduction Service No. ED374941).

Solorzano, D. G. (1994). The baccalaureate origins of Chicana and Chicano doctorates in the physical, life, and engineering sciences: 1980-1990. *Journal of Women and Minorities in Science and Engineering, 1*, 253-272.

Solorzano, D. G. (1995). The doctorate production and baccalaureate origins of African Americans in the sciences and engineering. *Journal of Negro Education, 64* (1), 15-32.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. *Review of Educational Research, 69* (1), 21-51.

St. John, E. P. (1991). The impact of student financial aid: A review of recent research. *Journal of Student Financial Aid, 21* (1), 18-32.

St. John, E. P., Kirshstein R. J., & Noell, J. (1991). The effects of students' aid on persistence: A sequential analysis. *Review of Higher Education, 14* (3), 383-406.

Sullivan, L. L. (1980) Growth and influence of the learning center movement. *New Directions for College Learning Assistance, 1,* 1-7.

Swinton, S. S., & Powers, D. E. (1983). A study of the effects of special preparation on GRE analytical scores and item types. *Journal of Educational Psychology, 75* (1), 104-115.

Thile, E. L., & Matt, G. E. (1995). The ethnic mentor undergraduate program: A brief description and preliminary findings. *Journal of Multicultural Counseling and Development, 23* (2), 116-126.

Tidball, M. E. (1980). Women's colleges and women achievers revisited. *Signs, 5*, 504-517.

Tidball, M. E. (1986). Baccalaureate origins of recent natural science doctorates. *Journal of Higher Education, 57*, 606-620.

Tidball, M. E., Smith, D. G., Tidball, C. S., & Wolf-Wendel, L. E. (1999). *Taking Women Seriously.* Phoenix: Oryx Press.

Tinto, V. (1987). *Leaving college: Rethinking the causes and cures of student attrition.* Chicago: University of Chicago Press.

Tobias, S. (1990). They're not dumb. They're different: A new "tier of talent" for science. *Change, 22* (4), 10-30.

Tobias, S. (1993). Why poets just don't get it in the physics classroom: stalking the second tier in the sciences. *NACADA Journal, 13* (2), 42-4.

Topping, K. J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education, 32* (3), 321-45.

Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. *College Mathematics Journal, 23* (5), 362-72.

Trippi, J., & Cheatham, H. E. (1991). Counseling effects on African American college student graduation. *Journal of College Student Development, 32* (4), 342-49.

Torres, A. (2000). Rethinking the model. In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 219-21). New York: Oxford University Press.

Velez, W. Y. (2000). University faculty: Priming the pump or lying in the ambush? In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 215-8). New York: Oxford University Press.

Venglar, C., Goldberg, A., Cavanaugh, M., & Whiteneck, G. (1982). The challenge of career education to the arts and sciences. *NACADA Journal, 2* (1), 37-47.

Walters, N. B. (1997). Retaining aspiring scholars: Recruitment and retention of students of color in graduate and professional science degree programs. ASHE Annual Meeting Paper. (ERIC Document Reproduction Service No. ED415816).

Wilson, R. (2000). Barriers to minority success in college science, mathematics, and engineering programs. In G. Campbell, R. Denes, & C. Morrison (Eds.), *Access denied: Race, ethnicity, and the scientific enterprise* (pp. 193-206). New York: Oxford University Press.

Wolf-Wendel, L. E. (1998). Models of excellence: The baccalaureate origins of successful European American women, African American women, and Latinas. *Journal of Higher Education, 69,* 141-186.

Wolf-Wendel, L. E. (2000). Women friendly campuses: What five institutions are doing right. *Review of Higher Education, 23*, 319-345.

Wolf-Wendel, L. E., Baker, B. D., & Morphew, C. C. (2000). Dollars and sense: Institutional resources and the baccalaureate origins of women doctorates. *Journal of Higher Education, 71*, 165-186.

Wyer, M. B. (2001). Intending to stay: Positive images, attitudes, and classroom experiences as influences on students' intentions to persist in science and engineering majors (Doctoral dissertation, North Carolina State University, 2000). *Dissertation Abstracts International, 62*, 1063.

U.S. Department of Education. National Center for Education Statistics. (2000). *Entry and persistence of women and minorities in college science and engineering education* (NCES Publication No. 2000-601). Washington, DC: Author.

APPENDIX B. Telephone Interview Protocols

OMB No.: 3145-0190
Approval Expires: 5/2005

LSAMP TELEPHONE INTERVIEW (PART I)

Conducted by

The Urban Institute
2100 M Street, NW
Washington DC, 20037

For the

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Evaluation of Louis Stokes Alliances for Minority Participation

LSAMP Telephone Interview Part I

(Project Manager/Director)

One hour

I. Background Information

1. How long have you been manager/director of this project?

2. What are your main functions as project manager/director? (Probe: Ask interviewee to differentiate between role as manager of the lead institution's own activities and role as coordinator of Alliance activities)

3. Do you hold any other position within the institution?

II. Administrative and Governance Structure

1. To whom do you report?

2. Where within the institutional structure is your project located? How and why was the decision made to locate the project there?

3. Is there an advisory committee to your project?

4. If yes, please describe its composition. (Probe: What constituencies are involved?) Has its membership changed over time? How?)

5. Please describe how your advisory committee functions. (Probe: How often do you meet? What is the role of the committee? What type of input does it provide [for example, does it provide input into policy and practice relating to project components?])

6. Are there any other committees that are part of your project? If so, please describe their membership and role vis a vis the project.

III. Project Staffing

1. Please list your staff by title and describe the role of each.

2. Who is responsible for the day-to-day operation of your project? What does this responsibility entail?

IV. Program Goals and History

1. What would you say are your Alliance's main goals? Have these goals changed over time? How do these goals relate to the institution's overall goals?

2. Why did your institution wish to establish an LSAMP project? Can you give me a brief history of what led to the establishment of an LSAMP project? (Probe: Is there a history of activities to increase the number of underrepresented minority students in S&E?)

3. How and why were your partner institutions in the Alliance chosen?

4. How and why were your approaches and strategies determined from project goals?

V. Program Functions

1. How are participants recruited for your project? What would you say is your project's most effective recruitment strategy?

2. Is there a application/selection process? If so, what is it?

3. How is student progress monitored? Who gets monitored? How often? By whom? What kind of information is used to monitor student progress?

4. Do students receive systematic feedback on their progress (Probe: How often? Through what mechanism?)?

VI. Collaboration Among Alliance Partners

1. What are the main ways in which partners in your Alliance interact? (Probe: Do they share resources? Hold regular decision-making meetings? Are there activities designed to bring together students and/or faculties from different institutions?)

2. What, in your opinion, have been the most effective strategies employed to promote collaboration among the various partners in your Alliance? (Probe: Between four-year and feeder schools [two-year colleges, tribal colleges, HBCUs]? Between your Alliance and high schools? Between your Alliance and graduate institutions?)

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

VII. Evolution of the Model

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

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

VIII. Project Outcomes

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

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

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

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

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

IX. Interviewee Referrals

1. We are interested in speaking with other key individuals whose knowledge of this Alliance would be helpful to our evaluation. Is there anyone else we should speak with and why?

X. Contact Information of Graduates

1. Does your Alliance have current contact information of project graduates?

2. If the need arises, may we contact you or someone on your staff for help obtaining contact information for graduates? (get that person's name and contact information)

OMB No.: 3145-0190
Approval Expires: 5/2005

LSAMP TELEPHONE INTERVIEW (PART II)

Conducted by

The Urban Institute
2100 M Street, NW
Washington DC, 20037

For the

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Evaluation of Louis Stokes Alliances for Minority Participation

LSAMP Telephone Interview Part II

(Program Activities/Components)

40 minutes

Project Components/Activities

1. I am going to list program components and I'd like you to tell me which of these you consider to be a major project component. (Refer to chart of project activities that is attached. Place a √ next to those that interviewee indicates as "major".) By "major" I mean an activity in which at least a third of Level 1 students participate.

2. Are there any additional "major" project components which I did not name? If so, what are they?

3. Please identify the five most crucial components of your project.

4. Now I will ask a set of questions regarding each of the major components that you have identified.

a. Who participates in this activity?

b. On average, how many students participate?

c. How often is this activity offered?

d. What is the duration of this activity?

ALLIANCE NAME (Lead Institution Name)

	Project Components	Check if Major Component	Top 5
Precollege to College	Academic Enrichment		
	Summer Bridge		
	HS Outreach		
	Career Awareness		
Student Development (Academic)	Scholarship/Stipend		
	Peer Study Groups		
	Skills Building Seminar		
	Drop-in/Learning Center		
	Tutoring		
	Summer Academic Enrichment		
	Peer Support Groups		
	Academic Advising		
Professional Development	Mentors		
	Research Experience		
	Internships		
	Conferences		
	Career Awareness		
Faculty Development	Workshops on Teaching		
	Faculty Research Program		
	Faculty Enrichment		
	Faculty Exchange		
	Diversity Sensitivity		
Curriculum Development	Reform Gatekeeping Courses		
	Curricular Material Sharing		
	Distance Learning Courses		
	Course Development		

	Project Components	Check if Major Component	Top 5
College to Graduate	GRE test prep		
	Graduate School Admissions Support		
	Bridge Program		
Community College	CC Outreach		
	Articulation Agreement		
	Linkage with CC Teachers		
	Summer Research for CC Students		
Additional Components			

APPENDIX C. LSAMP Graduate Survey Materials

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD • ARLINGTON, VIRGINIA 22230

Date

LSAMP Graduate
Street Address
City, State Zip Code

Dear LSAMP Graduate:

The National Science Foundation is seeking your help in gathering important information about the Louis Stokes Alliances for Minority Participation (LSAMP). You may have experienced the program as the Alliances for Minority Participation (AMP) but the name has been changed recently. We are very interested in obtaining information from our program's successful participants as to their professional and educational experiences after leaving the program. In other words, we would like to know: **Is there life after AMP?** Please give a few minutes of your time to enlighten us about what you have been doing professionally and academically since obtaining your bachelor's degree in science, technology, engineering, or mathematics. We'd also like you to share your perceptions about AMP as well as any suggestions you may have to improve the program. By sharing this information with us and with our evaluators you will be helping other talented minority students to continue to benefit from the support of programs such as AMP.

We are asking that you complete a survey that will take about 15 minutes and we have provided several options for doing so. Of course, your individual responses to the survey will be kept confidential and the information you provide will be grouped with that of all others who complete the survey. The box below provides options for responding to the survey:

Survey Response Options

Mail: To respond by mail, simply fill out the paper survey and return it in the enclosed business reply envelope.

On-line: To respond via the Internet, please go to www.voxcosurvey.com and enter the PIN 12345abcd to access the survey. In order to complete the survey on-line you must have Internet Explorer 4.1 or higher, or Netscape Navigator 4.2 or higher, installed on your computer. If you experience technical difficulties when accessing the survey, please call 1-800-999-9999.

Telephone: To respond by telephone, please call the Data Source interview line at 1-800-888-8888 and request the LSAMP survey. An interviewer will be available to take your call between the hours of 9AM and 9 PM Eastern Time.

Please complete the survey using your preferred option—mail, internet, or telephone—at your earliest convenience. If you have any general questions about the survey, you may call the project manager, Dr. Tanya Guthrie at 800-123-4567. Your time and cooperation are greatly appreciated. We look forward to hearing from you.

Sincerely,

A. James Hicks, Ph.D.
LSAMP Program Director
National Science Foundation

OMB No. 3145-0190
Expiration Date: 05/31/2005

Evaluation of the Louis Stokes

LSAMP

Alliances for Minority Participation Program

Graduate Survey

Conducted by

The Urban Institute
2100 M Street, NW
Wasington DC, 20037

For the

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Information from this survey will be retained by the National Science Foundation, a federal agency, and will be an integral part of its Privacy Act System of Records in accordance with the Privacy Act of 1974 and maintained in the Education and Training System of Records 63 Fed. Reg. 264, 272 (January 5, 1998). These are confidential files accessible only to appropriate National Science Foundation (NSF) officials, their staffs, and their contractors responsible for monitoring, assessing, and evaluating NSF programs. Only data in highly aggregated form, or data explicitly requested as "for general use," will be made available to anyone outside of the National Science Foundation for research purposes. Data submitted will be used in accordance with criteria established by NSF for monitoring research and education grants, and in response to Public Law 99-383 and 42 USC 1885c.

Submission of the requested information is voluntary. The public reporting burden for this collection of information is estimated to average fifteen minutes, including the time for reviewing instructions. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Suzanne Plimpton, Reports Clearance Officer for OMB Collection 3145-0190 (LSAMP), National Science Foundation, 4201 Wilson Blvd., Suite 295, Arlington, VA 22230.

LSAMP GRADUATE SURVEY

PART A: EDUCATION

The following questions concern your undergraduate degree and any graduate or continuing education you have undertaken since the attainment of your undergraduate degree.

A1. Do you hold a Bachelor's degree in a science or engineering field (including math and computer science)?

❑ Yes ❑ No → If **no**, please terminate this survey and return it in the enclosed business reply envelope.

A2. If yes, please mark the year in which you took your <u>first</u> college credit course (as a post-high school graduate).

Mark only one box.

- ❑ 1987 or earlier (*Specify*: ________)
- ❑ 1988
- ❑ 1989
- ❑ 1990
- ❑ 1991
- ❑ 1992
- ❑ 1993
- ❑ 1994 or later (*Specify*: ________)

A3. Please mark the year that you <u>completed</u> your Bachelor's degree in a science or engineering field.

Mark only one box.

- ❑ 1991 or earlier (*Specify*: ________) → **IMPORTANT:** If you graduated in 1991 or earlier please terminate this survey and return in the enclosed business reply envelope.
- ❑ 1992
- ❑ 1993
- ❑ 1994
- ❑ 1995
- ❑ 1996
- ❑ 1997
- ❑ 1998 or later (*Specify*: ________) → **IMPORTANT:** If you graduated in 1998 or later, please terminate this survey and return in the enclosed business reply envelope.

A4. Were you a part-time student during the time you took courses towards earning your undergraduate degree? ("Part-time" means taking 1 to 12 credit hours during a semester)

❑ Yes ❑ No

A5. Did you begin your undergraduate studies at a community college or junior college?

❑ Yes ❑ No

A6. Using a <u>4-point scale</u>, what was your overall <u>undergraduate</u> grade point average (GPA)? If you have more than one Bachelor's degree, give your overall GPA for your <u>first</u> Bachelor's degree.

Mark only one box.

❑ 3.75 – 4.00 GPA (Mostly A's)
❑ 3.25 – 3.74 GPA (About half A's/half B's)
❑ 2.75 – 3.24 GPA (Mostly B's)
❑ 2.25 – 2.74 GPA (About half B's/half C's)
❑ 1.75 – 2.24 GPA (Mostly C's)
❑ 1.25 – 1.74 GPA (About half C's/half D's)
❑ Less than 1.25 GPA (Mostly D's or below)
❑ Have not taken courses for which grades were given.
❑ If on a 5-point scale, give actual GPA: ____________

A7. Since obtaining your Bachelor's degree in science or engineering, have you taken courses or enrolled in a college or university?

❑ Yes ❑ No → If no, please skip to question A18, page 6.

A8. During that time, toward what degree or certificate, if any, were you (or are you) working? If working on more than one degree, please mark the <u>highest level</u>.

Mark only one box.

- ❑ No specific degree or certificate
- ❑ Bachelor's degree
- ❑ Postbaccalaureate certificate
- ❑ Master's degree (including MBA)
- ❑ Post Master's certificate
- ❑ Doctorate (Ph.D., D.S.C., D.Sc., Ed.D.)
- ❑ Other professional degree (JD, L.L.B., Th.D., M.D, DDS, etc.)
  → *Please specify*: ____________________ *(Use English or Spanish)*
- ❑ Other
  → *Please specify*: ____________________ *(Use English or Spanish)*

A9. After completing your Bachelor's degree in science or engineering, have you completed any other degrees or certificates?

❑ Yes ❑ No → If no, please skip to question A14, page 4.

A10. What is the highest level of degree or certificate that you have completed?

Mark only one box.

- ❑ Bachelor's degree
- ❑ Postbaccalaureate certificate
- ❑ Master's degree (including MBA)
- ❑ Post Master's certificate
- ❑ Doctorate (Ph.D., D.S.C., D.Sc., Ed.D.)
- ❑ Other professional degree (JD, L.L.B., Th.D., M.D, DDS, etc.)
  → *Please specify*: ____________________ *(Use English or Spanish)*
- ❑ Other
  → *Please specify*: ____________________ *(Use English or Spanish)*

A11. If you have a doctorate, have you ever held a postdoctoral position?

❑ Yes ❑ No ❑ Do not have a doctorate

A12. In what month and year was your postbaccalaureate degree or certificate completed? If you completed more than one degree, enter the date for the <u>highest</u> degree or certificate awarded.

Date: [m][m] / [y][y][y][y]

Enter date in mm/yyyy format

A13. From which college or university did you receive this degree or certification (after receiving your Bachelor's degree in science or engineering)?

School Name: ______________________________

Please <u>do not</u> abbreviate the school name.

City/Town: ______________________________

State/Foreign Country: ______________________________

A14. Think about the coursework you took <u>after</u> you received your Bachelor's degree in science or engineering. What was your <u>primary field of study</u> for that coursework or degree program? Use the Education Codes List on pages 18-19 to choose the code that best describes your <u>primary field of study</u> during that time.

Code: [#][#][#]

Enter three digit education code

A15. For each item below, please indicate if it was a reason you took classes or enrolled in a degree program after having received your Bachelor's degree in science or engineering.

Mark yes or no for each.

	Yes	No
a. To gain further education before beginning a career	❑	❑
b. To prepare for graduate school	❑	❑
c. To change your academic or occupational field	❑	❑
d. To gain further skills or knowledge in your academic or occupational field	❑	❑
e. For licensure or certification	❑	❑
f. To increase opportunities for promotion, advancement, or higher salary	❑	❑
g. Required or expected by employer	❑	❑
h. For leisure or personal interest	❑	❑
i. Other	❑	❑

If yes, please specify "other" reason: ______________________

(Use English or Spanish)

____

A16. During the month of May, 2002 were you taking college or university courses or enrolled for other reasons such as completing a Master's, Ph.D., or a medical or law degree? Mark "yes" if you were enrolled in school but on vacation that month.

❑ Yes ❑ No

A17. Did you receive any scholarship or fellowship funding for the degree that you completed or for the coursework you took since receiving your Bachelor's degree in science or engineering?

❑ Yes

❑ No

Please skip to question A20, page 7.

A18. For each item below, please indicate if it is a reason you have not taken classes or enrolled in a degree program since receiving your Bachelor's degree in science or engineering.

Mark yes or no for each.

	Yes	No
a. You had achieved your educational goals (at least temporarily)	❑	❑
b. You were waiting for the next school term to start	❑	❑
c. You felt burdened by undergraduate school loans	❑	❑
d. Other financial reasons (e.g., too expensive, needed the money for other priorities)	❑	❑
e. Had a job, needed to work	❑	❑
f. Had to stop due to family responsibilities (e.g., caring for children or other family members, had a baby)	❑	❑
g. Moved, could no longer take courses at the school you were attending	❑	❑
h. No longer certain of which field of study you wanted to pursue	❑	❑
i. Needed a break, tired of going to school	❑	❑
j. Other	❑	❑

If yes, please specify "other" reason: ______________________________
(Use English or Spanish)

____

A19. How likely is it that you will one day take additional college or university courses?

Mark only one box.

❑ Very likely
❑ Somewhat likely
❑ Very unlikely

Please skip to question B1, page 7.

A20. If your highest degree is a doctorate (Ph.D., D.S.C., D.Sc., or Ed.D.), please provide the following information on any Master's or professional degrees you may have completed.

- ❑ I have a doctorate, but do not have any Master's or professional degrees
- ❑ I do not have a doctorate

Please skip to question B1, below.

Master's or Professional Degree 1

⇨ **In what month and year was this degree awarded?**

Date: [m][m] / [y][y][y][y]

Enter date in mm/yyyy format

⇨ **What type of degree did you receive?**

- ❑ Master's degree (including MBA)
- ❑ Other professional degree (JD, L.L.B., Th.D., M.D, DDS, etc.)

Specify: ______________________

⇨ **Using the education codes on pages 18-19, select the relevant field title and code:**

Major Field: ______________________

Code: [#][#][#]

Enter three digit education code.

Master's or Professional Degree 2

⇨ **In what month and year was this degree awarded?**

Date: [m][m] / [y][y][y][y]

Enter date in mm/yyyy format

⇨ **What type of degree did you receive?**

- ❑ Master's degree (including MBA)
- ❑ Other professional degree (JD, L.L.B., Th.D., M.D, DDS, etc.)

Specify: ______________________

⇨ **Using the education codes on pages 18-19, select the relevant field title and code:**

Major Field: ______________________

Code: [#][#][#]

Enter three digit education code.

PART B: EMPLOYMENT

The following questions concern your current or most recent full-time employment experience.

B1. Are you currently employed full-time? (If yes, all subsequent questions in the Employment section refer to this job.)

❑ Yes ❑ No

If yes, please skip to question B4, page 8.

B2. Have you been employed at any time since the time you completed your highest degree?

❑ Yes ❑ No

If no, please skip to question C1, page 11.

B3. What was the most recent date that you were employed full-time? (All subsequent questions in the Employment section refer to this job.)

Date: | m | m | / | y | y | y | y |

Enter date in mm/yyyy format

☐ I have not been employed **full-time** since completing my highest degree

Please skip to question C1, page 11.

B4. Which of the following categories best describes your employer in this job?

Mark only one box.

- ☐ A Private For-Profit company, business or individual, paying your wages, salary or commissions
- ☐ A Private Not-For-Profit, tax-exempt or charitable organization
- ☐ Self-Employment in own Not Incorporated business, professional practice, or farm
- ☐ Self-Employment in own Incorporated business, professional practice, or farm
- ☐ Local Government (e.g., city, county)
- ☐ State Government
- ☐ U.S. Military Service, active duty, or Commissioned Corps (e.g., USPHS, NOAA)
- ☐ U.S. Government as a civilian employee
- ☐ Other

  Please specify: ____________________________

  (Use English or Spanish)

B5. Thinking about your employer's main business (i.e., what your employer makes or does), please indicate below the single category that best fits your employer's main business. If your employer has more than one type of business, please answer for the type of work primarily performed at the location where you work.

Mark only one box.

- ❑ Agriculture, forestry, or fishing
- ❑ Biotechnology
- ❑ Construction or mining
- ❑ Education
- ❑ Finance, insurance, or real estate services
- ❑ Health services
- ❑ Information technology or computer services
- ❑ Other services (e.g., social, legal, business)
- ❑ Manufacturing
- ❑ Public administration/government
- ❑ Research
  - → *Please specify:* ______________________ *(Use English or Spanish)*
- ❑ Transportation services, utilities or communications
- ❑ Wholesale or retail trade
- ❑ Other
  - → *Please specify:* ______________________ *(Use English or Spanish)*

B6. Was/is your employer an educational institution?

❑ Yes ❑ No → If no, please skip to question B10, page 11.

B7. Was/is this educational institution a:

Mark only one box.

- ☐ Preschool, elementary, or middle school or system
- ☐ Secondary school or system

If checking one of these two boxes, please skip to question B10, page 11.

- ☐ Two-year college, community college, technical institute
- ☐ Four-year college or university, other than a medical school
- ☐ Medical school (including university-affiliated hospital or medical center)
- ☐ University-affiliated research institute
- ☐ Other
  → *Please specify:* ______________________________ *(Use English or Spanish)*

B8. What was/is your faculty rank?

Mark only one box.

- ☐ Not applicable at the institution
- ☐ Not applicable for my position
- ☐ Professor
- ☐ Associate professor
- ☐ Assistant professor
- ☐ Instructor
- ☐ Lecturer
- ☐ Adjunct Faculty
- ☐ Other
  → *Please specify:* ______________________________ *(Use English or Spanish)*

B9. What was/is your tenure status?

Mark only one box.

- ☐ Not applicable: no tenure system at this institution
- ☐ Not applicable: no tenure system for my position
- ☐ Tenured
- ☐ On tenure track but not tenured
- ☐ Not on tenure track

B10. Using the Job Codes List on pages 20-21, choose the code that best describes the work you were/are doing on this job.

Code: [#] [#] [#]
Enter three digit job code

B11. Thinking about the relationship between your work and your education, to what extent was/is your work on your job related to your highest degree in science or engineering?

- ❑ Closely related
- ❑ Somewhat related
- ❑ Not related

If checking one of these two boxes, please skip to question C1, below.

B12. If not related, did the following factors influence your decision to work in an area outside of the field of your highest science or engineering degree?

Mark yes or no for each.

	Yes	No
a. Pay, promotion opportunities	❑	❑
b. Working conditions (e.g., hours equipment, working environment)	❑	❑
c. Job location	❑	❑
d. Change in career or professional interests	❑	❑
e. Family-related reasons (e.g., children, spouse's job moved)	❑	❑
f. Job in highest degree field not available	❑	❑
g. Other	❑	❑

If yes, please specify "other" reason: ______________________
(Use English or Spanish)
____

PART C: OTHER WORK AND CAREER RELATED EXPERIENCE

The following questions concern your involvement in professional societies and career development activities.

C1. During the past year, did you attend any professional society or association meetings?

❑ Yes ❑ No

C2. How many professional societies and associations are you a member of?

❑ 0 ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5+

C3. During the past year, did you attend any work-related workshops, seminars, or other work-related training activities? (Do not include college courses. Do not include professional meetings unless you attended a special training session conducted at the meeting/conference.)

❑ Yes ❑ No → If no, please skip to question D1, page 13.

C4. In which of the following areas did you attend work-related workshops, seminars, or other work-related training activities during the past year?

Mark yes or no for each.

	Yes	No
a. Management or supervisor training	❑	❑
b. Training in your occupational field	❑	❑
c. General professional training (e.g., public speaking, business writing)	❑	❑
d. Other work-related training	❑	❑

If yes, please specify "other" work-related training: ______________________
(Use English or Spanish)
____

C5. For which of the following reasons did you attend training activities during the past year?

Mark yes or no for each.

	Yes	No
a. To facilitate a change in your occupational field	❑	❑
b. To gain further skills or knowledge in your occupational field	❑	❑
c. For licensure/certification	❑	❑
d. To increase opportunities for promotion/advancement/higher salary	❑	❑
e. To learn skills or knowledge needed for a recently acquired position	❑	❑
f. Required or expected by employer	❑	❑
g. Other reason	❑	❑

If yes, please specify "other" reason: ______________________
(Use English or Spanish)
____

PART D: LSAMP EXPERIENCE

The following questions pertain specifically to your experience with the Louis Stokes Alliances for Minority Participation program at your college or university.

D1. How many years were you involved in the LSAMP Program? (If involved for less than one year, please mark appropriate box.)

Number of years: ___________

☐ I was involved in LSAMP for less than one year

D2. In which LSAMP activities did you participate?

➡ In **Column A**, please indicate **all activities that you participated in** by placing a mark in the corresponding box.

➡ In **Column B**, please indicate the **three** LSAMP activities that you considered **most helpful** to you by placing a mark in the corresponding box.

	Column A Mark ALL activities you participated in	**Column B** Mark ONLY the three activities that were most helpful to you
a. Summer Bridge	☐	☐
b. Research with faculty	☐	☐
c. Research internship	☐	☐
d. Mentorship program	☐	☐
e. Received tutoring	☐	☐
f. Peer study group	☐	☐
g. Skills building workshops and seminars	☐	☐
h. Career awareness activities	☐	☐
i. GRE training/preparation	☐	☐
j. Graduate school admission support	☐	☐
k. Other LSAMP activity	☐	☐

If yes, please specify "other" activity: ___________

____

(Use English or Spanish)

☐ **Mark here if you did not participate in any of the LSAMP activities**

D3. On a scale of 1 to 5 (1=not helpful; 5=extremely helpful) how helpful was your LSAMP experience to you in:

Mark only one number for each

a. Earning a Bachelor's degree in science or engineering

1	2	3	4	5
❑	❑	❑	❑	❑

b. Completing college

1	2	3	4	5
❑	❑	❑	❑	❑

c. Attending graduate school

1	2	3	4	5
❑	❑	❑	❑	❑

d. Attaining a post-college job

1	2	3	4	5
❑	❑	❑	❑	❑

D4. For those who attended Graduate School only. Of the LSAMP activities, which most influenced your decision to enroll in a graduate program? Please mark the three activities that were most influential.

	Mark **ONLY** the **THREE** activities that were most influential
a. Summer Bridge	❑
b. Research with faculty	❑
c. Research internship	❑
d. Mentorship program	❑
e. Received tutoring	❑
f. Peer study group	❑
g. Skills building workshops and seminars	❑
h. Career awareness activities	❑
i. GRE training/preparation	❑
j. Graduate school admission support	❑
k. Other LSAMP activity	❑

If yes, please specify "other" activity: ______________________

____

(Use English or Spanish)

❑ **Mark here if none of the LSAMP activities influenced your decision to enroll in graduate school**

D5. Have you recommended or would you recommend LSAMP to others?

❑ Yes ❑ No

D6. If you could make changes or additions to strengthen the LSAMP Program you attended, what would these be? ***(Use English or Spanish)***

____

____

____

____

____

____

____

D7. Have you stayed in contact with:

	Yes	No
a. fellow students from LSAMP?	❑	❑
b. faculty from LSAMP?	❑	❑
c. your campus LSAMP coordinator?	❑	❑

PART E: BACKGROUND INFORMATION

E1. What is the highest educational attainment of your mother and father?

Mark one for each parent.

	Mother	Father
a. Less than high school/secondary school	❑	❑
b. High school/secondary school graduate	❑	❑
c. Some college	❑	❑
d. Bachelor's degree	❑	❑
e. Master's degree	❑	❑
f. Professional degree	❑	❑
g. Doctoral degree	❑	❑

E2. During May, 2002, which of the following best describes your marital status?

Mark only one box.

- ❑ Married
- ❑ Widowed
- ❑ Separated
- ❑ Divorced
- ❑ Never married

E3. Because we may need to follow up with graduates of the LSAMP program in the future, we request that you fill out the next page with your current information.

CURRENT CONTACT INFORMATION

Your Name: ____
Last Name First Name M.I.

Address: ____
Street Address Apt. #

____
City State Zip Code

Phone: ( ) ______ - ________ Best time to call: ________AM/PM

Cell Phone: ( ) ______ - ________ Best day to call: M Tu W Th F Sa Su

Email Address: ____

PERMANENT CONTACT INFORMATION

Mark here if permanent information is the same as above: ❑

Permanent Address: ____
Street Address Apt. #

____
City State Zip Code

Permanent Phone: ( ) ______ - ________

THANK YOU FOR COMPLETING THIS SURVEY!

PLEASE RETURN YOUR COMPLETED SURVEY IN THE ENCLOSED BUSINESS REPLY ENVELOPE.

List I: Education Codes

This list is ordered alphabetically. The titles in bold type are broad fields of study. To make sure you have found the BEST code, please review ALL broad categories before making your choice. If you cannot find the code that BEST describes your field of study, use the "OTHER" code under the most appropriate broad field in bold print. If none of the codes fit your field of study, use Code 995.

Agriculture Business and Production
601 Agriculture, economics (also see 655 and 923)
602 OTHER agricultural business and production

Agricultural Sciences
605 Animal sciences
606 Food sciences and technology (also see 638)
607 Plant sciences (also see 633)
608 OTHER agricultural sciences

610 **Architecture/Environmental Design**
(for architectural engineering, see 723)

620 **Area/Ethnic Studies**

Biological/Life Sciences
631 Biochemistry and biophysics
632 Biology, general
633 Botany (also see 607)
634 Cell and molecular biology
635 Ecology
636 Genetics, animal and plant
637 Microbiology
638 Nutritional sciences (also see 606)
639 Pharmacology, human and animal (also see 788)
640 Physiology, human and animal
641 Zoology, general
642 OTHER biological sciences

Business Management/Administrative Services
651 Accounting
652 Actuarial science
653 Business administration and management
654 Business, general
655 Business/managerial economics (also see 601 and 923)
656 Business marketing/marketing mgmt.
657 Financial management
658 Marketing research
843 Operations research
659 OTHER business management/admin. Services

Communications
661 Communications, general
662 Journalism
663 OTHER communications
673 Computer science (also see 727)
674 Computer systems analysis
675 Data processing technology
676 Information services and systems
677 OTHER computer and information sciences

Computer and Information Sciences
671 Computer/information sciences, general
672 Computer programming

Conservation/Renewable Natural Resources
680 Environmental science studies
681 Forestry sciences
682 OTHER conservation/renewable natural resources

690 **Criminal Justice/Protective Services**
(also see 922)

Education
701 Administration
702 Computer teacher education
703 Counselor education/guidance services
704 Educational psychology
705 Elementary teacher education
706 Mathematics teacher education
707 Physical education/coaching
708 Pre-elementary teacher education
709 Science teacher education
710 Secondary teacher education
711 Special education
712 Social science teacher education
713 OTHER education

Engineering
721 Aerospace, aeronautical, astronautical engineering
722 Agricultural engineering
723 Architectural engineering
724 Bioengineering and biomedical engineering
725 Chemical engineering
726 Civil engineering
727 Computer/systems engineering (also see 673)
728 Electrical, electronics, communications engineering
(also see 751)
729 Engineering sciences, mechanics, physics
730 Environmental engineering
731 General engineering
732 Geophysical engineering
733 Industrial engineering (also see 752)
734 Materials engineering, including ceramics and textiles
735 Mechanical engineering (also see 753)
736 Metallurgical engineering
737 Mining and minerals engineering
738 Naval architecture and marine engineering
739 Nuclear engineering
740 Petroleum engineering
741 OTHER engineering

LIST I: EDUCATION CODES (CONTINUED)

Engineering-Related Technologies
751 Electrical and electronic technologies
752 Industrial production technologies
753 Mechanical engineering-related technologies
754 OTHER engineering-related technologies

Languages, Linguistics, Literature/Letters
760 English Language and Literature/Letters
771 Linguistics
772 OTHER foreign languages and literature

Health Professions and Related Sciences
781 Audiology and speech pathology
782 Health services administration
783 Health/medical assistants
784 Health/medical technologies
785 Medical preparatory programs (e.g., pre-dentistry, pre-medical, pre-veterinary)
786 Medicine (e.g., dentistry, optometry, osteopathic, podiatry, veterinary)
787 Nursing (4 years or longer program)
788 Pharmacy (also see 639)
789 Physical therapy and other rehabilitation/therapeutic services
790 Public health (including environmental health and epidemiology)
791 OTHER health/medical sciences

800 **Home Economics**

810 **Law/Prelaw/Legal Studies**

820 **Liberal Arts/General Studies**

830 **Library Science**

Mathematics
841 Applied (also see 843, 652)
842 Mathematics, general
843 Operations research
844 Statistics
845 OTHER mathematics

850 **Parks, Recreation, Leisure, and Fitness Studies**

Philosophy, Religion, and Theology
861 Philosophy of science
862 OTHER philosophy, religion, theology

Physical Sciences
871 Astronomy and astrophysics
872 Atmospheric sciences and meteorology
631 Biochemistry and biophysics
873 Chemistry
874 Earth sciences
680 Environmental science studies
875 Geology
876 Geological sciences, other
877 Oceanography
878 Physics
879 OTHER physical sciences

Psychology
891 Clinical
892 Counseling
704 Educational
893 Experimental
894 General
895 Industrial/Organizational
896 Social
897 OTHER psychology

Public Affairs
901 Public administration
902 Public policy studies
903 OTHER public affairs

910 **Social Work**

Social Sciences and History
921 Anthropology and archeology
922 Criminology (also see 690)
923 Economics (also see 601 and 655)
924 Geography
925 History of science
926 History, other
927 International relations
928 Political science and government
929 Sociology
910 Social work
930 OTHER social sciences

Visual and Performing Arts
941 Dramatic arts
942 Fine arts, all fields
943 Music, all fields
944 OTHER visual and performing arts

995 **Other Fields (Not Listed)**

LIST II: JOB CODES

This list is ordered alphabetically. The titles in bold type are broad job categories. To make sure you have found the BEST code, please review ALL broad categories before making your choice. If you cannot find the code that BEST describes your job, use the "OTHER" code under the most appropriate broad category in bold print. If none of the codes fit your job, use Code 500.

010 **Artists, Broadcasters, Editors, Entertainers, Public Relations Specialists, Writers**

Biological/Life Scientists
021 Agricultural and food scientists
022 Biochemists and biophysicists
023 Biological scientists (e.g., botanists, ecologists, zoologists)
024 Forestry and conservation scientists
025 Medical scientists (excluding practitioners)
026 Technologists & technicians in the biological/life sciences
027 OTHER biological/life scientists

Clerical/Administrative Support
031 Accounting clerks, bookkeepers
032 Secretaries, receptionists, typists
033 OTHER administrative (e.g., record clerks, telephone operators)

040 **Clergy & Other Religious Workers**

Computer Occupations (Also see 173)
*** Computer engineers (See 087, 088 under Engineering)
051 Computer programmers (business, scientific, process control)
052 Computer system analysts
053 Computer scientists, except system analysts
054 Information systems scientists or analysts
055 OTHER computer, information science occupations

*** **Consultants** *(Select the code that comes closest to your usual area of consulting)*

070 **Counselors, Educational & Vocational** (Also see 236)

Engineers, Architects, Surveyors
081 Architects
*** Engineers (Also see 100-103)
082 Aeronautical, aerospace, astronautical engineer
083 Agricultural engineer
084 Bioengineering & biomedical engineer
085 Chemical engineer
086 Civil, including architectural & sanitary engineer
087 Computer engineer - hardware
088 Computer engineer - software
089 Electrical, electronic engineer

*** Engineers (continued)
090 Environmental engineer
091 Industrial engineer
092 Marine engineer or naval architect engineer
093 Materials or metallurgical engineer
094 Mechanical engineer
095 Mining or geological engineer
096 Nuclear engineer
097 Petroleum engineer
098 Sales engineer
099 Other engineer
*** Engineering Technologists and Technicians
100 Electrical, electronic, industrial, mechanical
101 Drafting occupations, including computer drafting
102 Surveying and mapping
103 OTHER engineering technologists and technicians
104 Surveyors

110 **Farmers, Foresters & Fishermen**

Health Occupations
111 Diagnosing/Treating Practitioners (e.g., dentists, optometrists, physicians, psychiatrists, podiatrists, surgeons, veterinarians)
112 Registered nurses, pharmacists, dieticians, therapists, physician assistants
236 Psychologists, including clinical
113 Health Technologists & Technicians (e.g., dental hygienists, health record technologist/technicians, licensed practical nurses, medical or laboratory technicians, radiologic technologists/technicians)
114 OTHER health occupations

120 **Lawyers, Judges**

130 **Librarians, Archivists, Curators**

Managers, Executives, Administrators (Also see 151-153)
141 Top and mid-level managers, executives, administrators (people who manage other managers)
*** All other managers, including the self-employed – *Select the code that comes closest to the field you manage*

Management-Related Occupations (Also see 141)
151 Accountants, auditors, and other financial specialists
152 Personnel, training, and labor relations specialists
153 OTHER management related occupations

LIST II: JOB CODES (CONTINUED)

Mathematical Scientists
171 Actuaries
172 Mathematicians
173 Operations research analysts, modeling
174 Statisticians
175 Technologists and technicians in the mathematical sciences
176 OTHER mathematical scientists

Physical Scientists
191 Astronomers
192 Atmospheric and space scientists
193 Chemists, except biochemists
194 Geologists, including earth scientists
195 Oceanographers
196 Physicists
197 Technologists and technicians in the physical sciences
198 OTHER physical scientists

*** **Research Associates/Assistants**
(Select the code that comes closest to your field)

Sales and Marketing
200 Insurance, securities, real estate, & business services
201 Sales Occupations - Commodities Except Retail (e.g., industrial machinery/equipment/supplies, medical and dental equip/supplies)
202 Sales Occupations - Retail (e.g., furnishings, clothing, motor vehicles, cosmetics)
203 OTHER marketing and sales occupations

Service Occupations, Except Health (Also see 111-114)
221 Food Preparation and Service (e.g., cooks, waitresses, bartenders)
222 Protective services (e.g., fire fighters, police, guards)
223 OTHER service occupations, except health

Social Scientists
231 Anthropologists
232 Economists
233 Historians, science and technology
234 Historians, except science and technology
235 Political scientists
236 Psychologists, including clinical (Also see 070)
237 Sociologists
238 OTHER social scientist

240 **Social Workers**

Teachers/Professors
251 Pre-Kindergarten and kindergarten
252 Elementary
253 Secondary - computer, math, or sciences
254 Secondary - social sciences
255 Secondary - other subjects
256 Special education - primary and secondary
257 OTHER precollegiate area
*** Postsecondary
271 Agriculture
272 Art, Drama, and Music
273 Biological Sciences
274 Business Commerce and Marketing
275 Chemistry
276 Computer Science
277 Earth, Environmental, and Marine Science
278 Economics
279 Education
280 Engineering
281 English
282 Foreign Language
283 History
284 Home Economics
285 Law
286 Mathematical Sciences
287 Medical Science
288 Physical Education
289 Physics
290 Political Science
291 Psychology
292 Social Work
293 Sociology
294 Theology
295 Trade and Industrial
296 OTHER health specialties
297 OTHER natural sciences
298 OTHER social sciences
299 OTHER Postsecondary

Other Professions
401 Construction trades, miners & well drillers
402 Mechanics and repairers
403 Precision/production occupations (e.g., metal workers, woodworkers, butchers, bakers, printing occupations, tailors, shoemakers, photographic process)
404 Operators and related occupations (e.g., machine set-up, machine operators and tenders, fabricators, assemblers)
405 Transportation/material moving occupations

500 **Other Occupations (Not Listed)**

THANK YOU FOR COMPLETING THIS SURVEY!

PLEASE RETURN YOUR COMPLETED SURVEY
IN THE ENCLOSED BUSINESS REPLY ENVELOPE TO:

NUSTATS DATASOURCE
133 W. SAN ANTONIO ST.
SAN MARCOS, TEXAS 78666

APPENDIX D: Site Visit Interview and Focus Group Protocols

Evaluation of Louis Stokes Alliances for Minority Participation

Case Study Site Visit

Interview with Project Staff (Site/Institutional Coordinator)

45 Minutes

A. Background Information

1. How long have you been site coordinator?

2. What do you see as your main functions a site coordinator?

3. Do you hold any other positions within the institution?

B. Administrative and Governance Structure

1. To whom do you report?

2. Where within the institutional structure is the LSAMP project located? [**Probe:** Why was the decision made to locate it there?]

3. Is there an advisory committee to the project? If so, please describe its composition and role. [**Probe**: Does it provide input on policy? Assist with project functions such as recruitment and selection of participants?]

C. Project Staff

1. Please list your project staff and describe their roles.

2. Who is responsible for the day-to-day operation of your project? What does that responsibility entail?

D. Description of LSAMP Activities and Services

1. How did the LSAMP project come about on your campus? [**Probe:** for history and background of project. Why did the institution decide to join the Alliance? Who were the major players in establishing the project on your campus?]

2. How would you describe the project's goals as it applies to your campus? As far as you know, have these goals changed over time?

3. How were your approaches and strategies in implementing the LSAMP project determined from your project goals? [**Probe:** We are interested in how and why you chose your targeted population and how and why you identified the specific approaches/strategies you now use to meet project goals.] Have these approaches and strategies changed over time?

4. Please describe each project feature implemented by your LSAMP project.

E. Participants

1. If you were to draw a profile of your typical participant, what would he or she look like?

2. How effective do you think the strategies and approaches used by the project have been in meeting the needs of your target population?

3. On average, what is the percentage of underrepresented minority S&E majors who switch out of S&E institutionwide? Among LSAMP Level I participants?

4. On average, what is the percentage of underrepresented minority S&E majors who leave your institution altogether? Among LSAMP Level I participants?

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

F. Collaboration

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

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

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

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

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

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

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

G. Institutional Support/Institutionalization

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

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

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

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

5. How might the project or elements of the project be funded after NSF funding ends?

H. Project Implementation

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

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

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

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

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

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

Evaluation of Louis Stokes Alliances for Minority Participation

Case Study Site Visit

Interview with Faculty/Faculty Mentor

45 minutes

A. Background Information

1. In which department do you teach?
2. What specific subject(s) do you teach?
3. How long have you been involved with LSAMP?

[Ask questions A4 and A5 if interviewee is a faculty mentor.]

4. How did you become a mentor?
5. How many participants have you mentored? How many are you currently mentoring?

B. Faculty Involvement

[Ask questions B1-B3 if interviewee is a faculty mentor.]

1. Please describe your role as a mentor with LSAMP. [**Probe**: How many times a month do you have contact with a mentee? What are typical types of interaction you have with mentees?]
2. What, in your opinion, is the most valuable service you provide as a mentor?
3. Did you receive training to be a mentor? Please describe.

[Ask question B4 if interviewee is a non-mentor.]

4. Please describe your main involvement with LSAMP.
5. Are you involved in LSAMP in other ways? [**Probe:** for different ways the respondent may be involved: as an instructor, advisory board member, member of curriculum revision committee, participant in AMP development workshops for faculty, etc.]
6. What do you see as the project's goals?
7. Have you taught LSAMP students in your classes?

[If yes, ask the following questions:]

a. In general, what kind of students are LSAMP participants? How would you describe the typical LSAMP participant?

b. How well prepared are they to do the required work in a course?

c. Do they appear to be appropriately placed?

d. What do you see as the main problems encountered by LSAMP participants in your classes? How has the project helped to address these problems?

e. What do you see as LSAMP participants main strengths?

8. Have you derived any benefits from your involvement with LSAMP? What have these been? [**Probe**: Has your involvement with LSAMP affected your teaching? The way you interact with students?]

9. What are the main challenges that you've faced in working with the project?

10. From your perspective, does the project run smoothly?

11. Do faculty involved with LSAMP interact or collaborate across partner institutions within the Alliance? If so, please describe.

C. Impact on Students

1. What effects has the LSAMP project had on student participants? [**Probe**: Are student participants more likely to do better in their coursework? Do you think student participants are more likely to graduate with an S&E degree?]

[Ask question C2 if interviewee is a faculty mentor.]

2. More specifically, what effects do you think the **mentorship program** has had on participants? [**Probe**: In terms of helping them graduate? Go on to graduate school in STEM?]

3. Do you feel that student participants are better prepared to attend graduate school in a STEM field because of their LSAMP experience? Why?

4. Do you feel that student participants are more likely to attend graduate school in a STEM field because of their LSAMP experience? Why or why not?

D. Recommendations

1. What recommendations do you have for improving the overall LSAMP project?

[Ask question D2 if interviewee is a faculty mentor.]

2. What recommendations do you have for improving the mentorship program?

Evaluation of the Louis Stokes Alliances for Minority Participation

Case Study Site Visit

Focus Group Guiding Questions: LSAMP Participants

(Freshmen & Sophomores)

One Hour

QUESTION 1: **HOW DID YOU COME TO BE AN LSAMP PARTICIPANT?**

Probes: How did you find out about LSAMP?

Why did you apply?

How did you expect to benefit from being in LSAMP?

Have your expectations been met?

QUESTION 2: **HOW EFFECTIVE ARE THE SERVICES PROVIDED BY LSAMP TO MEET YOUR NEEDS?**

Probes: What kinds of services are provided by LSAMP at your institution?

Of these, which would you say are the most helpful? Why?

Which would you say are not really helpful? Why not?

What role have LSAMP services played in helping you complete your STEM degree so far?

Do you think additional services are needed? What are they?

QUESTION 3: **WHAT DO YOU THINK ABOUT THE MATH AND SCIENCE COURSES YOU'VE TAKEN IN YOUR PROGRAM?**

Probes: What courses have you found particularly helpful? Have you enjoyed them?

What courses have you had the most difficulty with? Why?

What are your perceptions about the quality of the instruction that you receive from faculty in your program?

QUESTION 4: HOW WELL DOES LSAMP RUN AT YOUR INSTITUTION?

Probes:

How efficiently does the LSAMP project run?

What difficulties have you encountered in accessing services provided by LSAMP? Why do you think you have had these difficulties?

Have you experienced difficulties as a STEM major at your institution? How has LSAMP helped you to overcome these difficulties?

What changes would you recommend to improve LSAMP?

Evaluation of the Louis Stokes Alliances for Minority Participation

Case Study Site Visit

Focus Group Guiding Questions: LSAMP Participants

(Juniors & Seniors)

One Hour

QUESTION 1: **HOW DID YOU COME TO BE AN LSAMP PARTICIPANT?**

Probes:

How did you find out about LSAMP?

Why did you apply?

How did you expect to benefit from being in LSAMP?

Have your expectations been met?

QUESTION 2: **HOW EFFECTIVE ARE THE SERVICES PROVIDED BY LSAMP TO MEET YOUR NEEDS?**

Probes:

What kinds of services are provided by LSAMP at your institution?

Of these, which would you say are the most helpful? Why?

Which would you say are not really helpful? Why not?

What role have LSAMP services played in helping you complete your STEM degree so far?

Do you think additional services are needed? What are they?

QUESTION 3: **WHAT DO YOU THINK ABOUT THE MATH AND SCIENCE COURSES YOU'VE TAKEN IN YOUR PROGRAM?**

Probes:

What courses have you found particularly helpful? Have you enjoyed them?

What courses have you had the most difficulty with? Why?

What are your perceptions about the quality of the instruction that you receive from faculty in your program?

QUESTION 4: HOW WELL DOES LSAMP RUN AT YOUR INSTITUTION?

Probes:

How efficiently the does LSAMP project run?

What difficulties have you encountered in accessing services provided by LSAMP? Why do you think you have had these difficulties?

Have you experienced difficulties as a STEM major at your institution? How has LSAMP helped you to overcome these difficulties?

What changes would you recommend to improve LSAMP?

QUESTION 5: WHAT ARE YOUR PLANS FOR THE FUTURE?

Probes:

What do you plan to do immediately after graduation?

If your plans include graduate school, do you plan to continue in STEM?

If your plans include graduate school, what was the role of LSAMP in helping you make the decision to go to graduate school? In preparing you for graduate work in a STEM program?

Evaluation of the Louis Stokes Alliances for Minority Participation

Case Study Site Visit

Focus Group Guiding Questions: LSAMP Participants

(Community College Transfers)

One Hour

QUESTION 1: **HOW DID YOU COME TO BE AN LSAMP PARTICIPANT?**

Probes:

Were you involved in LSAMP at your two-year college? How?

How did you find out about LSAMP?

Why did you apply?

How did you expect to benefit from being in LSAMP?

Have your expectations been met?

QUESTION 2: **HOW EFFECTIVE ARE THE SERVICES PROVIDED BY LSAMP TO MEET YOUR NEEDS?**

Probes:

What kinds of services are provided by LSAMP at your institution?

Of these, which would you say are the most helpful? Why?

Which would you say are not really helpful? Why not?

What role have LSAMP services played in helping you to make the transition to a four-year college? Which have been most helpful in this regard?

What role have LSAMP services played in helping you complete your STEM degree so far?

Do you think additional services are needed? What are they?

QUESTION 3: **WHAT DO YOU THINK ABOUT THE MATH AND SCIENCE COURSES YOU'VE TAKEN IN YOUR PROGRAM?**

Probes: What courses have you found particularly helpful? Have you enjoyed them?

What courses have you had the most difficulty with? Why?

What are your perceptions about the quality of the instruction that you receive from faculty in your program?

QUESTION 4: **HOW WELL DOES LSAMP RUN AT YOUR INSTITUTION?**

Probes: How efficiently does the LSAMP project run?

What difficulties have you encountered in accessing services provided by LSAMP? Why do you think you have had these difficulties?

Have you experienced difficulties as a STEM major at your institution? How has LSAMP helped you to overcome these difficulties?

What changes would you recommend to improve LSAMP?

[For Juniors and Seniors Only:]

QUESTION 5: **WHAT ARE YOUR PLANS FOR THE FUTURE?**

Probes: What do you plan to do immediately after graduation?

If your plans include graduate school, do you plan to continue in STEM?

If your plans include graduate school, what was the role of LSAMP in helping you make the decision to go to graduate school? In preparing you for graduate work in a STEM program?

APPENDIX E. Case Studies

I. LSAMP Case Study: Colorado Alliance

Introduction

This case study is based on information collected through site visits to six institutions belonging to the LSAMP Colorado Alliance: Colorado State University, Fort Lewis College, Metropolitan State College, Trinidad State Junior College, University of Colorado at Boulder, and University of Southern Colorado. A team of Urban Institute (UI) staff that included Laurie Forcier, Ella Gao, Dr. Lisa Tsui, and Nicole Young visited six COAMP institutions in April 2003. During these visits the team conducted both interviews and focus groups with project administrators, Site Coordinators, Activity Coordinators, Institution Vice Presidents, administrators in minority affairs or of minority programs, Native American tribal representatives, department deans and chairpersons, faculty members, project evaluator, student participants, and coordinators of similar programs (i.e., McNair program, AGEP, and MASP). In addition, the UI team conducted an informational interview with the LSAMP project coordinator and a dean from Adams State College.

Project Description

The Colorado Louis Stokes Alliances for Minority Participation (CO-AMP) has been in existence since November 1996. It is one of two alliances funded as part of the sixth LSAMP cohort and is currently in the midst of Phase II of their project. The CO-AMP is comprised of 14 universities and colleges (9 four-year institutions and five community colleges) as well as 4 tribal partners. The 9 four-year institutions are: Adams State College, Colorado School of Mines, Colorado State University (CSU), Fort Lewis College (FLC), Metropolitan State College of Denver, University of Colorado – Boulder (UCB), University of Colorado – Colorado Springs, University of Colorado – Denver, and the University of Southern Colorado (USC). The five community colleges are: Aims Community College, Diné College, Front Range Community College, Pueblo Community College (PCC) and Trinidad State Junior College. The four tribal partners are: the Jicarilla Apache Tribe, the Navajo Nation, the Southern Ute Tribe, and the Ute Mountain Ute Tribe. Colorado State University serves as the lead institution to the project and is where the Principal Investigator, who is also the Project Director, is located.

According to data found in the NSF MARS database for reporting year 2002, the Colorado Alliance serves 598 Level I participants[1], of whom 53% are male and 47% are female; sex was unreported for 0.33% of participants. Participants' racial/ethnic breakdown is as follows: Hispanic—55.35%, Black—20.57%, American Indian—10.03%, Non-minority—7.19%, Asian/Pacific Islander—0.67%, Alaskan Native—0.33%. Less than 1% of participants were reported as having more than one race/ethnicity. Race and ethnicity data was not available for the remaining 5.35%.

[1] For the purpose of this case study, Level I students are considered to be students that were reported in the MARS database as having received LSAMP funding during the summer or academic year during reporting year 2002.

Administrative and Governance Structure

<u>Lead Institution and Staff</u>

As the lead institution for CO-AMP, CSU administers the funds that are shared among the participating Alliance institutions and houses the central CO-AMP administrative offices. The Project Director, who has a joint appointment with the faculties of CSU and FLC, is also a Professor of Civil Engineering. In addition to her responsibilities as a faculty member and to CO-AMP, she serves as Co-Principal Investigator to the Colorado "PEAKS" Alliance for Graduate Education and the Professoriate (AGEP), another NSF-funded project. When asked about her role in CO-AMP, the Project Director listed a number of routine responsibilities such as overseeing the program office, budget, staff, and activities, conducting weekly (with main office staff) and monthly (with Campus Coordinators) meetings, and securing internship opportunities for students. The Project Director also discussed her role more broadly in terms of overseeing the well being of the entire project by "working to change the current culture". For example, she spoke about methods she utilizes to build program infrastructure and enhance existing programs such as, keeping in frequent communication with high level administrators and faculty, soliciting fundraising from industry and other non-profit agencies, and collaborating with on- and off-campus advocacy offices on common goals. The Project Director reports to the Governing Board, the President of CSU[2], the Dean of Engineering at CSU and the Vice President of Academic Affairs at Fort Lewis College (FLC).

The Project Manager, who is based at CSU and does not hold any other position within the institution, handles the day-to-day administration of the CO-AMP project. This person reports to the Project Director and co-PIs, visits and communicates with all Alliance campuses regularly and obtains data from the institutions for the production of all Alliance-wide reports. The Project Manager also plans Management Team and Steering Committee meetings and agendas in collaboration with the co-PIs, publishes a quarterly newsletter, and organizes and operates an annual CO-AMP participant conference. In addition to the Project Director and Manager, CO-AMP also employs two administrative assistants, a web site developer, an external evaluator, and a database coordinator. The administrative assistants (one at CSU, one at FLC) follow up on project meetings and undertake general administrative duties. The web site developer coordinates the collection of data across Alliance campuses, maintains the CO-AMP web site and carries out other assignments on an as-needed basis. The external evaluator assesses program activities and makes recommendations based on findings. The database coordinator is responsible for submission of annual CO-AMP data and maintains points of contact at each of the partner institutions in order to collect data in a timely manner.

CO-AMP staff who work directly with the CSU campus include a Site Coordinator and two Activity Coordinators (one stationed in the College of Engineering and the other in the College of Natural Sciences). The Site Coordinator, a Co-PI to the project and a member of the CO-AMP Management Team, also serves as the Associate Dean of the College of Engineering, and was one of the major players responsible for bringing the LSAMP program to Colorado. Given his significant responsibilities to the institution and the Alliance as a whole, the Site Coordinator has relied heavily on the two Activity Coordinators, serving mainly as a "sounding board" and leaving much of the actual implementation of activities to them. Both Activity Coordinators have other responsibilities within their respective Colleges. The Activity Coordinator in the College of Engineering also serves as the Director of the Women and Minorities in Engineering Program and as the advisor to the Student Leaders in Engineering (SLE) student organization. The Activity Coordinator in the College of Natural Sciences also serves as the Director of Minority Retention for the college and as the advisor to the Student Leaders in Science

[2] The same person holds the positions of President of CSU and Chancellor of the Colorado State system.

student organization (SLS [the counterpart to SLE]). They see their primary role as providing students with a support organization that will help students develop academically, professionally, and as leaders. As such, the Activity Coordinators undertake a number of recruitment and retention activities and both expressed that informal counseling or "mentoring" was an important part of their jobs. The projects at other Alliance institutions seem to follow a staffing pattern similar to that of the lead institution with the Site Coordinator position typically occupied by an upper-level faculty or staff member (such as a dean, department chair or director of a related project) within a STEM field. However, Site Coordinators at other Alliance institutions were typically more involved in the day-to-day implementation of the project, with most stating that their responsibilities encompass project oversight, coordination, development, and budgeting as well as student recruitment. Also, unlike the lead institution, most partner institutions only have one Activity Coordinator, typically a member of institutional staff who may be involved in other related projects.[3] At one institution, the Activity Coordinator was an undergraduate student.

Project Location within the Institution

The CO-AMP office at CSU is located in the office of the Dean of the College of Engineering at the request of the Dean and because the Project Director is a member of the Engineering faculty. The location of the CO-AMP offices varies across the Alliance with the physical location often differing from the projects "location" in the institutional infrastructure. In one instance the project is positioned under the office of the Vice President of Academic Affairs, but is physically located in the Engineering Department. In general, it can be said that the physical location of the project is closely connected with that of the Site Coordinator.

Advisory Committees

There are three alliance-wide CO-AMP advisory committees: the Governing Board, the Steering Committee, and the Management Team. The Governing Board, which meets once a year, is chaired by the president of CSU and is composed of Alliance institution presidents, provosts and some deans, the lieutenant governor of Colorado, and the presidents of the four tribal councils. The group provides oversight and policy guidance on the future direction of CO-AMP as well as the institutionalization of project components. The Steering Committee is comprised of the Site Coordinators and members from the community (such as representatives from school districts, local government, and industry). They meet twice during the academic year and focus on long-term planning and guidance. The Management Team, which is comprised of the PIs, the Project Coordinator and some of the Site Coordinators, makes most of the programmatic, policy, and financial decisions for the project. For example, the Management Team determines which specific activities will be implemented at participant schools and what the funding levels will be (all institutions submit "proposals" to the lead institution on a yearly basis). The Management Team has two major meetings yearly (one strategic and one financial) and communicates weekly via conference call. In addition to these three committees, the Site Coordinators also meet frequently as a group (monthly conference calls, frequent meetings, and an annual Site Coordinator conference) to talk about what one Co-PI termed "the details that are best left to the Site Coordinators."

Most Alliance institutions do not have a formalized CO-AMP advisory committee specific to their campus. However, one campus does have an advisory committee that is comprised of faculty members (some of whom are department chairs) from various STEM disciplines. The committee meets about twice a month and members "pretty much discuss everything" that has to do with the project. For example, they discuss the mission and focus of the project, and they also make decisions related to student recruitment and selection. At another campus the Site Coordinator spoke about a very informal advisory committee made up of herself and the two faculty members who are most active with the project.

[3] For example, one Activity Coordinator also served as the associate director for minority recruitment to an engineering program; another served as the advisor to the campus AISES chapter.

In the past year, their discussion focused primarily on the addition of a research component to their project, but they also talk frequently about identifying appropriate students for CO-AMP.

Project History and Background

According to the Project Director, the institutional rationale for developing an LSAMP program in Colorado grew out of the desire to:

- enhance and strengthen existing STEM programs through regional coordination and interaction,
- institute new program components,
- introduce minority STEM programs to campuses where they were not in existence, and
- focus on the untapped potential of the community college student population.

Also, the demography of Colorado (where Hispanic and Native American representation is higher than the national average) was a major factor in the decision to establish an LSAMP project.

Before CO-AMP came about, the Project Director and one of the Site Coordinators had funding from NSF in the form of a Research Careers for Minority Scholars (RCMS) grant. Once that grant ended it became a "very attractive idea" for the Project Director to utilize the connections she had established through her joint appointment at CSU and FLC and the existence of three "sister" schools (CSU, USC and FLC) to bring about a collaboration that would enhance opportunities for students across institutions. She approached leaders from four regional Native American tribes as well as area colleges and universities with the idea for CO-AMP and they "self selected" into the collaborative effort. Almost all the people interviewed agreed that the initiative for the LSAMP proposal came from the work and determination of the Project Director.

According to institutional administrators and project staff, many of the Alliance partners have a history with programs similar to LSAMP, some of which now co-exist alongside CO-AMP. One institution's Vice President for Research and Information Technology seemed to echo the sentiments of others in asserting that they take their "role in promoting diversity seriously and so they have been engaged in these kinds of programs and initiatives for years." However, two other administrators also raised the point that "CO-AMP is a little bit different from the programs that have been undertaken previously in that it cuts across all the STEM disciplines where some past efforts have been more subject specific." Some examples of past and current activities undertaken at Alliance institutions include the above mentioned RCMS grant at Fort Lewis College, federally funded TRIO programs such as PAA (Program for Academic Achievement) at FLC and McNair at CSU, an NSF-funded REU (Research Experience for Undergraduates) grant at CSU, and a number of other institution-based departmental entities such as leadership programs based in STEM departments or engineering programs specifically focused on women and minority students. There are also a number of advocacy offices present on the campuses (such as El Centro at CSU and the Native American Center at FLC) and many active student chapters of professional societies such as AISES (American Indian Science and Engineering Society), SHPE (Society of Hispanic Professional Engineers), NSBE (National Society of Black Engineers), and MAES (Mexican-American Engineering Society).

Goals and Strategies

<u>Project Goals</u>

According to the Project Director, the goals of CO-AMP directly relate to the institutional mission statements of Alliance partners, all of which include a call to enhance diversity in Colorado institutions of higher education over the next decade. Many of the administrators interviewed also commented on the close alignment between the goals of CO-AMP and the goals of their institutions. The project goals are:

- Substantially increase the quantity and quality of education for underrepresented minority students receiving baccalaureate degrees in STEM
- Institutionalize CO-AMP programs and activities at participating institutions
- Increase the number of underrepresented minorities obtaining Ph.D. degrees and entering the professoriate
- Introduce and recruit middle and high school students and their teachers into engineering early

The Project Director stated that goals had changed somewhat over time. In particular, the focus on increasing the number of students entering graduate school and the professoriate was added around the beginning of Phase II in collaboration with the AGEP program. A Site Coordinator (and member of the Management Team) also mentioned a shift in focus from student retention during Phase I to student recruitment in Phase II.

In discussing their understanding of the project goals, many of the interviewees were aware of the numerical goals of the Alliance as the phrase "double the number" of minority graduates in STEM was mentioned frequently. Several faculty members and administrators expressed the sentiment that CO-AMP was established to enhance the recruitment, retention, and graduation of underrepresented populations. "The goals of the program are to reach out to students that are traditionally underrepresented in the STEM fields and once they are in the program to assure their success through the provision of resources," explained one administrator. While acknowledging the goal of increasing STEM students and retention, one faculty member noted that CO-AMP also strives to build "infrastructure within the institution" so that it "becomes a way of life, a way of doing things." While those involved in the writing of the proposal of this project talked in most detail about the goals, everyone interviewed had at least a general understanding of the goals of CO-AMP.

According to the Project Director, the approaches and strategies of CO-AMP are primarily derived from the past personal and programmatic experience of the Project Director and other members of the Management Team. The Project Director defines herself as a minority, and explained that she "knows how it feels when you have potential and do or don't have opportunity." She and her co-PIs agreed that investment in education is the best way to affect underrepresented populations. In speaking with the Site Coordinators, most indicated that approaches and strategies utilized on their campuses are mostly determined from previous personal or institutional experience. "Strategies really come out of the experiences of the different sites, which vary widely in [terms of] population," concurred a member of the Management Team. One Site Coordinator commented that developing approaches and strategies has "been a learning experience" for her. She explained that as she became more familiar with CO-AMP and learned of activities undertaken by other institutions, she became better able to adapt the initiative to the particular needs of her institution.

Project Functions and Components

For the purposes of the case studies, the term "project functions" refers to student recruitment, application/selection, and monitoring/feedback. The term "project components" refers to those activities and services that an Alliance offers to its LSAMP participants. While there is considerable overlap, project components do vary across Alliances, as well as across partner institutions within the same Alliance. In this section, the discussion of project components is divided into two sections: common and uncommon. A "common" component is one that is utilized by most Alliances, while an "uncommon" component is less prevalently utilized.

Project Functions

Recruitment: Recruitment strategies vary across the Alliance institutions. However, the Project Director spoke of "personal contact," that is speaking directly with students and educators via telephone calls, email, and personal appearances, as their most important recruitment practice. Sometimes this takes the form of community outreach. For example, project staff and students have gone into local communities to "recruit" for CO-AMP by serving as coordinators of high school Science Bowls and Science Fairs, and assisting students with science projects. Another example is project staff and students serving as advisors and camp "counselors" at STEM summer camps for middle-school students and their teachers. One Site Coordinator said that she travels to regional community colleges each summer to recruit and another travels with members of her institution's Admission Office during recruitment trips.

Other strategies used frequently in recruiting students include student referrals through professors (professors both informing their entire class about the program and specifically referring individual students) and recruitment through other STEM intervention programs. Many students also reported hearing about the program through their friends and relatives. One Site Coordinator told of a summer bridge at her institution where a third of the students were relatives of students who had been through the summer bridge. She said, "They drag other students into my office and say, 'You've got to get involved.'" Two Coordinators reported that they review lists of students (provided by institutional administrative offices) to determine CO-AMP eligible students and then send recruitment packets or letters. At one institution where tutoring is in particularly high demand, flyers advertising CO-AMP tutoring serves as a major recruitment tool.

Application/Selection: There is an application process for students to become part of CO-AMP. The Project Director describes the application as a "contract" because they ask permission to use their social security numbers and their GPAs for submission to NSF. The application also seeks permission to use student contact information in order to disseminate literature to them about graduate opportunities. Students are required to sign all these contracts for admission to the program. All students who apply are admitted to the program; in order to receive any kind of funding award, however, students must have a GPA over 2.79.

Monitoring/Feedback: According to the Project Director, all CO-AMP students are monitored by and receive feedback on an informal basis from both tutors and mentors at least once a week. Each semester course grades for each student are reviewed, but otherwise personal contact is the main method of monitoring with students self-reporting on their progress and asking for assistance as needed. Site Coordinators and project staff also provide informal monitoring and feedback throughout the academic year, and meet with students in what they term their "mentoring program" during which they provide one-on-one counseling to the students. In these counseling sessions, project staff members speak with students about goals and the types of skills participants might like to develop further. They then try to provide opportunities to students that are well suited to their aspirations. This counseling happens at least once a year, although they strive to speak with students at least once a semester.

Project Components (Common)

Research (all institutions): Paid undergraduate research experiences with faculty mentors are available to CO-AMP students during both the academic year and summer. The stipend amount varies widely across institutions, with some professors choosing to supplement student stipends with funds from their own grants. Funding is sometimes also available for research materials and supplies and for travel to related conferences. Research experiences are generally undertaken by juniors and seniors, but there are opportunities for all students, including community college students. It is reported that Site Coordinators are frequently able to match students with appropriate faculty members and research opportunities because of their own involvement in STEM. Some students and faculty members, however, facilitate their own match. Faculty members are responsible for reporting to CO-AMP on student work and progress and are also expected to assist students in preparing research presentations. Research opportunities are available at all sites to some degree and research undertaken during the academic year generally occurs at a student's home campus. (Because of the high level of collaboration between CO-AMP and other STEM intervention programs at some Alliance institutions, research experiences are sometimes "located" within the structure of another program with CO-AMP funding a portion of research placements.) Students on smaller campuses have the opportunity to apply for summer placements at the more research oriented universities in the Alliance.

Mentoring and advisement (all institutions): The faculty mentoring component is reported to be an integral part of the research component. Faculty mentors who are involved with the project reported a high-level of interaction with their mentees, particularly during summer research placements where they interacted with students on a "daily" basis in the lab. As one professor commented, "the students that I work with, I'm right beside them...all day long." During the academic year, contact was not as frequent, but many professors still reported "regular" interaction through formal mechanisms such as weekly research meetings and more informal means such as the oft-cited "open-door policy." When asked about the most valuable service that mentors provided to their mentees, many felt that providing a role model to students and sharing their "own past experience with them" was very important. Instilling confidence in students by allowing them to both succeed and fail in the lab, and helping them to learn from their mistakes was also seen as an important contribution so that students can "realize that failure is not the end of the road – but more of a means to an end." None of the mentors interviewed had received formal training through CO-AMP, although one faculty member said that the Project Director went over some general guidelines for mentors at the beginning of the project, and a few others mentioned training they had received through other groups, such as STEM oriented professional societies.

Outside of the research component, mentoring is strongly encouraged for all students involved in CO-AMP, but is required on a "contractual" basis at only a handful of institutions (that is, students must meet with a faculty mentor as a requirement of their funding). In other instances, students must request a mentor, typically a member of the faculty, although non-faculty mentors can be secured at student request. The Site and Academic Coordinators also serve in mentoring capacities, generally helping students outline a plan of action for their academic and professional development as well as counseling students on a more personal level. Informal peer mentoring is also said to take place between CO-AMP students.

Tutoring (all institutions): Tutoring services are available to CO-AMP students at all Alliance institutions. Campus tutorials are generally available, but CO-AMP will pay for private tutoring for CO-AMP students when necessary. Some sites have an individual tutoring service where a student will come in and ask for assistance when they have trouble with a particular class or subject. Both peer and faculty tutoring are available and students generally access the service by filling out a tutor request form. Peer tutors, usually CO-AMP upperclassmen, receive a stipend for their services. Other sites have more of a blanket tutoring approach – especially for the gate keeping courses. In these cases, leaflets and flyers advertising the additional help that is available for those classes are disseminated. Some students who started out in CO-AMP needing tutoring have gone on to become tutors themselves.

Bridging activities (all institutions): There are a number of "bridging" activities available through CO-AMP. Summer Bridge is a summer experience (generally five weeks long) involving academic and life skills activities where students take college level coursework and participate in workshops that will acclimate them to college life. Summer Bridge programs are supplemented by university funds. Some students receive stipends for participation while others receive academic credit. However, the format of the bridge program varies by site. For example, one institution holds a bridge specifically for their engineering students while another sponsors a bridge program geared toward STEM overall. Although community college transfer students are sometimes eligible for these types of bridge programs, they are generally directed to enter into university run Transfer Bridge programs that are geared specifically to transfer students. However, according to the Project Coordinator, there are two community college bridges "fostered" by CO-AMP: one between Pueblo Community College and the University of Southern Colorado and the other between Diné College and Fort Lewis College.

Bridge Scholars Program, a bridge between undergraduate studies and graduate school is a 9-week bridge research program for juniors and seniors providing course credit. Students from all over the country are invited to participate and activities include research and social interaction with faculty, lab tours, and a symposium involving poster research presentations. There is also some graduate school assistance available including GRE preparation. This bridge is co-sponsored by AGEP and McNair, but CO-AMP students participate with CO-AMP funds. Additionally, a Career Bridge is available in which minority STEM professionals in industrial and university communities serve as mentors to graduating seniors and graduate students. This bridge is a three-week program covering topics such as professional career opportunities, resume writing, leadership, communication skills and interviewing.

Leadership activities (some institutions): At some Alliance institutions, a focus on leadership has been incorporated into the project. Students participate in leadership enhancing activities such as community service, leadership retreats, and conferences. At one institution, first year participants are required to take a course focusing on academic skill building, career awareness, self-management, and leadership.

Scholarships and stipends (all institutions): All Alliance members offer scholarships and stipends in one form or another, with award qualifications and funding amounts varying across institutions. Some awards are based on very specific criteria – for example, students might be required to attain or maintain a specified level of academic achievement or fulfill an activity requirement such as participation in a professional society or community service. At other institutions, awards are made on the basis of need. At one institution the focus is on current progress and as such small stipends are awarded to all students who pass their courses.

Conferences (all institutions): Students throughout the Alliance are strongly encouraged to attend conferences and many have attended professional (i.e.-SWE, AISES, MAYES, NSBE) and school sponsored conferences (e.g., lead institution holds annual undergraduate research symposium and undergraduate science institute where students present their research). In addition, CO-AMP hosted the national LSAMP conference recently. During conferences, students are exposed to information on internships, scholarships, careers, and graduate school. Approximately 150 CO-AMP students attend at least one conference each year, many of them with some kind of funding support, according to the Project Coordinator.

Internship opportunities (all institutions): Students are strongly encouraged to pursue off-campus research internships, and CO-AMP serves as both coordinator and clearinghouse to make these opportunities accessible to students by establishing contacts and disseminating relevant information to students in a timely manner. As internships, which are generally available during the summer with Colorado industry, become available, students receive information from the CO-AMP office via email and fliers. Students also reported locating internships opportunities through conference attendance.

Professional development (all institutions): The Alliance institutions provide CO-AMP students with a number of professional development opportunities including field trips to STEM related companies and job fairs, and workshops dealing with practical "real world" skills such as how to act during interviews, networking, and study skills. Institutions also host a number of speakers who address a range of topics, including careers in STEM.

Articulation agreements and community college outreach (all institutions): According to the Project Coordinator, articulation agreements between two- and four-year institutions in the Alliance are in place, with CO-AMP programs revitalizing and enhancing many of the existing agreements. In one example, PCC and USC are in the process of developing better course coordination to create a smooth transition for those transferring between the schools. Articulation agreements between four-year colleges and their engineering departments and programs are another significant development resulting from CO-AMP. For example, CSU has articulation agreements with both FLC and USC to transfer engineering majors to CSU as juniors.

Graduate school assistance (all institutions): Once students decide to apply to graduate school Site Coordinators assist students with the application process. As a person in STEM, the Site Coordinator is able to facilitate the application process given his or her contacts and knowledge of the field. CO-AMP also works with programs such as AGEP and McNair to assist students with the decision and application process (see "Bridge Scholars Program" above).

In addition, two Site Coordinators have collaborated with their respective admissions offices to make planned community college outreach and recruitment a joint effort between the Alliance and the institutions. Many of the other four-year institutions are close to community colleges and have some type of collaborative relationship established. CO-AMP has also fostered a high level of networking between Site Coordinators on two- and four-year campuses to the benefit of transfer students.

Learning centers (all institutions): All Alliance institutions have learning centers available for use by CO-AMP students. Learning centers are typically co-sponsored by CO-AMP and the institution and/or STEM departments or related programs. Students generally utilize this space for homework, computer access, tutoring, group study and meeting up with friends.

Peer study groups (all institutions): Through the Peer Advisory program, CO-AMP students are encouraged to form study groups, and to use them as an avenue for social and cultural support. Peer study groups often meet in the learning centers where resources such as computers are specifically made available to them; these gathering and study places are sponsored by both CO-AMP and the institutions.

Academic development workshops (UCB): The purpose of the Academic Excellence Workshops (AEWs) is to provide students with a stronger academic foundation by assigning additional problem sets for first-year courses. Currently, AEWs exist for Calculus I and II, Chemistry I, and Physics I and meet twice a week, 1-½ hours for each session, and are usually facilitated by graduate students. CO-AMP students also receive supplemental instruction through the Co-seminar Series, an activity similar to AEWs in purpose, but structured as credit-bearing courses. Some of the Co-seminar Series are tied to a course while others are not. CO-AMP sponsors about three Co-seminar Series each term.

Project Components (Uncommon)

New course development (some institutions): There have been a number of new courses developed in association with CO-AMP. One example is a course developed by the Site Coordinator at CSU entitled "Engineering for non-Engineers". This course, for students outside the science disciplines, was designed in order that non-STEM students might gain a better understanding of what engineering is. Also at CSU, a small scale chemistry model curriculum has been developed, and plans are in the works for Alliance-wide implementation of a Freshman Leadership curriculum developed at the University of Colorado-Boulder.

Recognition events (some institutions): Student recognition events have become an important component on some CO-AMP campuses. At these events, which are attended by high-level institutional administrators, students are recognized and presented with awards, a member of the project staff will speak on the state of CO-AMP, and there is often an "inspirational" speaker on hand to encourage students in their STEM endeavors. At one of the Alliance institutions, there is an annual faculty recognition event co-sponsored by CO-AMP in which 10-15 students each invite a faculty member to lunch. During the luncheon, students give a speech as to why they have chosen their invited faculty member to be honored.

Community outreach (some institutions): CO-AMP staff and students undertake a number of community outreach activities. At the middle-school level, there is a two-week summer camp for students and teachers from nearby Native American reservations where CO-AMP students serve as counselors and work with students on a number of hands-on science related activities. Participants and program staff from some Alliance institutions also spoke of recruitment/awareness site visits where they have showcased STEM research projects to middle, junior, and senior high school students and their teachers to heighten student awareness and interest in STEM fields. Reciprocal visits by students and their parents to college and university campuses are encouraged in this manner. In another example, CO-AMP students from about four campuses participate in the annual Science Fair program, a competition designed to engage and recruit junior and senior high students in STEM during which CO-AMP students serve as science project mentors.

Faculty diversity sensitivity workshops (available to faculty from all institutions): CO-AMP sponsors a number of faculty workshops designed to increase sensitivity to minority issues, both general and academic. Approximately 15-20 faculty members attend these workshops each year.

Most Important Features

In speaking about the most important features of CO-AMP, the Project Director identified the research for undergraduates component as "extremely important" and crucial to students staying in the pipeline and doing well in graduate school. The research experience is a "tremendous learning process" she explained, as students enter their classes with a deeper understanding of the theoretical material after having applied the theories in a research setting. Moreover, a member of the Management Team described the experience as an "incredible motivator" for participants and added that he is "not aware of a single student who dropped out after having this research experience." CO-AMP bridging activities were cited as the most important feature by two Activity Coordinators, one of who described the activities as critical to giving students "that little bit of a head start, that little bit of a network when they start here." Tutoring was considered the most important feature by two Activity Coordinators because of the support tutors provide to the students, in terms of academic support as well as peer mentorship. Another Activity Coordinator identified Alliance collaboration as the most important feature.

In speaking of the project as a whole, the Project Coordinator identified the five most important features of the Colorado LSAMP project as being undergraduate research experience, tutoring, leadership development and skills building activities, bridge programs, and scholarships and stipends. The Project Coordinator also noted that "networking" between Alliance partners was critical to the success of CO-AMP.

Project Implementation

Factors Affecting Implementation

Main Factors Facilitating Implementation

Activity Coordinators and other project administrators were asked about the main factors that facilitated the implementation of CO-AMP. Responses focused on collaborative relationships that had been established as well as strong institutional support and leadership at various levels. According to the Project Director, a key factor is the collaboration among all members of the Alliance—"the students, the tribal councils, the advocacy groups, the university administrations – all of them working together." A member of the Management Team elaborated by explaining that the various committee mechanisms developed to coordinate the project, namely the meetings and conference calls held by the Management Team, Steering Committee, and Site Coordinators, have facilitated a high level of collaboration. For example, one Site Coordinator explained that he had initial doubts that the weekly conference calls of the Management Team would work, but now he finds them working "very efficiently" as everyone is "aware of the rules," and the central office sends an agenda before the call.

Another factor facilitating project implementation, as explained by two Site Coordinators, is the collaboration between CO-AMP and other similarly focused intervention programs such as other STEM departmental programs targeting underrepresented populations and STEM related leadership programs. These collaborations seem to result from their similar goals. Some of the coordinators of these programs credited this collaboration to their own working relationships with CO-AMP staff and its Project Director. Moreover, the sharing of resources has reportedly strengthened the programs. One coordinator felt that the opportunity for students to receive scholarships and summer research experiences has expanded due to their program's partnership with CO-AMP. As one Activity Coordinator stated, the "mingling" of these programs has had the effect of, "making the group stronger overall and making implementation of activities easier and more visible."

CO-AMP interacts with similar programs in a variety of ways. These programs often act as resources for students and inform them of other programs' strengths and goals. A coordinator for El Centro explained, "we all are resources and referrals for each other." Several interviewees discussed a leveraging of funds as other programs and CO-AMP often co-sponsor activities such as seminars and workshops, tutoring, and student travel to conferences. Others discussed their group effort in coordinating Summer Bridge activities. One Coordinator of AGEP noted that CO-AMP is a huge recruiter for their summer research program: "At least 40% of our participants come from CO-AMP — this year 5 out of 10 are CO-AMP students." At one partner institution in particular, the work of CO-AMP is not stand alone, but rather very much intertwined with the work of other minority and STEM-related programs on campus, namely the MEP (Multicultural Engineering Program) and MASP (Minorities in Arts and Science Program). The coordinator of MASP explained that both MASP and MEP helped put together the institution's proposal to be part of CO-AMP because the two programs were interested in collaborating because of their "long-standing relationship" and "the idea that we wanted our students to be able to move seamlessly across the two different colleges." By combining their efforts and pooling resources, students are said to have access to expanded service offerings while minimizing duplication in effort. Program collaboration has led to shared physical space and jointly sponsored activities such as summer bridge and workshops.

In addition to these types of collaborations, some Coordinators noted the presence of particular key individuals as critical to the success of the program. Coordinators and administrators across the Alliance cited the "passion" and "drive" of the Project Director, and described her as a person "who gets people involved" and who really "promotes and markets" the project. Also identified as an important facilitator, is the "support" of the President at the lead institution. As one administrator explained, "the President is extremely committed to the concept, and this leadership we see from the top has permeated throughout the campus." In the words of one Activity Coordinator, he [the President of CSU] "has brought people together throughout the state. The leadership is definitely supporting it and people are aware of that."

The Project Manager noted the importance of having key people as Site Coordinators, "not just figureheads or people with big titles, but rather people who are in the trenches working with students... Our people have passion." One Activity Coordinator spoke about the contributions of the Steering Committee. He explained that it is "rare for a program on campus to have as many Chairs on board" as CO-AMP, and that this facilitates recruiting for when students see in writing that the Chair has recommended them for the program it motivates students even more. Two other Activity Coordinators also identified students as facilitating factors, particularly student contributions as peer recruiters.

Main Implementation Challenges

Although some members of the faculty reported that they had not encountered any challenges implementing the CO-AMP project, most faculty and project administrators were able to describe problems they had encountered. The most frequently mentioned challenge was that of time, for in the words of one professor, "It's one more thing that we do on top of all the other pieces that we do." The Activity Coordinator (who is also a faculty member) at one institution said that scheduling meetings and activities has been a challenge in part because of "her own busyness" and another Activity Coordinator said that she does not have the time to keep up with the clerical work of the project because CO-AMP students are in her office so frequently. In an associated problem, the Activity Coordinator at a commuter institution spoke of communication problems caused by the disparate and busy schedules of students, almost all of whom have family and work obligations in addition to schoolwork. He said that he spends a lot of his time "tracking students down" to check on them when they do not respond to his correspondence.

Mentioned almost as frequently as time constraints were the challenges associated with funding. A number of the faculty members cited low funding as a general constraint to project implementation, with one member saying specifically that the lack of funding for lab supplies has proven difficult. The Project Manager spoke of the difficulties of apportioning out NSF funding to the institutions in the Alliance. She said that "funding is tight and we are not able to provide as much support as we would like to," but added that they are "always doing alternate fundraising to try and leverage the NSF funds." Another faculty member who has been closely associated with the project spoke about the continuing challenge of funding, particularly in light of the current fiscal crisis in the state. "It is a continuing struggle to get the university to continue funding parts of the program...it has required active lobbying." Administrators and faculty at most Alliance institutions spoke about the budget cutbacks in Colorado as a major constraint to project implementation. Those at partner institutions with fewer resources felt that they were facing especially hard times.

In speaking about barriers to implementation, the Project Director also spoke about the initial difficulties she encountered in convincing people that a diversity initiative like CO-AMP was important. She feels that it may have been particularly difficult because Colorado is a "majority" state and that perhaps the problems faced by underrepresented groups are not well understood.

Lessons Learned

Asked about the lessons learned through implementing an LSAMP project, the Project Director and the Project Manager spoke about the realization that it is not effective to take "a cookie cutter approach to the programs offered to students." They explained that they can't "apply the same exact thing at every site" because each partner in the Alliance has "a very unique set of qualities" including weaknesses and strengthens. They also spoke about learning the importance of having key people as Site Coordinators. The Project Manager explained that one needs to find people who are already in a position working towards the same end, and who truly want to be involved for this is something that one "can't dictate." He recommends starting with a small group of key individuals who are enthusiastic and to build from that. The two explained that while some Site Coordinators have moved on, they have been "fortunate enough to have them identify others who they can hand off to." They see involvement of the president at each institution on the governing board as vital, because then "the deans and provosts know about it and buy into it." Finally, the Project Director and Project Manager spoke about the important lesson that they have learned about the value of collaboration over competition, which they consider to be "the key" to their success. In the words of the Project Director, "there is no more competition...we just work together on what's best for students." For example, through the statewide collaboration of the Alliance, they have developed a network of contacts that directly benefits students. Thus when a student is interested in transferring to another institution in the state, they are now able to put a call into the institution and secure a contact for that student.

Activity Coordinators were also asked about the lessons they had learned in implementing the CO-AMP project. One Activity Coordinator said that she had learned the importance of utilizing the program name as leverage for additional funding. She found that companies that were well informed about programs like CO-AMP were more willing to make corporate donations, provide internships to students, and supply guest speakers to the institution. A second Activity Coordinator pointed out the need to keep better alum records so as to leave a paper trail for future staff and to facilitate student tracking in the future. A third Activity Coordinator said that he learned that the LSAMP students (primarily adult learners) at his institution tend to have a very strong sense of self and that it is best for him "to guide them instead of pushing them." Two other Activity Coordinators spoke about the importance of having confidence in students. "I never even allow myself to think that some student isn't going to succeed," said one, and "it is very important to be there and to always be upbeat" said the other.

How Smoothly Does the Project Run?

Participants and faculty members at Alliance institutions were queried as to their opinion of how smoothly the project ran at their institution. The overwhelming opinion from both students and faculty is that the program runs very smoothly. Students remarked that the program is run "well," "smoothly," and "efficiently," and described staff as "accessible," like "family" and "going above and beyond." Three students told of difficulties that they encountered when meeting with their major faculty advisors – one student described the experience as "discouraging" and another as "excruciating". They spoke of how they were then able to turn to the CO-AMP advisors and staff, whom they described as "very encouraging." Other students corroborated this assessment, saying that they viewed CO-AMP staff members as mentors and a "great source of support". One group of students went so far as to describe the Site Coordinator at their institution as not only an "efficient" manager, but also a "teacher, counselor, friend, tutor and sometimes, father figure". Other students characterized CO-AMP staff as people who are willing to take time to help, are attentive to students, and provide immediate assistance to students when needed. Another student compared CO-AMP services to others using the example of tutoring, saying that "when you go to other tutoring programs and request help they may not link you with someone until the semester is half way over...With CO-AMP you are matched with someone immediately." Students also credited Activity Coordinators with doing a good job in disseminating relevant information to them in a timely fashion.

Overall, faculty felt that the program "runs smoothly" and many expressed that they were not aware of any problems. Most comments made by faculty focused on the performance of the Project

Director in coordinating the project, with one member remarking that she "runs a tight ship." Another faculty member was particularly impressed with the level of communication between the Alliance partners and commented that the Project Director has done a good job "making sure that she knows who is doing what in other programs and keeping us all [the faculty] informed". In addition to the faculty, representatives from one of the Native American tribes associated with CO-AMP said that they were impressed both with how smoothly the project ran and with how much the Project Director "truly cares about the kids."

Collaboration among Alliance Partners

Site Coordinators across the partner institutions were asked to weigh in with their opinion of the leadership role of CSU within CO-AMP. Responses were positive, and adjectives such as "excellent" and "phenomenal" were used to describe the work of the CO-AMP central administrative office. Furthermore, Coordinators added that CSU has been "a very good host to program activities," that the central office staff are "very responsive" and that the "leadership at CSU has been very supportive." The Project Director also feels that the president of CSU has been instrumental to the success of the collaboration, and has provided "top down" support at the lead institution that filters down to all Alliance partners.

Because Alliance institutions in Colorado face geographic challenges that restrict opportunities for sharing physical resources, Site Coordinators identified the sharing of ideas across institutions as the main way in which Alliance partners collaborate and share resources. One Site Coordinator stated that the collaborative relationship fostered by CO-AMP offers a "great place" to gather ideas. There is great value in this as explained by another Site Coordinator because "We are always after ideas. How do you do your tutoring? We can't get enough tutors. It is that kind of feedback that I find most valuable. I am in the trenches kind of guy, and I teach a full load as well, so I like to know what others have done." "CO-AMP has made it possible for us to share a lot of information that otherwise we would not be sharing," asserted one Activity Coordinator. Coordinators reported that they help one another with ideas for project activities, and that the steering committee meetings were great opportunities to share best practices and new ideas. Moreover, there are some instances when students from different campuses gather together for shared programming such as the national LSAMP conference recently held in Colorado. Additionally, Site Coordinators spoke about the sharing and transfer of students as an important form of collaboration. The Site Coordinator at a large university commented that there now exists among the partners a "network" that was not there previously. And, that the Alliance has encouraged the four-year institutions not only to partner with one another, but also to collaborate with the two-year colleges, which "caused them to realize what is possible with more resources." Site Coordinators from some of the "smaller" institutions confirmed this statement, saying that through CO-AMP they now have a network of contacts to draw upon when they have students who are interested in a summer research position, transfer, or graduate school.

Meetings of the Management Team, the Steering Committee and the Site Coordinators were all named as mechanisms that have been established by the Alliance to facilitate decision-making among the partners. Coordinators felt that these mechanisms have proved to be both "effective and efficient," and that the Project Director is to be "credited" for the structure of regular meetings (both physical meetings and conference calls) which allow participants to share best practices and play a real part in the decision making process. As one Coordinator put it, the Project Director is very "open in her style of management," and often consults Project Coordinators about ideas. The Project Director feels that the frequent meetings and personal contact encouraged by these committees are effective, and that collaboration has been emphasized over the competition that previously existed between the institutions. In fact, Steering Committee members are reminded at every meeting that CO-AMP is about collaboration and that they are all there for the same reason – to help the students.

Site Coordinators recognize that participation in the Alliance yields a number of benefits to their institution. One Coordinator credited the collaborative effort of the participating institutions as being the driving force behind his institution having a CO-AMP project at all and said that without the collaboration, "[the] whole program would not be here." At another institution, the strengthening of previously shaky minority STEM programs was also attributed to the collaborative relationship of CO-AMP. The Site Coordinator from this institution said that some of their minority programs have now become "completely institutionalized" and called this "level of stability" one of their greatest accomplishments. Another Site Coordinator felt that the benefits of the collaboration were spreading statewide. He sees the example set by CO-AMP as prompting other state institutions to "get excited about what is possible in terms of enhancing their success with minority retention in STEM" in a way that no other program has previously.

Two Site Coordinators spoke directly about the benefits gained by the project's participants – the students – in terms of transfer opportunities and mobility. In particular, a Site Coordinator from a community college stressed the importance of two-year students having connections to four-year institutions, particularly during the transfer process. Through the collaboration of CO-AMP, she is now able to provide students with contacts and put them in touch with the CO-AMP office at their new institution, which she thinks can help ease the transition, and make students feel more comfortable in their new environment.

A unique aspect of the CO-AMP alliance is its inclusive partnership with Native American tribes indigenous to the region. Tribal representatives play an active role in both the Alliance Steering Committee and in coordinating CO-AMP activities on certain campuses. One tribal representative said that her tribe has been involved with CO-AMP for eight years; she primarily works to coordinate tribal participation in the summer research camps offered at one CO-AMP partner institution. The residential summer research camp, in which CO-AMP scholars serve as camp counselors, is designed for both middle school students and their teachers. Participating teachers gain college credit towards certification and curriculum improvement ideas through the workshops. The tribal representatives recognized this activity as being mutually beneficial to the tribes as well as the institution. In the words of one tribal representative, "It helps the non-tribal people in the community... to get the feeling and understanding of tribal culture." Moreover, she explained, it helps students to "broaden their horizons" and experience the college environment. On the same CO-AMP campus there is also a great deal of collaboration with the institution's Native American Center, which is designed to support students and give them a "home away from home." The Center makes a special effort to inform students about CO-AMP and its offerings. For example, it is reported that students at the center are often referred to CO-AMP tutors for assistance.

Overall, Site Coordinators did not report many problems associated with the collaboration of Alliance institutions. A few Site Coordinators mentioned geographic distance as the major difficulty, while one Site Coordinator reported that she had not encountered any difficulties whatsoever. Another Coordinator mentioned frustrations associated with the amount of reporting required for what came down to a fairly small grant once it was broken down amongst all the Alliance members. One Site Coordinator, who is also a member of the Management Team, said that he does find that the partners are "headed in different directions" at times but that this is generally related to the different missions of the institutions which is something they are "very aware" of. He finds the most difficult aspect of collaboration to lie with reconciling the very different missions of the Native American tribes and the academic institutions. We are told that because of her experiences at Fort Lewis College, the Project Director is most aware of potentially sensitive cultural issues that could arise and has taken the lead in fostering this collaboration.

When asked about how well the collaborative relationship works across the Alliance, one interviewee commented that he has been "surprised" with just how well the collaborative relationship has worked. He said initially they had questions and doubts given the far-flung locations of the partners, the different missions of the institutions and the different personalities and expectations that were going into the mix. He thinks that the answer of why it does work lies in the "exceptional leadership" of the Project Director. Another Site Coordinator said that the reason the collaborative relationship worked so well is because CO-AMP has helped transform the culture of how minority programs look at one another as collaborators rather than competitors. Moreover, he noted that it has helped them to realize that they have "far more to gain in helping each other because there are far more resources to be gotten if we do so." Overall, the partners feel strongly that the collaboration of the Alliance works "very well" and is something they "can be very proud about."

LSAMP Participants

Profile of Participants

Characteristics of Typical Level I Participants

When asked about the typical Level I participant, faculty and project staff provided a range of responses some described them as "motivated," "diligent," "confident," "resourceful," and "go-getters." One professor explained that she has witnessed many CO-AMP students "transformed" from being not very confident to those who are leaders among their peers. Moreover, she sees CO-AMP students as being more acquainted with faculty members, having a better understanding of available resources, and more apt to be part of a good study group. Several faculty members reported a range of skills and preparation among CO-AMP students that is reflective of the overall college student population. According to one professor, some students "need" CO-AMP to "survive" college, while others really thrive in the college environment and mature more quickly. Another professor explained that there appears to be a "bimodal distribution" because you get "stars" as well as those who arrive with "significant disadvantages." Because CO-AMP students are so "well integrated" on campus, it is difficult to distinguish them from other students, explained another professor.

Preparation for Coursework

Asked whether students are prepared to do the required coursework, faculty members gave a range of responses often varying by institution. Some reported that CO-AMP students are generally well prepared, while others noted a mix of preparation levels. Those teaching at four-year institutions were more apt to see students as being prepared for the coursework than are those at two-year institutions. Some professors noted no difference in preparedness between CO-AMP students and other students. One faculty member explained that a lot of students don't take the time to find out about what is available to them, but that CO-AMP students are very aware of resources such as tutorial systems.

On the whole, faculty members reported that CO-AMP students are appropriately placed in their classes. A few professors commented that CO-AMP students are as appropriately placed as other students on campus. One faculty member noted that CO-AMP students at his institution tend to receive "a little bit more individualized advising." Another faculty member explained that improper placement is a common problem among students on the whole at his institution, with some students taking two classes simultaneously that should be taken in sequence, or non majors taking STEM courses designated for majors. During the focus groups students acknowledged this problem and have in turn sought academic advisement from CO-AMP staff. As one student explained, the project "helps you to make decision as to the best route you should take because what the curriculum says you need isn't always the best route." At another institution a professor explained that students at her institution are appropriately placed because students are given math placement tests upon arrival.

Main Strengths and Main Problems Encountered

When identifying CO-AMP participants' main strengths most faculty members mentioned students' high interest in their majors and their motivation to succeed. One professor said "LSAMP students show an interest in their coursework and are motivated enough to get to where they want to go." Other faculty members also seemed impressed with students' drive to succeed and how hard working they are. A few professors commented that CO-AMP students became more resourceful while participating in the program, "They become more savvy about the whole culture of success....They learn to access resources better."

Faculty members were also asked to describe the main problems encountered by CO-AMP participants. As one administrator noted, "financial issues are a source of concern for minority students." "Students have to work low paying jobs, which cuts down time for studying," explained one faculty member, but "the great thing about the internship is that they can do research, learn at the same time, and get paid for it." According to several faculty members, some students struggle because of family problems or a lack of family support. Several individuals pointed out that where there isn't a history of college education in the family, parents often fail to see the importance of school and would much rather see their sons and daughters working and receiving an income. Other faculty members spoke about distractions stem from family responsibilities to take on a part-time or full-time job, or raise children.

Participants were asked about difficulties they had encountered as a STEM major at their institution. Several students spoke about how they feel the effects of a low minority population at their institution. One student said she experienced "cultural shock" upon arrival at the school, while another commented on how attending Summer Bridge made him feel "less lost in the crowd." Another student noted that while he has experienced mostly "homogeneity" in his courses, meeting STEM upperclassmen through the project has encouraged him to stay in engineering. Another student explained that while the drop-out statistics for engineering students are "depressing," CO-AMP lets him know that he has potential, instills a "can do it" attitude, and "energizes" him. Several students mentioned they had encountered difficulties in their courses, and that the tutoring they received through CO-AMP made a difference. One student, however, pointed out that there are not as many tutors available to upper-division students. Several students also spoke about receiving poor advisement from the school, and how it has been "beneficial" to have another avenue for advising through CO-AMP. Moreover, several transfer students spoke about their initial difficulties and noted how CO-AMP has increased their confidence and comfort in working with other students.

Participants Experiences with LSAMP

How Students Learned about LSAMP

When asked about their introduction to the CO-AMP program many students said they found out through their involvement with other student clubs and organizations. Because many of these other organizations share similar goals and objectives, they often co-sponsor activities and or invite CO-AMP project staff to speak at their events. Several students were referred to CO-AMP by staff in other student support offices and programs. Many CO-AMP students also said they were encouraged to participate by faculty members who were involved in the program. And yet others learned of CO-AMP via word of mouth through discussions with CO-AMP project staff or friends who were involved in the program.

Most of the students who had transferred to a four-year institution had not participated in CO-AMP at their community college. However, one of the students who had participated while in community college attributed her interest in research to her early experience in CO-AMP. She was very grateful to have been introduced to the program by her community college professor. Two other students felt that although they had not been active in CO-AMP while in community college they decided to transfer to schools that were implementing CO-AMP, after hearing about the program.

Expectations of LSAMP

When asked why they had originally applied to the program students named several aspects that appealed to them. Many students recognized that CO-AMP would be able to connect them with tutors on their campuses. One student admitted that he was "struggling" in his courses and knew that CO-AMP would be able to provide tutorial assistance. Students on several campuses expected to benefit from the research and professional development activities CO-AMP offers. Two students said that they expected to gain networking and leadership skills. And another student thought involvement in CO-AMP would be a nice addition to her resume. Other students were interested in the stipend that CO-AMP offered them. One student hoped that the CO-AMP stipend would offer considerable financial relief and he would not have to work during the academic school year.

In addition, students expected to gain confidence with laboratory equipment and research skills. One student who was taking courses after several years in the workforce said that she "wanted to get over the initial hesitation about coming back to school and get used to laboratory work." A few students expected to gain support and encouragement from project staff and peers. Another student mentioned that as a science major, he had felt isolated from others, and hoped that CO-AMP would help him find a community of science majors to associate with.

Participant Access to LSAMP Services

The majority of students in the focus groups reported no difficulty in accessing services offered by CO-AMP. A few students felt that certain CO-AMP services, such as tutoring, are more accessible than those offered by the institution. Many students mentioned flexible tutors and attentive project staff as positive attributes of the program. Students also explained how CO-AMP staff provided connections and resources to obtain certain services. For example, one student said that while his institution did not have the laboratory equipment needed for a particular research project, CO-AMP staff helped him make arrangements to do research at a university where the equipment was available.

Student Ratings of LSAMP Services

Students were asked to discuss which CO-AMP services were the most helpful to them. A majority of students felt that the CO-AMP stipend was the most helpful aspect of the program. One student explained that the financial support from CO-AMP was "very important" because it has allowed him to attend school. Students praised the tutoring services offered through CO-AMP. As one student noted, the tutoring aspect of CO-AMP sets it apart from other organizations on campus. The opportunity to perform research and to present research in front of others was seen as being beneficial to student development. A student who identified presenting research as the most helpful aspect of CO-AMP, told of how she overcame a fear of public speaking through her research presentation experience. In the words of another student, the practice of research has "renewed my interest in science…my professor [mentor] has gotten me excited about science again." In addition, the ability to make connections with peers and faculty members both at the home institution and at other institutions was mentioned as a helpful feature of the program. One student said, "the networking with faculty has helped me to be more assertive and I've gained information about graduate school and programs through my faculty relationships."

Students who participated in the focus groups could not name one CO-AMP service that was not useful to them. Most students responded by saying that all of the services were being used and were helpful. A couple of students noted that project staff put a lot of effort into the services. Students on a few CO-AMP campuses also discussed their concern that a decrease in funding would restrict the services that they currently received. As one student noted, "CO-AMP tries to provide a lot of services but without the funding they are limited; with more funding they could do so much more."

Project Effectiveness and Impact

Staff Perceptions of Project Effectiveness and Major Successes

CO-AMP project staff discussed whether they thought the chosen approaches and strategies were effective in meeting participants' needs. Overwhelmingly, they felt these strategies were highly effective. One Activity Coordinator explained that "CO-AMP has allowed [the campus] to retain students in the sciences because students have the opportunity to network with faculty, staff, and other students, which entices them to stay." Another Activity Coordinator reported that based upon student feedback she believes that the project is effective because it makes students feel "that somebody is looking after them."

When asked what CO-AMP's major successes had been, project staff members and institutional administrators named several accomplishments. Most responses pertain to CO-AMP's ability to increase the retention of minority students in STEM, as well as increase graduation rates within STEM disciplines. One department chairperson remarked, "In terms of impacting the number of underrepresented groups and sensitizing the issue of recruiting and retaining students from these groups, the program has brought these issues to the attention of faculty." Other administrators discussed how CO-AMP is increasing awareness of diversity among faculty. In addition, many felt that the program is a mechanism of support and encouragement for students on their campuses. Several faculty members agreed that CO-AMP makes an important contribution by effectively providing a "sanctuary" for minority students, especially in light of the difficulty that some campuses face in building a community for minority students.

Impact on Students

There is a commonly shared belief among interviewees that CO-AMP exerts a positive impact on students. Many individuals spoke about how CO-AMP has benefited students through facilitating academic progress and continuation in STEM; fostering supportive relationships with faculty and peers; enhancing confidence, motivation, and skills; and, developing interest and preparation for graduate studies. As one Academic Coordinator noted, the program's service offerings affect students "tremendously" and "set them up for success." Tutorial support through CO-AMP was commonly credited as helping students pass courses, and to either increase or maintain their grade point averages. According to one Activity Coordinator, the tutors they have are "really good" and when the professor "is not doing a good job, the tutor steps in and works well with the students individually." Another Activity Coordinator noted that tutoring helps students who "may have really struggled on their own to become successful." As one Site Coordinator noted, "speaking from personal experience over the years, I have seen LSAMP involvement keep students in STEM disciplines." One student indicated that if it had not been for the tutorial support that she received, she would not have passed her calculus class and would have changed her major. There are other instances of students reporting that they would not have graduated, or stayed in STEM had it not been for CO-AMP. Students appear to find serving as a tutor to be equally beneficial. Several students expressed a feeling of accomplishment in having gone from being tutored to serving as a tutor for others. One of those students remarked, "Being tutored helped me to develop certain skills, and being a tutor allows me to keep up with those skills."

Interviewees also spoke about how monetary support from CO-AMP indirectly helped students academically by enabling them to devote more time to studying. In the opinion of one faculty member, "financial troubles are the number one problem that students are dealing with. Many of the students have to work low paying jobs, which cuts down time for studying." He commented that students often take a "regular load" and yet still don't have time for all of their responsibilities. Another faculty member said, "The money makes a big difference. It buys their books. They [students] are all going to tell you that...their budgets are really tight." Students acknowledged that research stipends allowed them to spend more time on academics and less time on part-time or full-time jobs.

CO-AMP is also seen by interviewees as helping students to adjustment to the challenges of college life and as providing needed social support. For example, several coordinators spoke about how Summer Bridge gives incoming freshman a rare opportunity to take courses that ultimately prepare them for advanced learning. One coordinator described Summer Bridge as "an opportunity to practice some things before it actually counts for a grade." Others felt that Summer Bridge was a non-threatening way to introduce students to what otherwise can be an intimidating environment. Another coordinator noted that a goal of Summer Bridge is to get students to "never doubt that they belong here...that they never doubt they belong in college." Several faculty members suggested that the community environment fostered by CO-AMP directly impacts students' success. According to one professor, the project is working because they have built a real "community" wherein students get the help they need and are "a great support for one another." Another professor agreed and added, "Students have formed a CO-AMP family and they really care for each other." One Activity Coordinator reported that CO-AMP students are more likely to form study groups and to use tutors, and that she is purposefully connecting students with one another so that they can help each other. Students commonly spoke about how they value the encouragement and support that project staff provides, and how CO-AMP is enabling them to network with more faculty. One student said that CO-AMP has helped him "to narrow the path" and "to focus" on what he really wants to do, while another said that it has "opened doors" for her and showed her the different options available.

According to interviewees, CO-AMP through its various offerings, but particularly through the research experience, enhances student interest and preparation for graduate study in STEM. Opportunities to conduct research and gain laboratory skills reportedly allow students to derive mentorship from faculty, and a better understanding of what graduate school is like. Other benefits mentioned include the learning of problem solving skills and procedural techniques in the laboratory. A professor who believes that lessons learned while conducting research have far-reaching effects on a students' academic life explained, "Students who have research experience are better able to understand the theoretical concepts taught in class because they are able to observe them practically in the lab. Research also helps to bridge together knowledge from separate, independent classes." Faculty members also spoke about how students engaged in research appear to be more motivated in courses, for in the words of one professor, it is a "strong impetus for them to go out and learn the material...find out why something works and how it connects to other things and subjects." According to one Site Coordinator, the CO-AMP research experience at his campus also entails a leadership aspect that motivates students for "they really start understanding their responsibilities and are unlikely to drop out." And, faculty point out that publishing and attending conferences boosts student confidence. Moreover, as one professor pointed out, "if a student doesn't have some type of research experience, their chances of getting into graduate school are much less" for it is becoming more the case that "graduate school will not even look at you unless you have some research experience."

Finally, there is also a general feeling among interviewees that the overall CO-AMP experience imparts students with greater confidence, motivation, and valuable skills. A faculty member who feels that CO-AMP encourages students to be assertive and confident explained, "These students are not as nervous about approaching faculty with questions and are secure about their knowledge and ability." One Activity Coordinator noted that the faculty mentoring aspect, along with other CO-AMP activities, has been "extremely important to motivating and preparing students for graduate school" by giving them the "determination and drive to go further" and to succeed in graduate school. According to another Activity Coordinator, the students that she has been working with are now graduating because they are invested in their majors, able to make contacts, and did well academically, which has "allowed them to be competitive enough to get them to the next step." As one student explained, CO-AMP has given him "motivation to continue" and "to see the broader picture" for he now knows that he will ultimately attend graduate school.

Impact on Institutions

CO-AMP is reported to have had an impact on partner institutions in several ways, notably by enhancing diversity on campus and in the STEM majors; increasing the institution's ability to both attract and support minority students through community building, and linking students to services and resources; and, affecting a "cultural change" at the institution level through greater faculty awareness, understanding, and responsibility for diversity. Interviewees commonly pointed out CO-AMP's positive effect on increasing campus diversity. Many interviewees spoke specifically about CO-AMP's impact on increasing minority enrollment and retention in STEM disciplines. For the Alliance, underrepresented minority student enrollment in STEM fields has increased from 1,922 students in 1995/1996, to 3,322 students in 2001/2002. This reflects a 58% increase. The senior graduation rate for underrepresented minority students in STEM has risen from 47% to 49% from 1998/1999 to 2001/2002[4]. Between 1995 and 2002 the number of underrepresented minorities obtaining BS STEM degrees has nearly doubled from 215 to 400 (data cited in the 2002 CO-AMP Annual Report). According to the Project Director, CO-AMP's impact on diversity is due to the strong involvement and support of the university presidents and deans because they set the tone for those issues on their campuses and work hard to institutionalize CO-AMP components.

"A lot of community building" has resulted from CO-AMP, according to one faculty chair, as "you'll often see students mentoring other students." "Our current students will infect new students with the same attitude where they are more success oriented and open to relocation and transfer. This has been a cultural change for the institution, and CO-AMP has had a big impact on allowing this to happen," explained one Site Coordinator. A student affairs staff member discussed how her institution has benefited because CO-AMP has helped connect students to services, and has helped bring faculty and student support staff together. According to an administrator at another school, CO-AMP has "stretched" the institution by causing them to think differently about community outreach and recruitment, particularly as it pertains to students on Indian reservations. He credits CO-AMP's recruitment practices as part of the reason why they have so many Native American students on campus. According to one high-level administrator, CO-AMP's emphasis on inclusiveness has influenced the way they solicit students to come to the university. For example, CO-AMP reportedly helped bring about an institutional change in practice insofar as there is now a standardized scholarship form for all students, which creates a larger applicant pool and facilitates access of students to appropriate funding opportunities.

Chairs spoke about how CO-AMP represents a "microcosm" of what can be done to retain students and how it has inspired other groups to provide students with more personal attention. At another campus, similar sentiments were expressed, as one Site Coordinator explained that the minority

[4] Graduate rates were unavailable for the years prior to 1998.

retention model that CO-AMP helped build is now being replicated across the entire campus. A couple of interviewees noted that CO-AMP helped their institutions to achieve a reputation for supporting minority students. As one dean explained, "It is an incredible marketing tool for [the school]...we are getting our name out, particularly at the Native American reservations and among students of Mexican-American descent particularly along the southern border of state. They are seeing [us] in a different light...rather than a place they could never reach. That's advertisement. The institution is benefiting greatly."

The Project Director's belief that "faculty attitude and understanding have changed" as a result of CO-AMP was echoed by a number of individuals across partner campuses. One Site Coordinator, for example, spoke about how CO-AMP has affected faculty outlook on advising by making them more apt to engage in advising on various levels, including more informal ways such as reaching out to students to chat with them in the hallways. Another Site Coordinator spoke about a "whole cultural change" on his campus wherein faculty and administrators are now more likely to encourage and push students to stay in the sciences. He reported that faculty doing research in the summer have "come to rely on CO-AMP students" whereas before CO-AMP some of these faculty members probably did not look at Native Americans as potential researchers. It has "really opened some eyes," he explains, because a lot of these students have been successful and gone on to graduate school. According to one high-level administrator, CO-AMP has increased the emphasis on the responsibility that the faculty hold in promoting diversity because previously many would ask "how are we expected to do this on top of everything else we are doing?" but "the university is beyond that discussion now and most faculty accept that it is not an add-in piece, but a part of their job description." According to one dean, CO-AMP has "helped to reinforce the notion that we need diversity because we are needing more role models." He commented that having been at the institution for 30 years, he notices a "tremendous change in the way we do business," and that sensitivity now is "beyond our wildest dreams."

Institutional Support and Institutionalization

The central office staff praised the support received from the Chancellor of the Colorado State University system. They felt that his involvement and ability to lead the Governing Board had made a significant impact on their ability to institutionalize components of CO-AMP. The Site Coordinators and institution administrators all agreed that their respective institutions were "very supportive" of the LSAMP program. Interviewees spoke about the different forms and sources of support they had received, including the tremendous support from their institution's president and high-level administrators. Often mentioned were the in-kind contributions like office space, and use of institution support personnel for data gathering and other tasks. Several mentioned faculty release time as an example of institutional support including the release time granted to the CO-AMP Project Director for management and planning purposes. At one institution the Special Assistant to the President said that his institution has also provided support by making involvement in programs like CO-AMP an expectation of their faculty members, particularly by factoring in participation in such programs in evaluation and promotion decisions.

When asked when institutionalization began within the Alliance, responses varied somewhat across institutions. The Project Director feels that institutionalization really emerged after about five years when instead of having 3 or 4 faculty involved, they now have 30-40. One Site Coordinator noted that while attitudes were being changed with the first summer of research, he feels that talk about institutionalization "in a more calculated manner" with administrators came about at the beginning of phase two. Two other Site Coordinators thought institutionalization began to take place around the third year. It was at this time, explained one Site Coordinator, that the Alliance experienced a cut in NSF funding, and his institution elected to cover the costs of participating faculty that was previously paid for by Alliance funds. Another Site Coordinator feels that institutionalization began "to take shape in a better way," when the department chairs became involved with his institution's CO-AMP steering committee.

Project Evolution and Future Plans

The Project Director and involved faculty members noted that while CO-AMP components have generally remained stable over time, they have expanded components that were determined to be successful and eliminated those that were not. In addition, several interviewees discussed the expansion of the Alliance with the addition of two four-year institutions in 1998, and then another four-year institution in 2001. These institutions reportedly waited to join the Alliance until CO-AMP was firmly established. CO-AMP project staff members view the addition of these institutions as evidence of their achievement and promising future. The Project Director also explained that CO-AMP has evolved over time by placing a special emphasis on undergraduate research, and implementing more bridge programs at Alliance campuses. One Site Coordinator reported, that "with Phase II there has been much more of an emphasis on graduate work…I am really encouraging my students to think about graduate school and to come and speak with me about it." Students acknowledge that CO-AMP has been very flexible, that in the words of one students, "Times change and the program is good at evolving with the needs of the students."

In preparation for when NSF funding ends several project coordinators and institutional administrators discussed efforts to solicit industry funds to maintain the project. Several institutions in the alliance have been successful in gaining sponsorship from local businesses for CO-AMP activities. Interviewees agreed that expanding this type of support would become more of a priority when NSF funding ended. One Site Coordinator remarked, "Industry knows and has known from the inception of CO-AMP that they will be expected to step in and be more involved financially once the NSF funding ends. They are willing to do this because they have a vested interest in programs like CO-AMP because that is where their future workers will come from." In the past project staff members have leveraged this funding by selling the success of their program and its students; with continued success they hope they will be able to do this in the future as well. Others hope that support from their institution would increase through either a boost in institutional funding as a regular or academic department budget line item or through an increase in faculty and institutional grants.

Recommendations

Student participants on the whole indicated that CO-AMP has exceeded their expectations. However, some individuals did suggest that CO-AMP expand by adding more social activities to foster student and faculty interaction, especially at the beginning of the year so that participants become acquainted with one another; offering more assistance with job and internship placement; creating a LSAMP alumni network; and, increasing the number of tutors and project staff. Students on some campuses expressed a desire for a meeting space specifically for CO-AMP students to meet, use computers, or study together. Some felt that the CO-AMP office space on their campuses were inadequate and recommended more space for project staff.

Several faculty members and students wanted to see greater advertising of CO-AMP on their campuses. A faculty member who would like to see CO-AMP enjoy a higher profile at her institution said, "Many of the STEM faculty know about the program, but I'm trying to stretch this awareness across all the disciplines on campus." Some students feel that greater publicity around campus would enable more students to benefit from the program. However, one Activity Coordinator brought up the point that while he would like to give more students an opportunity to participate, he knows that bringing in more students would decrease the amount of the stipend that students currently receive.

Several students at one institution suggested that CO-AMP develop "a research foundation course" that would integrate the components of their research experience including scientific literature, Internet research and scientific reporting. Students felt that while they learn much of this information from their research mentor, "something more formal that teaches you basic research methods would be good."

Some students and project coordinators suggested improvements in CO-AMP's high school and K-12 teacher outreach components. One student suggested that CO-AMP students be involved in recruiting and stimulate early interest in research sciences by presenting their research to high school students, as this highlights that fact that CO-AMP students accomplish a lot more than just completing course work and receiving a degree.

Some faculty members suggested that LSAMP create a faculty award, similar to the distinguished teaching awards that institutions honor faculty with. One faculty member felt that her peers and superiors often overlooked her involvement and participation in the program. Three professors agreed that some type of "Distinguished Mentor" award would encourage faculty involvement and recognize those who have maintained a commitment to the program.

One Activity Coordinator said that she would like to see what other Alliances are doing, and how they're doing it. She suggested that they have profiles of other Alliances on a main LSAMP web site to highlight best practices so that she doesn't have to "reinvent the wheel."

One faculty mentor recommended that students start their undergraduate research earlier, during the sophomore year, and to carry on consecutive years working with the same research mentor. She acknowledged that limited resources would restrict participation, but suggested that supplemental funding be pursued to make it possible for more students to have earlier research opportunities. Two other faculty mentors discussed the importance of working with students for a longer period of time – at least two years. They feel that a lot of times students are not on a research project long enough to get a lot of results, for a summer or even a single school year is not long enough.

Three faculty members at one institution, which has a large population of Native American students, suggested that CO-AMP sponsor cultural workshops for faculty members that focus on teaching and working with Native American students. According to one faculty member, "It took me probably two years or more as an instructor to learn how to deal with primarily Native American students. I didn't understand the culture. I didn't understand why they didn't ask questions. I didn't understand why when you get them behind your office, they just talk and talk and talk. And yet they will not raise their hand in class." She, like some of her colleagues, feels that a workshop explaining these cultural norms would assist faculty members in similar situations.

II. LSAMP Case Study: Florida/Georgia Alliance

Introduction

This case study is based on information collected through site visits to six institutions belonging to the LSAMP Florida-Georgia Alliance: Bethune Cookman College, Florida A&M University, Florida International University, Florida State University, Miami Dade Community College, and Tallahassee Community College. A team of Urban Institute (UI) staff that included Dr. Beatriz Clewell, Laurie Forcier, Ella Gao, Dr. Lisa Tsui, and Nicole Young visited three of the institutions in February 2003 and another three institutions in April 2003. During these site visits the team conducted both interviews and focus groups with project administrators, Institutional Coordinators, Academic Coordinators, Institution Vice Presidents and Provosts, department deans and chairpersons, faculty members, and student participants.

Project Description

The Florida/Georgia Louis Stokes Alliances for Minority Participation (FGAMP) project has been in existence since November 1992. They are one of five alliances funded as part of the second LSAMP cohort and are currently in Phase III of their program. The FGAMP project is comprised of 13 universities and colleges (10 four-year institutions and 3 community colleges); 12 institutions are located in Florida and 1 in Georgia. The 10 four-year institutions are: Albany State University, Bethune-Cookman College, Florida A&M University, Florida International University, Florida Memorial College, Florida State University, University of Florida, University of Miami, University of Central Florida and University of South Florida. The three community colleges are: Florida Community College at Jacksonville, Miami-Dade Community College and Tallahassee Community College. Florida A&M University serves as the lead institution to the project and is the location of the Principal Investigator of the program.

According to data found in the NSF MARS database for reporting year 2002, the Florida/Georgia Alliance serves 488 Level I participants[5], of whom 52% are male and 48% are female. Participants' racial/ethnic breakdown is as follows: Black—75.20%, Hispanic—18.44%, Non-minority—4.30%, American Indian—0.41%, Asian/Pacific Islander—0.41%. 0.41% of participants were reported as having more than one race/ethnicity. The remaining 0.82% represents data that is unknown or missing.

Administrative and Governance Structure

Lead Institution and Staff

Florida A&M University (FAMU) is the lead institution for FGAMP. The Project Director, who reports to the Governing Board, is also the Principal Investigator, a member of the Chemistry faculty and the Acting Associate Dean of Arts and Sciences. He is responsible for FGAMP activities both across the Alliance and at the lead institution where he serves as the Institutional Coordinator. The Project Director described his primary responsibilities as monitoring and ensuring consistency of program elements and

[5] For the purpose of this case study, Level I students are those students who are identified in the MARS database as having received LSAMP funding during the summer or academic year.

activities across partner institutions, and ensuring that all activities are carried out "in accord with the NSF agreement so we maintain uniformity in our program." As part of this oversight, the Project Director plays a major role in developing the FGAMP budget and determining the project activities to be undertaken at each institution. As Project Director he also takes the lead in writing NSF required reports. The Project Manager for the Alliance, who does not hold any other position at the institution, handles the day-to-day operation of the project. She identifies and follows up on project "action items" and meets weekly with the FGAMP administrative assistant and budget officer to ensure smooth implementation of the project. The administrative assistant takes care of clerical work for the Alliance and a part-time budget officer pays bills and ensures that student stipend money is dispersed at each institution.

FGAMP project staff who work directly with the FAMU component of the project include the Institutional Coordinator and the Academic Coordinator. The Institutional Coordinator reports to the president of FAMU and ensures that all program goals and objectives are being achieved through the activities as laid out in the proposal. He tracks this through frequent interaction with the Academic Coordinator and the FGAMP faculty and by attending many of the FAMU FGAMP meetings and activities. He also meets with students to explain what is expected of them and helps students secure research and internship opportunities. Additionally, as a senior member of the faculty, the Institutional Coordinator serves as a person who can "get things done" for FGAMP at the university. The Academic Coordinator, who works as an adjunct professor at another Alliance institution, is responsible for the day-to-day activities at the lead institution and reports that her main function is to "facilitate the growth and achievement of the students." As such, she plans activities that expose students to opportunities that will help them succeed in their academic and professional careers. At other Alliance partner institutions visited, the FGAMP staff is similarly comprised of an Institutional Coordinator and either one or two Academic Coordinators (in the case of two Academic Coordinators, one is the Science Coordinator and the other is the Math Coordinator). At one institution, however, there is no Academic Coordinator and project activities are coordinated to a large degree by graduate student mentors. Institutional Coordinators typically report on the project to the president of their institution or to a high-ranking academic administrator and hold a variety of other positions within their respective institutions, generally having been appointed to the position internally.

Project Location within the Institution

At the lead institution, FGAMP is located administratively under the president's office. According to the Project Director, it was placed there because the former president was the PI on the grant and because it lends the project "prestige and clout." For the other Alliance partners, the location of FGAMP offices varies across institutions (e.g., School of Engineering, Division of Math and Sciences), with the location of the Institutional Coordinator being the main determinant for placement within the institution.

Advisory Committees

According to the Project Director, the FGAMP project has a Governing Board comprised of the presidents of partner institutions and which reviews the activities of the project in a "broad way." Governing Board meetings are generally planned to coincide in time and place with another meeting that all the presidents attend (such as a Board of Regents meeting) and are held once a year. Institutional Coordinators brief their respective presidents prior to each meeting and also attend the meetings of the Governing Board. During the meetings the Project Director reports to the Governing Board on project activities, and also fields questions and receives feedback from attendees. Reports, such as the GPRA report, and web-based materials, such as the MARS data, are also submitted to the Governing Board for review. During these meetings the Board examines the number of students in FGAMP to assess whether project goals have been met, explained the Project Director.

In addition to the Governing Board, the Alliance also has a Steering Committee made up of all the Institutional and Academic Coordinators. The Alliance Steering Committee meets three to four times throughout the year; most times it meets independently at a central location, although some meetings are planned to coincide with the Governing Board meetings and the annual EXPO. In addition to these face-to-face meetings, the Steering Committee also holds a number of telephone conferences. According to the Project Director, "In order for the whole Alliance to work, each institution must meet its goals and objectives," and as such, meetings and conference calls of the Steering Committee are structured as an interactive checkpoint. The Project Director develops and distributes an agenda prior to each meeting or call, and during these meetings they review items on the agenda and assign "action items" to the partners. Typical items of discussion include implementation of program activities, appropriate utilization of FGAMP funding, and project leadership.

Each partner institution has a FGAMP Institutional Advisory Committee on its campus. These committees, which on average meet twice a year, are typically comprised of the Institutional Coordinator, deans and department chairs from the STEM fields, and other institutional staff who are active with the project. Though it varies across institutions, committee members tend to be involved in a number of activities such as selecting students for FGAMP, reviewing the progress of students at the departmental level, attending and participating in the annual EXPO, and offering suggestions and feedback to Institutional Coordinators. According to the Project Director, these committees were established to circumvent programmatic isolation with the hope that the involvement of deans and department chairs will promote collaboration between the project and members of the faculty. "One of the biggest mistakes that we could make is to try and implement sustained, permanent change by operating in isolation," he pointed out.

Project History and Background

According to the Project Director, the initiative for developing an LSAMP project in Florida grew out of previous experience working with precollege students through the National Science Foundation's Comprehensive Research Centers (CRC) program. This "forerunner" of FGAMP focused on creating linkages with local schools, attracting students into STEM at an early age, and encouraging them to pursue STEM at the undergraduate level. After the CRC program was phased out nationally, the lead institution wanted to continue the pipeline by working with undergraduate and then graduate STEM students. The former Project Director (another FAMU faculty member) spearheaded the initiative and pulled together a team to work on the original FGAMP proposal. Some institutions came on board because of past collaborations. For example, FAMU had established relationships with Bethune Cookman College and Florida Memorial College while working on CRC and with Albany State University through collaborative work on Title III programs. Other institutions, such as Florida International University, Miami-Dade Community College, and Tallahassee Community College were recruited into the Alliance because of their large minority student enrollment. Additionally, the former president of the lead institution, an influential scientist himself, is said to have "good relationship(s) with the other presidents" and was instrumental in the recruitment of institutions into the Alliance, with many Institutional Coordinators citing the president as their initial point of contact with the project.

In addition to previous experience with CRC and Title III programs, some project staff spoke of their respective institutions' current involvement with other programs complementary to the goals of FGAMP. For example, one senior administrator at the lead institution talked about an NSF-sponsored alliance, the FAMU-Iowa Alliance for the Production of Mathematicians, which was formed in the hopes of increasing the number of minority Ph.D. candidates in mathematics. This alliance, which shares resources with FGAMP, is comprised of a major research university and four Historically Black Colleges and Universities (HBCUs). Funding from the grant provides financial resources and enrichment activities to students. FAMU, Albany State University, and the FAMU/Florida State University Joint College of

Engineering Program all reported participation in HBCU-UP, another NSF-sponsored initiative. The HBCU-UP program, which also shares resources with FGAMP, seeks to increase the number of African-American students entering graduate degree programs in STEM fields and to enhance the quality of undergraduate STEM education at HBCUs. Additionally, FAMU and Bethune-Cookman College collaborate on the NASA Minority Science and Engineering Improvement Grant, FSU is a recipient of NSF-funded Research Experience for Undergraduates (REU) grant, and both Miami-Dade Community College (MDCC) and the University of Miami (UM) are involved in the NIH-funded Bridges to the Baccalaureate program through which minority community college students from MDCC receive stipends and conduct research with UM faculty members fifteen hours a week.

Goals and Strategies

<u>Project Goals</u>

According to the Project Director, the overarching goal of FGAMP is to "increase significantly, the number of minority students who obtain undergraduate and graduate degrees in STEM." He reported that the goals and mission of FGAMP have played a "pivotal role" in addressing the goals of many of the partner institutions. Other program staff agreed, with one administrator stating that the FGAMP project addresses his institution's goals of recruitment, retention, and graduation "very directly". The goals of FGAMP make it "a leader on campus, facilitating retention at a high level as well as the transition of students to graduate school," according to one faculty member. In addition to their one overarching goal, the FGAMP project also espouses a number of more specific goals:

- To recruit increased numbers of students to the discipline at the freshman and junior levels and graduate these students from the STEM discipline of their choice in 4 years (5 years for some engineering disciplines) or 2 years respectively;
- To establish structured relationships with a significant number of graduate institutions for the purpose of facilitating the enrollment of STEM BS undergraduates into STEM PhD granting programs;
- To enhance the graduate school preparation of FGAMP participants through the provision of significant external research experiences, conferences and symposiums;
- To promote improved student academic performance through organized, well established working relationships among students and between students and faculty;
- To develop a critical mass of highly motivated students who, by their organized and serious approach to their work, will serve as positive role models for other students;
- To enhance faculty teaching skills and improve student learning through faculty conferences and workshops;
- To motivate students to pursue advanced STEM degrees through participation in regional conferences and Career EXPOS; and
- To have each participating institution establish a plan, with external partnership support, to institutionalize the FGAMP program.

When questioned as to whether project goals have changed over time, the Project Director spoke of two original goals that are no longer being pursued:

- To explore and plan for the establishment of several 5-year BS/MS combined degree programs at participating Alliance institutions; and
- To provide matriculants a summer experience that will review and preview important mathematics and science concepts as part of a plan to reduce high attrition in the freshman year.

The goal of establishing a five-year combined BS/MS degree was dropped due to difficulties with Florida's "120 hour rule." Under the 120-hour rule, a student cannot receive a bachelor's degree with any less than 120 credit hours, but also cannot go over this amount by 10%. In trying to merge a BS/MS into a five-year program, FGAMP encountered a number of bureaucratic difficulties and decided to abandon the effort. The goal of providing a summer experience for pre-freshman students was initially implemented as a "bridge" program, but has since been discontinued, in part because of shifting priorities. In addition to the phasing out of these goals, the Project Director also spoke about a change in focus over the course of the three phases of the project. In Phase I, the focus of the project was on recruitment of students into the program and the STEM disciplines, while in Phase II greater emphasis was placed on facilitating student transition to upper divisions and involving community colleges. Currently, in Phase III, the focus has shifted further along the pipeline, with the emphasis now being on graduate enrollment.

When questioned as to their understanding of FGAMP goals, administrators, faculty and project staff had a variety of responses. Some took a broad view: "The main goal is to turn [students] into scientists...that's what FGAMP is all about," while others spoke more specifically, with one faculty member describing the project as a "coordinating tool for NSF programs," and another stating that the goal of the project was to teach students how to "work with technology and teach students how to utilize the scientific method." Some project staff at the partner institutions perceived FGAMP as having an "end to end mission that covers the whole pipeline, starting out with pre-freshman bridge and extending out to placement in graduate school," while many others indicated that they were aware of the Phase III shift in priorities, responding that the main goal of the project was to encourage minority students to pursue graduate STEM study. Student networking and peer support were also highlighted as important goals of FGAMP by a number of respondents, with one Academic Coordinator commenting that "What FGAMP ought to be is a group of students supporting each other who have common interests and goals," and a high-ranking administrator citing "exposure to their peers also studying and working in the sciences," as critical to student success. Only one interviewee questioned indicated that he did not know what the goals of the project were; most interviewees had at least a broad understanding of the goals of FGAMP.

According to the Project Director, the approaches and strategies of FGAMP were primarily derived from the past personal, programmatic, and research experience of project staff. As one Institutional Coordinator described it, many of the people involved in FGAMP are "well-trained and experienced people, so they've used the resources that they have." The Project Director noted that Alliance institutions had "developed a lot of experience" from running the Comprehensive Research Centers (CRC), and that FGAMP was designed as a continuation and extension of CRC that spans precollege to graduate school. Additionally he noted that project staff are very familiar with the extant literature on educational interventions, and have utilized their knowledge in developing strategies. Two institutions reported that they had consulted an advisory panel of experts in developing their approaches and strategies, while an Institutional Coordinator from a community college reported that he has relied partially on input from the FGAMP central office regarding the approaches and strategies that they implement at his institution. He said that he has also gained insight through steering committee meetings and discussions with the other community college institutional coordinators.

Project Functions and Components

For the purposes of the case studies, the term "project functions" refers to student recruitment, application/selection, and monitoring/feedback. The term "project components" refers to those activities and services that an Alliance offers to its LSAMP participants. While there is considerable overlap, project components do vary across Alliances, as well as across partner institutions within the same Alliance. In this section, the discussion of project components is divided into two sections: common and uncommon. A "common" component is one that is utilized by most Alliances, while an "uncommon" component is less prevalently utilized.

Project Functions

Recruitment. FGAMP project staff members utilize many strategies in recruiting students to the project. Information spread by "word of mouth" by current and past FGAMP participants is considered to be the most effective recruitment strategy by the Project Director, an observation supported by the fact that the majority of students in our focus groups acknowledged that they had learned about and been encouraged to become involved with the project from their peers. The Project Manager recognized the recruitment contribution of the Institutional Coordinators saying that they "know their students well" and are able to identify some of the "best students…[the] cream of the crop" for FGAMP. High-school outreach, which encompasses "an extensive mailing system to counselors in high schools" in Florida and neighboring states, recruitment visits by Academic Coordinators and current FGAMP students to selected high schools and community colleges, and participation in high school career and college fairs, is also considered an important element of the recruitment effort. Some project staff members and students pointed out that FGAMP's Summer Bridge had previously served as a major avenue to recruitment. It is reported that students would learn about FGAMP and the opportunity to participate in the bridging program while still in high school via materials sent to their school and from guidance counselors. Since Summer Bridge has been discontinued, many Academic Coordinators now seek to make contact with incoming students during the institution's freshman orientation period.

In addition to word of mouth and high school outreach, other recruitment strategies mentioned include the FGAMP web site, brochures and fliers, informational workshops, student newsletters, and the involvement of professors and academic advisors. In fact, at one institution, all FGAMP participants are recruited into the project via faculty recommendation.

Application/Selection: There is a common application process for students to become a Level I FGAMP "scholar." The Project Director described the application as "a mini version of applying for the NSF graduate fellowship." Prospective participants are sent an application packet and are required to respond with their transcripts, letters of recommendation, and an essay. Then, utilizing "the same requirements." the FGAMP Institutional Advisory Committee on each campus selects their students. Once selected as a Level I participant, students must sign a statement agreeing to meet the requirements of FGAMP, which includes the maintenance of a minimum 3.0 GPA and an understanding that the project can send the student's grades to parents should it become necessary. Outside of Level I participants, there are also a number of Level II "scholars" who do not receive funding, but who are involved in other aspects of FGAMP, including professional and academic workshops, FGAMP clubs, and social activities.

Monitoring/Feedback: The Academic Coordinator monitors all FGAMP Level I participants at least twice a semester. Grades, coursework, class attendance, and FGAMP activities are all monitored to ensure that students are following the rules of the project and remain eligible to receive funding. Students also receive systematic feedback at least twice a semester via meetings or correspondence with the Academic Coordinator, although some Academic Coordinators reported more frequent formal and informal contact with students.

Project Components (Common)

Research (all institutions): Research experiences with faculty members are available to all FGAMP students. Students who participate in research are typically juniors or seniors who have a GPA of 3.0 or greater. These research experiences can take place during both the academic year and the summer, although some institutions specified that most research took place during the academic year while others specified that they encouraged students to undertake research during the summer when the academic course load is lighter. Students who participate in research experiences generally receive a stipend with faculty members sometimes supplementing FGAMP funding with research grants of their own. Students are typically required to identify and approach the professor(s) with whom they would like to work. Academic Coordinators talked about the importance of students taking the "initiative" and finding someone "they feel comfortable with" although they are supported in this effort. For example, at one institution, students are notified as to which faculty members are available for research and at another school, Academic Coordinators and graduate student mentors provide suggestions and advice to students about suitable faculty members for them to approach. FGAMP faculty research mentors must sign a form detailing the research project and approve the student's final work. Faculty members typically work with their research mentees on developing posters and presentations for the annual EXPO, and some take their mentees to professional conferences as well.

It is reported that most four-year institutions strongly encourage their FGAMP students participate in research sometime during their undergraduate experience. Some students choose to pursue research via an offsite internship rather than an on-campus experience. With some exceptions, community college students do not typically conduct research. Some community college students have had research internships but this typically occurs following the completion of their associate's degree. According to the Institutional Coordinators on these campuses, research experience for their students is an aspect of FGAMP that they are continuing to work towards with some staff members developing creative ways to get more students involved in and prepared for research. In one example, students learn the mechanics of a research presentation and gain conference experience by undertaking literature reviews of STEM topics of their choosing and then developing posters for presentation at EXPO with the assistance of their FGAMP faculty and peers.

Mentoring and advisement (all institutions): Mentoring is an important aspect of FGAMP, taking place on three levels: peer, faculty, and project staff. This is described by one Institutional Coordinator as a "mentoring network." Peer mentoring, in which freshman and sophomore students are paired with junior or senior mentors, takes place formally on at least two campuses and informally on at least one. At least one institution provides formalized orientation training and follow-up sessions for their peer mentors. Because the peer mentoring that takes place is typically more focused on common student experiences than on academics, students are not necessarily paired by major. At some institutions there is also peer mentoring in the form of graduate students mentoring undergraduates. Typically this takes place in a research lab setting, but at one institution, graduate students receive funding through FGAMP to organize activities and presentations for the undergraduates, mentoring them both as a group and on a one-to-one basis.

Most faculty members who are involved in mentoring FGAMP students do so through the research experience component of the project, integrating FGAMP students into already established workgroups in their labs. Although some faculty mentors were careful to draw a distinction between research and mentoring, one professor pointed out that most seek to "blend technical and professional mentoring." Faculty research mentors reported frequent contact with their mentees, with most reporting that they meet with their mentees formally at least once or twice a week, many times in a research group setting. Faculty mentors also reported frequent informal one-on-one interactions with mentees, with one professor noting that she is "constantly meeting with students all the time" because her "office is [her] lab." Formal meetings tend to focus on the research being carried out in the lab, but some faculty also incorporate supplemental activities into these meetings, such as practice sessions for research presentations. Informally, students seek out their mentors for advice on coursework, internships, graduate schools, and careers. Faculty typically learn about the project and become involved as mentors through direct contact with either interested or participating students or with FGAMP staff, although one faculty member mentioned that she had learned about the project through the Minority Programs office at her institution.

In addition to peer and faculty mentors, students at all of the partner institutions spoke about the vital mentoring role played by FGAMP project staff. In some cases, the Institutional and Academic Coordinators were looked to as "the main point of mentoring" with students coming to them on an individual basis for academic, professional, and personal advising. Group mentoring also occurs, where Coordinators speak to the students in a group setting and make themselves available for questions. In one example, students spoke about the mentoring they receive through FGAMP meetings, where the Institutional Coordinator will "speak a word of truth" at the end of each meeting about what it is like to be a minority student in the STEM fields.

Scholarships and stipends (all institutions): All Alliance members offer scholarships and stipends in one form or another, with award qualifications and funding amounts varying across institutions. At two institutions, students must participate in research in order to receive funding. At other institutions, awards are based on other criteria such as being required to attain or maintain a specified level of academic achievement or to fulfill an activity requirement regarding participation in FGAMP student organization activities or community service.

Graduate school assistance (all institutions): Students from all Alliance institutions are invited to participate in the Transitions to Graduate School workshop, which takes place at the lead institution. The workshop, which is offered every spring semester, is designed to give seniors who will attend graduate school, a realistic view of what they should expect. During the one-day event, current graduate students and faculty members provide advice about the process of applying to graduate school and how to adapt and survive the graduate school experience once they arrive. Students are advised how to make the transition and how to obtain funding. In addition to this annual workshop, Academic Coordinators provide graduate school assistance to students throughout the year by providing information and materials about graduate schools through the FGAMP office; helping students prepare applications; conducting GRE preparation workshops for juniors and seniors; and, organizing project sponsored visits to graduate schools. FGAMP students may also receive graduate school assistance from their faculty mentors who provide advice and guidance in the graduate school application process, and in many cases are able to tap into their personal networks and connections on behalf of students.

In addition to these resources, FGAMP students at the lead institution also have the opportunity to participate in the Graduate Feeder Scholar Program. This program is available to students across the university, and according to the previous Institutional Coordinator, FGAMP has tried to "funnel" many of their students into graduate schools through this program. The program consists of a nationwide association between FAMU and select major research universities nationwide. Through this cooperation, once a FAMU student meets a specified set of requirements, they are automatically granted admission and offered financial assistance at the participating institutions to which they apply.

Internship opportunities (all institutions): All Academic Coordinators reported that they strongly encourage students to partake in research internships and that they gather and disseminate relevant information on internships via email communication and the FGAMP clubs. Some coordinators also share the information they gather with other institutions across the Alliance. It is reported that many students also make contacts leading to internships at the annual research EXPO. Participants are typically rising upperclassmen and those who undertake a research internship can apply this to their research requirement and may present the work that they do at the annual EXPO. At least one institution has developed connections with local government labs.

Professional development (all institutions): Alliance institutions frequently sponsor professional development field trips, workshops, and seminars for their students. FGAMP students at least two of the partner institutions are required to attend some kind of professional development activity on a weekly basis. These activities often involve invited speakers, and are typically organized through the institution's FGAMP student organization, although on one campus activities are organized by a group of graduate student mentors. Topics covered during these sessions range from resume writing and how to get hired, to the importance of research. Personal development is emphasized as an important part of professional development.

Conferences (all institutions): FGAMP students have the opportunity to attend several conferences and symposiums, some held on Alliance campuses and sponsored by FGAMP, such as EXPO (a description of the FGAMP EXPO appears below), and some external conferences sponsored by other alliances, research laboratories, and educational institutions. Students attend conferences for the purpose of networking and sharpening their communication and presentation skills, and are expected to present oral or poster research presentations in a competitive forum. Typically students who are involved in research or internships are sent to conferences. Faculty members will sometimes bring students along to conferences and assist with their travel expenses.

Articulation agreements and community college outreach (all institutions): Articulation agreements are in place throughout the Alliance due to the common course numbering agreement between community colleges and four-year institutions that exists throughout the state of Florida. According to the Institutional Coordinator at the lead institution, Institutional Coordinators at the two- and four-year institutions work together to recruit STEM students and to help students make the transition from community college to four-year institution. Community college students are actively encouraged to participate in summer research activities at partner institutions, and both community college students and faculty attend and participate every year in the annual EXPO.

Tutoring (most institutions): Academic Coordinators arrange tutoring for FGAMP students needing assistance. Students generally ask for assistance when needed, but if an Academic Coordinator notices that a student's grades have dropped below a certain GPA, they may suggest tutoring to the student. Some institutions offer tutoring services directly through the FGAMP office, with the Academic Coordinator taking responsibility for hiring and coordinating tutors throughout the academic year and summer. This is typically paid peer tutoring; some of the peer tutors are FGAMP students themselves. At other institutions, tutoring and tutoring labs have been institutionalized and so Academic Coordinators help students find appropriate tutors through established institutional channels.

Drop-in/learning centers (some institutions): Some Alliance institutions have Learning Centers available for use by FGAMP students, although none of the centers are exclusive to the project. Students generally utilize this space for homework, computer access, tutoring, group study and meeting up with friends. The drop-in center at one institution is housed in an office that serves a number of STEM related programs, including FGAMP. This office provides several specialized resources to students, such as a "test bank," that allows students to review old tests and notes, and a collection of donated used textbooks that students may use or check out.

Bridging activities (previously available to students at all institutions): Previously, FGAMP offered a Summer Bridge program for incoming freshman from all partner institutions. The program was held at two locations (one each in northern and southern Florida), and approximately 40-50 students participated in Summer Bridge each year. The Summer Bridge entailed a five-week residential program designed to acclimate pre-freshman to college by exposing them to an undergraduate academic curriculum and social setting. During the program, students attended basic science and English classes, lived in a dormitory, attended academic and professional development workshops, and took part in social activities. According to project staff, Summer Bridge has been discontinued due both to cuts in funding and FGAMP's shift in focus from preparing pre-collegiate students for undergraduate studies to preparing undergraduate students for graduate school. The last Summer Bridge took place in 2001.

Project Components (Uncommon)

FGAMP Expo (all institutions participate in EXPO): EXPO is an annual research meeting hosted by a partner institution on a rotating basis. A committee comprised of the Academic Coordinators, representatives from the Central Office, and the Institutional Coordinators, coordinates EXPO. Students from across the Alliance present research through oral and poster presentations, while professors, representatives from industry and graduate schools, and others serve as judges. Students and faculty are also exposed to seminars, workshops, and networking opportunities with people from business, industry, and graduate and undergraduate institutions. Through these interactions students can learn about and secure scholarships, internships, job placements and sometimes, acceptance into graduate institutions. Students are also able to make connections with their peers from across the Alliance. In one example of this, students from one of the community colleges returned from their EXPO experience with the idea of starting their own FGAMP club (see description of FGAMP clubs below).

FGAMP clubs (most institutions): In various forms, the partner institutions have almost all established FGAMP clubs or organizations. According to the 2002 annual report "The FGAMP student organizations, based at the participating sites, serve a key role in promoting a STEM-community focus and in disseminating information about the project." Much like other student organizations, these clubs typically meet on a regular basis, organize social activities and trips, coordinate community service projects for the group, and elect student officers and a faculty advisor. Unlike other student clubs, however, there is a strong "academic component" and students are encouraged to think of themselves "professionally and as scholars." In this vein, FGAMP clubs sponsor seminars, speakers, and STEM related field trips; disseminate information about research opportunities; scholarships and internships; and, spend part of their meetings discussing and preparing for the annual EXPO. One institution reported that they do not have the same "club structure that other campuses do" but do have a weekly group meeting where FGAMP students get together with graduate mentors.

Community service (some institutions): A community service component of FGAMP has emerged at some of the Alliance institutions. At one institution, students are expected to "give back" and have a "social impact" on their community by participating in community service for at least three hours a week during their freshman and sophomore years. At least two other institutions also undertake community service, generally as part of their FGAMP club activities. Many undertake this community service in the form of tutoring at local public schools.

Most Important Features

When asked about the most important feature of the FGAMP project, Academic Coordinators offered varied responses. One Academic Coordinator at a community college exclaimed, "There is no doubt that the EXPO is the most important" feature of the project. She explained that it instills confidence in student: "they come back from EXPO feeling that even though they are from a community college, they are every bit as good as everyone else." She added that students "love it" and that the lessons students learned at EXPO "are absolutely amazing." Another Academic Coordinator agreed, applauding the opportunity the annual EXPO provides for FGAMP participants to meet each other and "find out what they [are] doing in terms of academics and community work." She also feels strongly, however, that tutoring and summer programs, such as Summer Bridge and research, are critical components that allow students to work with faculty mentors and to overcome "the freshman hurdle." Two Academic Coordinators narrowed in on the monitoring and mentoring aspects of FGAMP as being key to students' success. One said, "The most important feature is that we meet with our students on a regular basis. We get to know them. They get to know us. ...I think that if we didn't...we wouldn't see the numbers graduating that we do." "Keeping the students on track" is a critical part of the project, said another Academic Coordinator who explained, "We're here to not just help them academically, but to talk to them about whatever their problems may be." In addition to these comments, two Academic Coordinators also highlighted the availability of FGAMP scholarship funds as being very important.

Project Implementation

Factors Affecting Implementation

Main Factors Facilitating Implementation

Academic Coordinators and other project staff were asked about main factors that facilitate implementation of FGAMP. The most common responses pertained to support from institutional leadership, teamwork among Alliance partners, and the attributes of individual Institutional Coordinators. According to the Project Manager, the "commitment, dedication, and backing" of the presidents of partner institution has been "crucial" to FGAMP's success. Academic Coordinators also spoke about how instrumental it has been to have support from institutional administrators, most notably from the president of the institution. Such support is said to facilitate project success and usually involves financial support as well. According to another Academic Coordinator, support from the institution's administration has been "a major factor" in successful project implementation. She said, for example, that the president's contacts helped the institution develop a partnership with the USDA Agricultural Research Service (ARS) that provides summer internships to STEM students including FGAMP scholars. One Academic Coordinator explained that endorsement from the president, provost, and division chair means that she does not have to worry when she asks faculty to work with students.

Several Academic Coordinators also spoke of how project implementation has been facilitated by teamwork among partners of the Alliance. According to one Academic Coordinator who works at a multi-site institution, there is an implementation structure being built around FGAMP. She explains that it is because of FGAMP that she regularly interacts with the other five campuses (of her institution) and she speaks frequently with the division or departmental chairs there. Another Academic Coordinator reported that the steering committees expose her to activities and opportunities that other institutions are offering their FGAMP students and that this allows her to bring those ideas back to her students. A third Academic Coordinator spoke about being inspired by her FGAMP colleagues' dedication to the project, for as she described, "All of the people I work with have a very positive image; they're motivating and hardworking people." She said that she has not worked in any position that involves this many people dedicated to minority student achievement. The Project Manager praised the "good and strong leadership" offered by the Principal Investigators. Additionally, the Project Director and other project staff members applauded the Alliance partners and central office staff for their ability to work as a team in accomplishing FGAMP goals.

A third facilitating factor identified by interviewees is the importance of having a strong Institutional Coordinator. One Academic Coordinator reported that she finds doing the administrative work (getting paperwork signed, obtaining stipends, etc.) for the project to be easier precisely because their Institutional Coordinator has been at the institution for a long time and has developed relationships with many faculty members. Two Academic Coordinators spoke of the benefit of having a high-ranking administrator in the position of Institutional Coordinator. One Academic Coordinator explained that her Institutional Coordinator's position at the university gave FGAMP a certain amount of respect on campus and made it easier for the project to persuade other high-ranking administrators to become involved with FGAMP. One faculty member commented that he and his colleagues felt "fortunate" to have their Institutional Coordinator, adding that her "personality" and "high energy" helped to persuade people to become involved with the project. This Institutional Coordinator knows students "intimately" and is always promoting FGAMP, reported the director of the honors program at that institution. "FGAMP has remained active and vital because of the people who drive it," observed a dean at a partner institution.

Interviewees identified several other factors that facilitate project implementation. According to a former Academic Coordinator, project implementation is facilitated by a strong student base that develops "ownership of the program," for then students can be counted on to help carry out the project. The current Academic Coordinator at that institution described how peer mentoring, in the form of juniors and seniors mentoring underclassmen, has helped the project along. Finally, the Project Director also spoke about how the State of Florida has contributed to project implementation by being proactive with institutions in increasing minority enrollment and graduates in STEM while recognizing that this is a good avenue to increase human resources for technology based industries in Florida.

Main Implementation Challenge

When asked about the biggest challenges faced in implementing FGAMP, Academic Coordinators and faculty members discussed several matters. Interviewees at almost every campus cited funding issues as a major challenge. Several faculty members mentioned their desire to see more available funding for FGAMP students, especially as they participate in research projects. One professor explained that at her commuter university many students work, and a larger stipend would afford students the "financial independence to truly apply themselves in their coursework and opportunities like research." One Academic Coordinator explained how a decrease in funding has made things more difficult, and they no longer try to recruit as many students as in the past. A faculty member at the same institution noted that if they had more money they could expand activities and services. The Academic Coordinator at another school reported that the biggest challenge that they are tackling is to wholly institutionalize the project on their campus by getting the institution to fund it entirely. She added that FGAMP coordinators at her institutions are continuing to lobby university leadership for this. To get FGAMP components and activities completely funded by individual partner institutions was identified by the Project Direct as a major challenge of the Alliance.

Faculty members and project coordinators also commonly identified time limitations as a challenge. Some professors spoke about how the busy lives of students and faculty made it difficult to find time to work together. At a large partner institution, the Academic Coordinator noted that a big challenge is keeping up with the 300-500 student participants. The former Academic Coordinator there explained that it takes a lot of energy to keep so many students involved, especially with students who participate in other clubs and are already doing so much.

At another large partner institution, the Institutional Coordinator reported that he has found running the project to be very challenging given that he is a full-time administrator who has his "hands full" running a very large department. Part of the challenge is that he is essentially starting the project anew given that when he recently inherited the position there was no overlap in project personnel. He noted that while it will take some time, they aim to build the project up because they recognize that there is much more that they could and should be doing.

A handful of faculty members discussed the challenges of being a research mentor. A couple of professors spoke about the tough task of finding research that is both interesting to students and at an appropriate level of difficulty. One professor commented, "If it is too easy they will become bored and disillusioned; if it is too difficult they will become very frustrated." Another professor agreed that it was difficult to find research projects that are a "good fit" for students, adding that the process takes time because he wants to make sure that "they all find their niche." A couple of other faculty mentors discussed the challenge of directing the research experience of some students who have had low quality pre-college training in subjects like math and physics.

The Academic Coordinator at a community college noted that they face the difficult challenge of "continuity" because they have students for only a year or two. She has tried to tackle this by reaching out to and working with the chairpersons at partner institutions to make them more aware and involved with FGAMP. A professor at another community college partner institution noted that recruitment has been a challenge because his school is located near two other Alliance partner institutions against whom they compete for FGAMP students. Another Academic Coordinator reported that her biggest challenge is making the program visible to the campus and recruiting new students. They have adopted a number of strategies, including producing more fliers, passing out information to all counselors, including a FGAMP brochure in student orientation packets, reminding instructors to inform students about FGAMP, and giving out a FGAMP student of the year award.

Lessons Learned

The Project Director and Academic Coordinators were asked about lessons they have learned through implementing the FGAMP project. The Project Director felt that FGAMP benefited greatly by learning to collaborate with other entities like the AGEP program. The Project Director believes that this example of collaboration and resource pooling has furthered opportunities for FGAMP students to participate in summer research, and helped FGAMP to succeed in reaching more minority students. Two Academic Coordinators spoke about the important benefits of peer mentoring. They find that peer interaction helps students to develop social connections within their majors, positively affecting student success. Emerging from the focus groups were ample student reports of the perceived positive impact of peer support and mentoring on their own success.

One Academic Coordinator spoke about how familiarity with institutional resources and being connected to other offices on campus is critical for it enables her to direct students to counseling and other support services. She also explained that her office's location in the math and science division facilitated her understanding of how the division operates and the dynamics between faculty and students. She describes this understanding as being "fundamental" to her work, for it allows her to better deal with students' complaints about a grade or a faculty member. She has learned that students count on her for more than academic assistance, for, as she explains, "I've had a million things come in through the door that had nothing to do with academics, but students needed assistance with personal things...some are very serious, some are minor, and some just want to come in and talk."

Several Academic Coordinators spoke about learning to be more patient with students. One explained that she now realizes that "every student isn't going to respond to her [assistance] and the program in the same way. College is a maturing process...many [students] come around in the end." A former Academic Coordinator said that he came to be more patient with students' progress through the realization that "one cannot judge future performance from a first impression." He referred to "diamonds in the rough" and spoke about the case of a FGAMP student who barely had the GPA to participate in FGAMP, but went on to attain a 4.0 during college.

One Academic Coordinator said she learned that students respond well to FGAMP once program expectations are clearly conveyed to them. She implemented "scholar contracts" so that students would understand the requirements of FGAMP and how to remain in good standing. An Academic Coordinator at a university with a large number of FGAMP students explained that he learned that he could not do everything by himself. He said that while he likes "to be in charge" and finds it difficult to "relinquish the reins," he now recognizes the need to delegate and to use the help of students in such project efforts as recruitment.

How Smoothly Does the Project Run?

Students and faculty were asked their opinions of how smoothly FGAMP operates on their campus. The overwhelming response was that the project runs "efficiently" and "smoothly." Several students said that FGAMP does a good job of communicating information and news to them via scheduled meetings, emails, and phone calls. At one school there is a mandatory weekly FGAMP meeting, and students are given the Academic Coordinator's home phone number. Students generally seem to feel that FGAMP keeps them well informed of conferences and other interesting opportunities. One student credited this success to the Academic Coordinator by saying "[She] is very well organized...There should not be a reason why [a student] doesn't know about something because [the Academic Coordinator] always finds a way to keep students up to date." At one university, however, a couple of students complained about the occasional delay of stipend checks which were sometimes delayed for an entire semester. Students, however, acknowledged that the holdup is probably due to the university's cashing system and not FGAMP staff.

The majority of faculty members reported that FGAMP runs "smoothly" and credited its successful implementation to the project's staff. Many compliments were paid to both former and current Project Directors, as well as individual Academic and Institutional Coordinators. The central office staff has done "an excellent job of keeping us all informed," stated one professor. He described the dedication of both the former and current Project Directors as being "outstanding" and "phenomenal." He recounted how the former Project Director was receptive to his institution's desire to develop more internships at the community college level. He said that this responsiveness by the FGAMP central office was an indication of its commitment to the project and its willingness to try out suggestions offered by faculty members and project staff. Another professor applauded the efficiency of the Project Manager and specifically praised the helpfulness of the reports she generates to inform faculty members of students' progress. Several faculty members commended the efforts of individual Coordinators. For example, one professor praised his Institutional Coordinator's dedication to FGAMP students recounting how "[he] is there at the college all of the time...[he] even gives out early morning appointments to students on the weekend."

Collaboration among Alliance Partners

According to the Project Director, the central office has played a significant role in fostering collaboration among partner institutions. The Project Manager said that as the lead institution, FAMU has the ability to see the "big picture" in terms of LSAMP's future, while also ensuring that partner institutions have an equal role. All of the Institutional Coordinators seem pleased with the role that the lead institution has taken in guiding the direction of FGAMP. They described the leadership of the Alliance as being "excellent," and staffed by "committed" and "dedicated" people. When speaking of FAMU's role in the project, one Institutional Coordinator noted, "They are responsible for getting us where we are right now and I want them to continue to do that." Another Institutional Coordinator commented that FAMU's role was fitting because, "they have been the flagship institution in terms of producing STEM graduates." He added that their leadership has been very effective, and specifically praised the work of the Project Director and other central office staff for helping to maintain excellent relationships within the Alliance.

Many interviewees, including the Project Director, consider the annual Career Expo as a key mechanism by which collaboration takes place among Alliance partners. According to one professor, "faculty share ideas, content of courses, and other things" when they are together at Expo. A handful of faculty members interviewed said that they had worked with professors from partner institutions in planning conferences, workshops, and events like Expo. One professor reported that he frequently meets FGAMP faculty at conferences and if they are working on similar research they will bring their students together and attend the conference as a joint team.

Nearly all of the Institutional Coordinators view steering committee meetings as being integral to the manner in which Alliance partners collaborate. These meetings were described as a "good channel of communication," a "sharing of best practices," "where most of the decisions are made," and an effective way to gain consensus from partner institutions. The meetings are said to give participants "a chance to explore possibilities and ideas that improve the performance of students." It is reported that most steering committee members have visited partner institutions to see for themselves what other schools are doing. One Institutional Coordinator noted that the GPRA report is regularly referred to in the meetings, thus focusing steering committee members on the same goals and priorities.

Institutional Coordinators discussed ways that FGAMP collaborations have benefited their institutions. According to the Project Director, the main benefit is that they are able to accomplish more than they had been able to previously, or individually. Interviewees spoke about how Alliance collaboration results in joint sponsorship of FGAMP workshops and Expo, as well as facilitates institutional recruitment and transfer. For example, an Institutional Coordinator from the south of the state explained how he assists a partner institution from the north to recruit at his institution as well as in his region by passing along contact information of local high school counselors and principals.

Interviewees also discussed how collaboration among Alliance partners enhances the impact on student participants. Interviewees spoke about how interaction among partner institutions results in "cross pollination," that generates valued experience and knowledge. In the words of one Institutional Coordinator, "You learn more and gain more; it's as simple as that." Other Institutional Coordinators told of how they would derive valuable information from an Alliance meeting or activity and share that with other project staff or faculty members at their institution. Alliance collaboration, as pointed out by several interviewees, also benefits students by allowing them to network with other students of like interests at partner institutions, as well as with faculty from graduate institutions.

FGAMP has also developed collaborative relationships with other programs like HBCU-UP and SECME, Inc. (Southeastern Consortium for Minorities in Engineering). The collaboration with HBCU-UP has helped to fund effective teaching skills training for STEM discipline faculty members and helped bring FGAMP, AGEP, and C-STEP students together for a summer research presentation series. FGAMP's collaboration with SECME, Inc. focuses on student recruitment. Their arrangement involves a SECME employee who travels to high schools and college fairs informing students about engineering fields while at the same time talking to students about the FGAMP program and the opportunities it offers students. Both of these collaborations are examples of FGAMP's attempts to pool the resources of programs and activities with similar goals and increase student outreach.

On the whole, interviewees identified few problems associated with collaboration within the Alliance. According to the Project Manager, the main challenge to collaboration is "quick, swift, and timely" communication among partners. She felt that the demands of the primary positions held by the professors, deans, and presidents involved with FGAMP prohibited them from providing "undivided attention" to the project. Some of the interviewees indicated that the geographical dispersal of the partner institutions throughout the state makes it difficult to collaborate with all the partner schools. As explained by one Institutional Coodinator, "distance is a big problem in a state as long as Florida. Somebody has got to fly, and that means that you can have only a few students attend activities." Some interviewees pointed out, however, that collaboration often occurred regionally; schools within the northern, central, and southern regions of Florida would interact and collaborate amongst themselves to organize workshops and programs for their students. As an example, one Institutional Coordinator recalled how his institution and other nearby partner institutions recently shared the cost of buses in order to transport students to Expo. Another Institutional Coordinator said she hopes that FGAMP would formalize and strengthen regional activities because this would decrease travel for participants and thus increase overall involvement in Alliance activities. She also pointed out that given the increased focus on graduate education in Phase III, partner graduate institutions should host more of the regional Alliance activities.

Overall, Institutional Coordinators see the collaborative relationships within the Alliance as working very well. Many of them felt that their relationships had strengthened over time and were supported by one another's commitment to FGAMP goals. The Project Director perceives partner institutions as being very "comfortable" with one another, and that this aids their collaborative efforts. He added that the Alliance has continued to improve activities like Expo that foster faculty and student interaction.

LSAMP Participants

Profile of Participants

Characteristics of Typical Level I Participants

When asked to describe the typical Level I FGAMP student, faculty members and project staff reported that FGAMP students tend to be "mature," "motivated," "promising," and high academic achievers. A number of professors noted that FGAMP students tend not only to be at the top of the class, but that they seem more focused because of their greater understanding of graduate school admission requirements. FGAMP scholars are more confident because they know that if there is a problem there are others to assist them, reasoned one professor. Another professor noted that after some interaction, FGAMP students "are not afraid to ask questions, or even to challenge you," and that this confidence probably develops as a result of the presentations that they are required to make. Others said that FGAMP students seem more "driven" than other undergraduates and feel a greater "obligation" and "urgency" to succeed because of the FGAMP stipend that they receive. "I can see that FGAMP students, because of their involvement in the program and the discipline and structure it provides, seem more conscious and aware that they are expected to be successful," reported one professor.

Preparation for Coursework

The general feeling among the faculty members interviewed is that FGAMP students are well prepared for college level coursework. One faculty member commented that while FGAMP students are well prepared, the value of the program is that it also serves those considered to be average students. Some professors said that while they were impressed with FGAMP students' academic capability, they were also impressed with their initiative in seeking help when necessary. All of the faculty members interviewed felt that either most or all FGAMP students were appropriately placed in classes.

Main Strengths and Main Problems Encountered

When faculty members were asked to identify FGAMP participants' main strengths, they again spoke about such qualities as being "motivated," "committed," "focused," "diligent," and hard working. One professor said that because of their FGAMP participation, students really believe that they can succeed in fields where there are few minorities. Another professor said that FGAMP students possess "a strong degree of dedication to doing well" because many have "other things pulling at them" and have had to sacrifice a lot to attend college. One professor attributed FGAMP students' focus and determination to the fact that the project informs them of the career and education opportunities that await after graduation. Because FGAMP students tend to be academically strong and "very disciplined," it is "easy to mentor these type of students," observed one professor.

During the interviews faculty members were asked to describe the main problems FGAMP students encounter in their classes. Most faculty members said they observed little or no significant problems with students, or that the problems they observed were similar to those experienced by the general student population. A couple of faculty members spoke about how some FGAMP students experience academic difficulty because of weak high school preparation. One professor pointed out that the FGAMP project has helped to address deficiencies in students' math backgrounds by "bringing them to the surface" and forcing engineering and math faculty to deal with the issues. Some faculty members spoke about how some FGAMP students get "overloaded" as they struggle to help their families by maintaining a part-time job while going to school full-time and studying difficult STEM subjects that demand a lot of time.

When asked about the difficulties they encountered as STEM majors, students offered a range of responses. A few students discussed problems with scheduling classes; some complained that important courses are offered only once a year, instead of every semester. These students reported that FGAMP staff members have advised them on better ways to structure their course load. Other students, however, mentioned that they experienced difficulties gaining academic and career advice from professors in their departments. One of these students explained that professors tend only to suggest the same career path that they themselves had taken. The general feeling among FGAMP students in the focus groups was that when problems with courses or faculty occurs, FGAMP staff members serve as "sounding boards" and tend to be helpful in resolving problems.

Participants' Experiences with LSAMP

<u>*How Learned about LSAMP?*</u>

FGAMP students learn about the program through a number of avenues. The most common means is through friends, though several students mentioned hearing about the program from professors or academic advisors. A number of students said they had been recruited via letters or emails. Some students said they became aware of the program while they were in high school or while searching for scholarship money. Of focus group participants, a few at four-year institutions had transferred from a two-year college. One of these transfer students learned of FGAMP from an academic advisor who was helping him plan his transfer. None of the transfer students, however, were involved with FGAMP while enrolled in community college.

<u>*Expectations of LSAMP*</u>

Focus group participants were asked about the expectations they had of FGAMP when they first applied to the program. Although students gave a variety of responses, one of the most commonly cited was the expectation of getting financial assistance. Students view the FGAMP stipend as a means to spend more time studying and less time working. Several students spoke about how they expected FGAMP to help them make connections with "similarly minded" people in their discipline with whom they could do homework and discuss academic problems. Students also expected FGAMP to provide networking opportunities. One student who aspires to graduate studies said he knew that FGAMP was recognized throughout the state and felt that his involvement would make him attractive to graduate schools. Some students reported that they applied to the program because of the research and internship opportunities, while others mentioned the attraction of the mentoring and tutoring features. Several students explained that they wanted to take advantage of the "head start" provided by the summer program.

The majority of students reported that FGAMP has exceeded their expectations. In one focus group, most students said they were not aware of the full scope of FGAMP when they initially signed on to the program. Several students said that the support they have received from the FGAMP office has far exceeded their expectations. One student explained that the program exposed her to opportunities that she would never have been aware of, and added, "It is comforting to know that if I have any problems I can go to the LSAMP office. It is the only place on campus that I can turn to with these issues." Several students mentioned that FGAMP helped them learn what graduate school is about; how to put together a successful graduate school application; and, to prepare for their transition from undergraduate to graduate school. A handful of students, however, expressed some dissatisfaction with FGAMP. These students mentioned being disappointed at not finding a research opportunity related to their major, not receiving internship information, and not finding faculty mentorship. One student said that she knew that she was not getting as much as she could from FGAMP but faults herself for not being as involved as she could have been.

Participant Access to LSAMP Services

The overwhelming majority of students said they had no problems accessing FGAMP services on their campuses. One student commented, "Any difficulties that I've had have been corrected. [The Project Coordinator] does a really good job; she does exactly what she's supposed to do." Other students mentioned that FGAMP project staff were very accessible and often helped them resolve personal and academic problems. Overall students appeared happy with the services being offered to them. One student, however, raised the issue that there simply aren't that many FGAMP services available on her campus, but acknowledged that FGAMP staff members there are currently focused on expanding services and activities.

Student Ratings of LSAMP Services

When asked which FGAMP services were the most helpful, students spoke about a wide range of program components. Several students discussed their appreciation of the EXPO conference and how it allows them to network, secure internships, and improve their presentation skills. One student said he was encouraged to see so many other minorities who are "at the top of their game," and added that EXPO inspired him to pursue a Ph.D. According to the Project Manager, internal evaluations show that students commonly identify EXPO as the "most beneficial" activity. Students also spoke about the rewards of doing research, and the helpfulness of being able to present on the progress of one's research work. A couple of other students reported that mentoring from professors and graduate students were the most helpful aspects of FGAMP. "Being able to talk to a [graduate student mentor] who was more of a peer and who had gone through the same thing as me was very helpful," commented one student.

Several students identified receiving information from speakers, workshops, and project staff as the most beneficial feature of FGAMP. Information on internships, scholarships, and graduate schools is said to be most commonly disseminated through email and FGAMP meetings. Moreover, students at FGAMP campuses that have a FGAMP club or student organization generally seemed very pleased with the social aspect of the project. Some spoke about how FGAMP club meetings helped them to get to know peers, while others spoke about how taking on an officer position within the club allowed them to develop leadership skills.

The overwhelming majority of students could not cite any service that they felt were not useful. As one student explained, none of the FGAMP components are "irrelevant" because all are offered for a purpose. This was the general feeling regarding project services. One student, however, expressed concern that the FGAMP stipend seems to be getting increasingly smaller. Another student said that the research component could be improved if project staff offered more assistance in arranging such opportunities with professors.

Project Effectiveness and Impact

Staff Perceptions of Project Effectiveness and Major Successes

FGAMP staff members were asked if they felt the project's approaches and strategies were effective. All of the Academic Coordinators interviewed expressed a belief that FGAMP strategies are very effective in meeting the needs of their students. Some coordinators spoke about how FGAMP is particularly effective in exposing students to new opportunities, namely internships and graduate school programs. One Academic Coordinator stated that the effectiveness of FGAMP is evidenced by FGAMP alumni who return to campus as industry recruiters and request to interview only FGAMP students. According to a Dean of Engineering, FGAMP does a great job of informing students about graduate school. He added that this is an important function because many highly qualified students may never consider graduate school. According to departmental chairs at one institution, FGAMP is particularly effective at helping students to get into and prepare for graduate school, and this is much needed at institutions that enroll a majority of first-generation college students. According to one Academic Coordinator, FGAMP is effective in bringing about student success precisely because it "nurtures" students and gets them to believe in themselves.

When asked about FGAMP's major successes, interviewees discussed such accomplishments as having increased the rates of community college transfer, college retention, college degree attainment, and graduate school attendance. The Project Manager identified EXPO as a major success of FGAMP. According to her, this activity not only brings together students from "different walks of life" and "cultures" to network, but it also increases students' ability to obtain internships and job placements.

Impact on Students

During the interviews many project staff members, professors, and school administrators spoke about how FGAMP positively impacts students. They discussed how the project strengthens student commitment to STEM fields, creates a supportive community for students, and provides valuable professional development. Most importantly, perhaps, interviewees talked about the many ways that FGAMP helps its students to succeed academically. Both faculty and students discussed how the FGAMP stipend helped students to stay focus on their studies, and allowed them to get paid for working in an area relevant to their future goals instead of working in unrelated jobs. An Institutional Coordinator said that STEM retention is facilitated by the "camaraderie" among FGAMP participants as they support one another in difficult courses: "If you're in a challenging course and you're struggling and you're communicating with others that are struggling, you realize that you're all struggling and therefore maybe can make it through together. Whereas, if you feel like you're by yourself you may not have that same comfort." Several Academic Coordinators noted that they had collected data supporting the positive impact of FGAMP by showing that FGAMP scholars tend to achieve a higher GPA than other students; scholars' grades tend to improve while in FGAMP; and, those who took greater advantage of project services tended to perform better academically.

Interviewees also expressed a belief that FGAMP helps keep students on the STEM track while in college, and facilitates further pursuit of STEM in graduate school. According to the dean of arts and sciences at one partner institution, the biggest impact of FGAMP, is assisting students to explore and remain in STEM. He explained that FGAMP students are much less likely to become overwhelmed and to drop out of STEM because FGAMP helps students to make informed academic decisions earlier on, introduces them to STEM related experiences outside of the classroom, and exposes students to various areas in STEM. He commented that if FGAMP students switch out of a field, it is often to something else within STEM. One professor noted that the project affects how students look at graduate school, as they come to see that an undergraduate degree is not the end and that they need to go further. Students reported that FGAMP activities give them a "good sense" of what to expect from graduate school and help them to compete in the graduate school application process. Many credited their research and presentation experiences as providing them with the confidence to continue on in STEM fields.

Some interviewees talked about how FGAMP has created a nurturing and encouraging environment with lots of interaction for participants, and how this support promotes success. One student said that FGAMP served as an "inspiration" to succeed and strengthened his desire to be a role model for other students. A few students credited the encouragement and support they received with increasing their self-confidence and drive to attend graduate school. One professor reported that the "major thing" about FGAMP is that "it builds a cohort" that allows participants "to get to know each other, share ideas, and network." In the words of a former Academic Coordinator, FGAMP "prevents them [students] from feeling isolated." He reported that the participants that he has spoken with seem to really "treasure" their experience. One professor spoke about how FGAMP peer interaction frequently takes the form of more mature students serving as role models who influence younger ones to concentrate on academics. A vice president of institutional effectiveness at one institution says she sees FGAMP students as "a very close knit group of students" and knows from retention studies that it is important for students to feel like "they are a part of some community." She added that it is because of this group experience, which allows students "to feel unique within a larger set," that FGAMP students are more likely to graduate with a STEM degree.

Many interviewees spoke about how FGAMP has provided valuable professional development to participants through research experience and career advisement. "FGAMP has improved the university experience for students," observed one administrator who feels that the opportunity to do research and present scientific findings constitute a "high point" in students' academic careers. Since 1994, FGAMP has secured more than 1,133 summer internships for eligible FGAMP scholars[6]. Other professors noted that the hands-on research experience keeps students interested in STEM subject matter, while simultaneously "beefing up" their resumes. A faculty member commented that FGAMP helps students to feel and behave like "scholars." Several faculty members also discussed how FGAMP students gain "a better career orientation" and greater understanding of the kinds of careers that are possible in STEM and "how the research aspect fits into that." Likewise, students spoke about how FGAMP shows students the value of various STEM degrees and that those are "good majors that could get you far in life." Many first-generation college students do not understand that college is about more than attending class, taking tests, and getting good grades, observed one professor. He feels that FGAMP provides career advisement that shows students what is available to them including a career in research.

Impact on Institutions

The FGAMP program has affected Alliance institutions by increasing partner institutions' capability to retain and graduate a larger number of students in the STEM fields, impacting the way that faculty view students and their ability to do research, and influencing certain institutional procedures. The belief that FGAMP has improved retention rates within STEM disciplines was widely expressed by interviewees. As noted in a FGAMP annual report, the total number of STEM minority graduates at FGAMP institutions has "quintupled" since 1991, increasing from 416 to 2,319 in 2002[7]. According to one dean, FGAMP students tend to do better in their coursework because of the "help function" that is built into the project, which may take the form of help sessions, tutoring, computer assistance, and peer mentoring. Furthermore, he pointed out that while FGAMP works with a range of students, it is making a particularly impressive impact on those who are considered "average" students. An increase in institutional capability to bring about greater achievement in its students entails certain rewards, for as

[6] Data taken from FGAMP 2002 annual report.
[7] Data taken from FGAMP 2002 annual report.

one administrator noted, FGAMP brings recognition to her institution and serves as "a great recruitment tool." Another administrator stated that an "indirect" effect has been the subsequent addition of programs similar to LSAMP, like the McNair program, at partner institutions.

Program coordinators and administrators also spoke about ways that FGAMP has helped bring about change at their institution. A few program coordinators talked about a continuous change in campus culture and faculty attitudes towards students as a result of FGAMP. More specifically, one interviewee credited FGAMP with increasing dialogue among faculty about effective "teaching and learning strategies." Another interviewee noted that, "There is a change in culture or behavior to the extent that faculty have opened up their research labs to undergraduates." Another individual agreed saying that faculty has "seen minority students doing things that they [faculty] might not have normally thought about them doing before." Some faculty members suggested that the research component of FGAMP helped promote the idea of undergraduate research throughout the campus. At one partner institution, the science division just passed a rule that any faculty member who submits a research project that includes students, must now spend a certain amount of time supervising the student(s) on the project. According to the Program Director, "partner institutions now approach STEM education as a holistic venture."

Other interviewees spoke about how FGAMP has impacted institutional recruitment, information dissemination about research opportunities, the course-taking pathway, and student advisement at their institution. For instance, a description of the FGAMP Program is now included in the recruitment efforts of the admissions office at two partner institutions. In another case, while developing a research opportunity database for FGAMP, one Institutional Coordinator realized that this tool could benefit the larger student body. This database now helps all students gain access to science research internships and assistantships. At a couple of institutions, FGAMP's system of individual academic advisement has influenced the institution's advisement procedures. One program coordinator explained that through discussions between campus administration and FGAMP staff, his institution no longer allows students to take courses "out of sequence." In the past this lack of structure in this area reportedly caused student frustration and angst. Another Coordinator said that while FGAMP's system did not directly affect their school's decision to begin assigning students a permanent academic advisor, the task force that mandated this change was fully aware of FGAMP's success with this type of student advisement.

Institutional Support and Institutionalization

All of the Institutional Coordinators appeared pleased with the amount of support FGAMP receives from their institution. Several interviewees expressed appreciation for the "top-down" support and high responsiveness that their institutional administration has provided. Some coordinators specifically praised top administrators at their school for their involvement in FGAMP governing boards and management. One Institutional Coordinator observed, "Our former president was and is extremely supportive of the program. He would actually travel to Washington, DC to visit the National Science Foundation himself to testify about the program, whereas other institutions would generally just send letters of support."

A vice president of academic affairs at one institution said that she could not imagine a time in the future when the institution's commitment to FGAMP would not be there. She considers the program to be a "successful" vehicle in getting students involved in areas where they are underrepresented. Project staff members expressed much appreciation for the high level of support shown by institutional administrators and credit it with the positive campus-wide support they receive. One Institutional

Coordinator noted that they have been recognized in the dean and president's academic assemblies and that during these academic recognition ceremonies, FGAMP students usually "lead the bunch" because the "group is looked upon as having the most outstanding graduates." According to another Institutional Coordinator, the "biggest support" has come from faculty members who "take students into their labs and work with them one on one."

When asked about the support FGAMP receives from Alliance partners, interviewees discussed the matching scholarships and in-kind contributions made by the partner institutions. As an example of in-kind monies, several coordinators mentioned the institutionalization of FGAMP Coordinator salaries. The Project Director and project staff members talked about the annual $640,000 award FGAMP has continued to receive from the Florida State Legislature since 1993.

Institutional Coordinators and school administrators also talked about observing evidence of institutionalization on their respective campuses. One Institutional Coordinator estimated that institutionalization began in the third year of the program, while some feel that it began as institutions prepared for Phase III explaining that that was when the project "stepped it up" and began to follow an institutionalization model. Another Coordinator reported that at his institution planning for institutionalization began two years ago when they were unsure about whether they would be approved for Phase III funding. Given this concern, the Project Director asked each Institutional Coordinator to put together a plan for institutionalization. The Project Manager spoke about the development of an institutionalization model, which offers guidelines on how to secure funding and how to institutionalize the project at partner institutions.

Project Evolution and Future Plans

The Project Director discussed ways that the Alliance has evolved over time. He said that in Phase II, FGAMP expanded its student recruitment efforts by collaborating with SECME, Inc. and placed priority on transitioning community college students to four-year institutions. Several interviewees agreed that Phase III introduced a stronger emphasis on getting STEM students into graduate school programs. The Project Director pointed out that such modification in programmatic focus has been undertaken in response to the direction of NSF. In accordance with this change in focus some FGAMP institutions dissolved their pre-college summer programs in order to concentrate more on entrance into graduate school. FGAMP projects began to develop activities and initiatives like the lead institution's Graduate Feeder Program in order to orient students toward graduate school. While programmatic priorities evolved FGAMP also saw changes in the composition of the Alliance. In Phase II, Clark Atlanta University left FGAMP to lead the Georgia Alliance. In time, Florida Memorial University and the University of Miami joined FGAMP. Florida Memorial was included because of its large African-American student population and the University of Miami, well known for its graduate school programs, suited the graduate school focus of Phase III.

Many of the Coordinators were confident that their institutions would at least maintain portions of the FGAMP project when NSF funding ended. Interviewees planned to supplement NSF funding with additional monies from private sources, competitive grants, and alumni support. Several Coordinators said that the state of the economy makes it difficult to raise money, but that they were nonetheless committed to preserving FGAMP activities. The Project Director said he hopes to earmark additional scholarships and fellowships for FGAMP scholars through money from private industries and foundations. A vice president of academic affairs at one partner institution, who expressed great interest in maintaining the success of Florida's articulation agreements, said she is working towards maintaining local collaborations between partner institutions. She added that FGAMP is working on plans to keep the statewide collaborations between partner institutions strong, even after NSF funding ends.

Some of the institutions have been successful in soliciting funds from outside sources, and those who have successfully fundraised spoke about their efforts. The Project Director explained that the data collected on student performance, retention, and graduation rates helped in their successful lobbying efforts for funding from the state legislature because "the respect that the program has gained over time is a major factor in leveraging additional funds." He also mentioned that in the future they expect media exposure to assist them in attracting financial support. An Institutional Coordinator pointed out that NSF's support has brought the project "prestige and leverage," and that without NSF, "we couldn't have gotten money from the [Florida State] legislature."

Recommendations

The majority of comments made about the FGAMP project were overwhelmingly positive, as interviewees seemed to appreciate its beneficial effects on students and the campus environment. When asked about ways to improve the project, students, faculty members, and administrators offered several suggestions. For example, FGAMP community college students said that they would like to have more contact with FGAMP staff and faculty at four-year schools. While students were pleased that they were included in activities at local four-year colleges, they hoped that in the future they would have more of an opportunity to ask questions and gain a fuller understanding of the FGAMP projects at other institutions. FGAMP community college students also expressed a desire for more assistance from FGAMP staff with the transfer process. One student suggested that perhaps a "one on one relationship" could be established with a faculty member or FGAMP staff member at a four-year institution in order to assist with the transfer process.

A substantial number of faculty members recommended that FGAMP institute some form of mentor training. One faculty mentor said she wanted to see the mentorship component become more formal, since "the student component is very well documented, but the mentorship aspect is not. More documentation would be helpful as a guide." She felt that mentors were all operating within their own "bubble" when they should instead be sharing their experiences with each other. Some suggested a mentor orientation that informed faculty of FGAMP expectations and guidelines, while others recommended a FGAMP sponsored half-day workshop addressing "keys to successful mentoring." Faculty mentors expressed interest in interacting with each other and exploring effective mentoring techniques.

Students were very interested in increasing their exposure to internship opportunities. At one campus, some students voiced a concern that the internship information they received was not representative of all STEM disciplines but more limited to the engineering field. Some underclassmen expressed worry that they are under qualified for many of the available internships and thus would like access to more "shadowing" opportunities. Some students said that it would be nice if the project could directly procure a number of internships or shadowing opportunities specifically for FGAMP students.

While students appreciate opportunities through FGAMP to network with professors and other students in STEM, some students expressed a desire to make more of these types of connections at the regional or national level. In addition, there were calls to expand such opportunities for community college students through increasing research opportunities for them at universities or in the private sector. One student suggested that LSAMP develop an "AMP exchange program" that would allow students to study at other LSAMP institution for some established amount of time.

Several students suggested that FGAMP incorporate more social activities for students on their campus, as this would be a "good way for people to get to know each other." On campuses where these types of FGAMP social events already take place, students reported that these activities provided them with opportunities to both encourage one another and to bond with those in their majors.

Some students and faculty members recommended that FGAMP increase advertising efforts on campus and recruiting efforts in high schools. A few interviewees said that they didn't feel that the average student on their campus knows about FGAMP. Some suggested making information about FGAMP more accessible to students and faculty by creating a "web presence" for the project. One idea advanced is to insert a direct link to FGAMP on the home pages of partner institutions.

Many interviewees suggested that FGAMP find a way to increase funding. Again, faculty members talked about how the stipend eases financial pressure on students and helps them to focus on school. Some professors noted that an increase in funding would enable the project to involve more students and to scale up activities. More money for student travel, for example, would motivate a greater number of students to pursue conference submissions, explained some interviewees. Students on one campus voiced that they have watched their stipend decrease over time and feel that these cuts are discouraging students from participating in FGAMP. Some faculty expressed a desire to receive more direct financial support from FGAMP and its partner institutions for such things as supplies or student travel to conferences. A few faculty members suggested that their institution begin providing release time for those faculty members who are involved with the project.

Finally, there were recommendations to improve the project by increasing such offerings as personal development seminars, workshops on resume writing, and opportunities to participate in mock interviews. Some of those engaged in FGAMP activity planning spoke about plans to expand program components. For example, one institutional administrator said that he looked forward to "building up a circuit of speakers for a weekly colloquium for FGAMP," and that he hoped to include the "colloquium" in their institutionalization plan. Some interviewees also spoke about their disappointment that FGAMP no longer offers a Summer Bridge. One student described Summer Bridge as the perfect opportunity for freshman to get accustomed to college life and college courses like Pre-Calculus, Trigonometry, and Biology. A faculty member who was heavily involved with FGAMP said that he misses the summer program because it allowed them to recruit very good students.

III. LSAMP Case Study: New York City Alliance

Introduction

This case study is based on information collected through site visits to six institutions belonging to the New York City LSAMP Alliance: City College, Borough of Manhattan Community College, College of Staten Island, Herbert Lehman College, Medgar Evers College, and Queens College. A team of Urban Institute (UI) staff that included Dr. Beatriz Clewell, Laurie Forcier, Ella Gao, Dr. Lisa Tsui, and Nicole Young visited three CUNY institutions in November 2002 and another three institutions in March 2003. During these site visits the team conducted both interviews and focus groups with project administrators, Site Coordinators, Activity Coordinators, department deans and chairpersons, faculty members, student participants, and coordinators of similar programs (i.e., C-STEP and M-RISP).

Project Description

The New York City Louis Stokes Alliance for Minority Participation (NYC LSAMP) has been in existence since November 1992. They are one of five alliances funded as part of the second LSAMP cohort and are currently in Phase III of their project. The NYC LSAMP is comprised of 16 colleges from the City University of New York system (10 four-year institutions and 6 community colleges) as well as the CUNY Graduate Center. The 10 four-year institutions are: Baruch College, Brooklyn College, City College, the College of Staten Island, Hunter College, Lehman College, Medgar Evers College, New York City Technical College, Queens College, and York College. The six community colleges are: Borough of Manhattan Community College, Bronx Community College, Hostos Community College, Kingsborough Community College, LaGuardia Community College, and Queensborough Community College. Although the NYC LSAMP technically has no "lead" institution, the central administrative office for the alliance is located at City College as are two of the Principal Investigators. The third Principal Investigator is located at Medgar Evers College.

According to data found in the NSF MARS database for reporting year 2002, the NYC LSAMP serves 238 Level I participants[8], of whom 60% are male and 40% female. Participants' racial/ethnic breakdown is as follows: Black--60.9%, Hispanic—32.8%, Asian/Pacific Islander—2.5%, Non-Minority--0.4%. The remaining 3.4% represents unknown or missing data.

Administrative and Governance Structure

Lead Institution and Staff

The administrative center for the CUNY Alliance is City College, where the Project Director, who is also one of the Principal Investigators on the grant, is based. NYC LSAMP leaders, in the interest of fostering equal partnership among Alliance members, are emphatic in stating that City College is not a "lead institution" but a "central office" or "administrative center" for the project. The Project Director of the Alliance also serves as a professor of Civil Engineering, the Director of the CUNY Institute for Transportation Systems, and a Co-PI for the Alliances for Graduate Education and the Professoriate Program (AGEP), another NSF-funded project. The Project Director reports to the Governing Board and

[8] For the purpose of this case study, Level I students are those students who are identified in the MARS database as having received LSAMP funding during the summer or academic year.

sees his role as "keeping people focused on the overall mission [of the Alliance]." The Project Administrator for the Alliance, who is responsible for its day-to-day operations, holds no other positions within the institution. He interacts with the affiliate campuses and is the first point of contact for Steering Committee members. He also works directly with the City College LSAMP students and with involved faculty, meeting each semester with all students and reviewing their transcripts. Several Level I participants at other Alliance institutions indicated that they, too, meet regularly with the Project Administrator. The Alliance office also employs part-time student assistants and a newspaper editor who is responsible for producing four newsletters a year.

LSAMP project staff who work directly with the City College component of the project include the Site Coordinator, who is also the Deputy Provost and Professor of Electrical Engineering, and an Activity Coordinator, who is a graduate student at City College. The Site Coordinator sees his main functions as promoting the ideas of LSAMP at his institution and working with the Activity Coordinator and Steering Committee members at the College to implement the project. The Activity Coordinator works with faculty mentors, organizes LSAMP-sponsored workshops, assists in writing the annual report, supervises students in the Learning Center, advises students and answers questions about the project, and participates in recruitment efforts. (Projects at other Alliance institutions follow this staffing pattern: Site Coordinators, who are typically high-level administrators, generally report to their presidents or provosts and facilitate project implementation by presenting the project to the faculty and administration. Activity Coordinators are graduate students in STEM majors who directly oversee the NYC LSAMP sponsored activities.)

Project Location within the Institution

The NYC LSAMP office at City College is located "for purposes of convenience" in the Institute for Transportation Systems, which is part of the Department of Engineering, because the Project Director is also the director of the Institute. According to the Site Coordinator at City College, however, the LSAMP has its own independent status on the campus and within the CUNY system. For the other Alliance members, the location of LSAMP offices varies across institutions, with the location of the Site Coordinator being the main determinant for placement within the institution. For example, the LSAMP project at one college is located in the Mathematics Department because, as the Site Coordinator explained, "my roots are there, and that's where I had the most faculty involvement." LSAMP projects may also be located in an institutional unit where other similar projects are located, as is the case at another Alliance member institution.

Advisory Committees

According to the Project Director, the LSAMP project at CUNY has a Governing Board that meets every semester and is made up of five presidents of Alliance institutions who serve on a rotating basis; one faculty at-large; one student at-large; the CUNY Vice Chancellor for Academic Affairs; the CUNY Dean for Research; and representatives from the New York Board of Education. This Board, in the words of the Project Director, "serves as a watchdog on policy." As mentioned above, the Project Director reports to the Governing Board on project activities and plans and receives feedback and approval from the Board. NYC LSAMP also has a Steering Committee made up of one senior level administrator from each of the participating institutions (reappointed annually by the presidents). The function of this committee is to provide operational direction to the project PI's. Members are responsible for translating approved initiatives into action and each Steering Committee member is responsible for sharing the information from Committee meetings with their respective campuses. The Committee meets once a month. Operating under the Steering Committee are a series of subcommittees:

- Research and Teaching Committee (one Steering Committee member and one PI), with a focus on pedagogy, course restructuring, mentoring, and linkages to K-12 teaching careers.

- Transitions Committee (one Steering Committee member and one PI), with a focus on restructuring issues such as gatekeeper courses and articulation agreements.

- Agency-Industry Support Committee (representatives of industry and national labs), which focuses on strategic planning, fundraising and building business, industry and agency support for the NYC LSAMP.

- Industrial Relations Committee (CUNY designees and industrial partners), which serves as an external support group to the Agency-Industry Support Committee.

Most Alliance institutions also have a Campus Steering Committee, which usually consists of the Activity Coordinator, faculty members involved in the LSAMP project, and deans of STEM schools or department chairs of engineering or science departments. These institutional-level steering committees meet regularly. Their function is to ensure that campus-level activities are consistent with the overall LSAMP mission and goals. Other functions vary according to the campus. For example, some of the Campus Steering Committees do the "nitty gritty" work of implementing LSAMP activities on campus. Others help to recruit students to the project, work on course restructuring, help to identify tutors and faculty mentors, etc.

Project History and Background

The Project Director attributes CUNY's push to secure LSAMP funding to the desire of a previous Chancellor to pull the various STEM intervention programs at individual system institutions into one coordinated effort. The Chancellor was particularly interested in involving institutions across the CUNY system, including community colleges. Several of the current Site Coordinators at the Alliance institutions as well as the current PI's were involved in the initial effort to write a proposal to secure NSF funding to support a system-wide pipeline program such as LSAMP. These were individuals who had already been involved in running other minority STEM programs and who knew one another because of this interest. The Project Director was someone who had been particularly active for several years in promoting and implementing pipeline programs to increase minority access to STEM majors. The partner institutions in the Alliance, therefore, were those that chose to be part of the proposal and that, typically, had a track record of having implemented similar initiatives at the campus level.

Before NYC LSAMP was funded, individual CUNY institutions had several LSAMP-like programs such as the Career Minorities Scholars program, which began in 1989 with ten institutions. Several of these programs, such as STEP, CMI, and C-STEP, continue to co-exist with LSAMP. For example, RISE, an NIH-funded project to increase the number of minority researchers in the biomedical sciences, is located on the Hunter College campus. Medgar Evers Community College participates in MARC, MBRS and C-STEP projects for minority students as well as a Bridges program that they operate in collaboration with Kingsborough Community College.

Goals and Strategies

<u>Project Goals</u>

According to the Project Director, the goals of the project are congruent with the CUNY system's goals and "reflect what the institution is trying to do." He explained that as a minority-serving system CUNY has traditionally been involved in similar programs to increase minority representation in areas of underrepresentation. The project goals are:

- Double the success and retention rates of underrepresented STEM students in two-year, four-year and master's and doctoral study
- Facilitate the transition of community college students to senior college, senior college students to graduate schools, and master's degree students to doctoral programs
- Enhance the research skills of underrepresented students as preparation for graduate studies as well as for employment as researchers and educators
- Enhance the skills and potential of K-12 and college STEM teachers and to increase the number of well-prepared students who select teaching as a career.

The Project Director commented that the goals had remained "fairly consistent." Another staff member, however, commented that an earlier goal had been to double the success and retention rates of underrepresented social and behavioral science students, but that this goal has been dropped by NSF.

In discussing their understanding of the project goals, Site Coordinators, university administrators, and faculty pretty much agreed that one of the project's goals was to increase the participation of underrepresented groups in STEM. Some interviewees took a narrower view of project goals and said that they thought that the project's purpose was to provide mentoring and research experiences for minority students in science or to encourage minority students to go to graduate school and obtain Ph.D.'s. At least one respondent said that the project was to increase student awareness of various fields and to provide them with "research which goes beyond what they would normally get in their classroom." Another felt that the project's goal was to stimulate student interest in math and science and [get students to believe] that they can do well in physics or mathematics. As might be expected, those who had a more limited involvement with the project (such as faculty members who serve only as research mentors) were less clear about the project's goals than were those who were most involved in the project, such as Site Coordinators.

We were interested in how the project determined which approaches and strategies were best suited to helping them achieve their goals. As the Project Director explained the process, the Alliance "looked at what was happening, tried to evaluate what was working and what was not, and tried to find out how to help students get through the pipeline." He went on to say that these issues continue to be addressed frequently at Steering Committee meetings. In responding to this question, Site Coordinators at different Alliance institutions focused on different strategies employed by the NYC LSAMP. For example, one Site Coordinator stressed that the CUNY approach to achieving project goals was to develop a model of "what would be best for a university system with 17 campuses and a graduate center...that didn't always talk to each other." She added that, consequently, course restructuring, peer tutoring, and mentoring were strategies employed "across the Alliance." Another Site Coordinator cited the NYC LSAMP's focus on student research as a "long-standing strategy that is promoted in professional societies" as a way of increasing student interest in the sciences. And a third Site Coordinator commented that, "most PI's that are working on pipeline programs use the same approaches and strategies [and] these approaches are consistent....AMP crystallized them."

Project Functions and Components

For the purposes of the case studies, the term "project functions" refers to student recruitment, application/selection, and monitoring/feedback. The term "project components" refers to those activities and services that an Alliance offers to its LSAMP participants. While there is considerable overlap, project components do vary across Alliances, as well as across partner institutions within the same Alliance. In this section, the discussion of project components is divided into two sections: common and uncommon. A "common" component is one that is utilized by most Alliances, while an "uncommon" component is less prevalently utilized.

Project Functions

Recruitment. Recruitment strategies vary widely according to campus. The NYC LSAMP Project Director characterized the Activity Coordinators as having a central role in recruitment by suggesting to eligible students that they should apply for an LSAMP-sponsored research assistantship. Faculty involvement is considered the most important recruiting tool because faculty members have access to students through their classes and research projects. This observation is supported by the fact that most participants in our focus groups acknowledged that they had learned about the project from their professors.

Activity Coordinators stated that other STEM intervention programs were good recruitment sources for LSAMP. CSTEP and SEEK, for example, have served as feeders into LSAMP at some campuses. According to the Project Administrator, there are many on campus summer programs at CUNY institutions for high school students that LSAMP could draw on for recruitment purposes. Activity Coordinators said that they give presentations about the project to local high schools or even college-level classes to introduce prospective LSAMP scholars to the project. Flyers and brochures posted in science and engineering buildings or available at Learning Centers on campus are also means of publicizing the project as are mailings to high school and college students and presentations at open houses. A few students mentioned that they had heard about the project from friends/classmates, so word of mouth is another, though minor, recruitment tool.

Application/Selection. There is no formal application process for LSAMP, but in order to participate in undergraduate research (as required of Level I participants), students must apply. Successful applicants should have GPA's of at least 3.0 (for four-year institutions) or 2.8 (for community colleges) and must write a description of proposed research to indicate area of research interest. They must also identify faculty members with whom they wish to work. Applications are reviewed by faculty and project staff and selection takes place once a semester. Activity Coordinators play a central role in this process because they help the students identify likely faculty members to work with and refer applicants to sources of assistance in formulating their proposals.

Monitoring/Feedback. All LSAMP students are monitored to assess their academic progress, although the monitoring process is more intense for Level I participants. These students submit progress reports every semester at mid-semester detailing the progress they have made in their research projects. Additional information that is collected on each Level I student includes GPA and courses they have selected. Monitoring is done by the Activity Coordinators on each campus and may vary according to campus. Usually, mentors provide students with guidance and feedback on their progress, although the Project Administrator meets with all the Level I participants at City College every semester and reviews their transcripts.

Project Components (Common)

Research (all institutions): All Level I students are expected to participate in the undergraduate research component of the project as research assistants. (Please see previous section for application/selection process and minimum requirements for eligibility.) As research assistants they receive a stipend from LSAMP that varies depending on their attendance at a community college or a senior college and their rank as freshmen, sophomores, lower or upper juniors or seniors. Stipends range from $1,000 to $5,000 per academic year. Research assistantships are available during the academic year and in the summer and require that students maintain a minimum GPA of 2.8 for community college students or 3.0 for senior college students. Students typically spend 8-10 hours in the research per week during the academic year, and 10-25 hours per week during the summer. Students who participate in research are monitored on a bi-weekly basis by the Activity Coordinators on their campuses. In addition to giving participants first-hand experience in conducting research projects, this component helps them to learn presentation skills and provides them with the opportunity to make research presentations.

Mentoring and advisement (all institutions): The mentoring component is an integral part of the research component. As part of this component, Level I LSAMP students are assisted by the Activity Coordinators on their campuses to find a faculty "match," that is, a faculty member who will agree to become involved in LSAMP and who is doing research in the student's area of interest. Faculty typically learn about the project and become involved as mentors through direct contact with LSAMP staff or with interested or participating students, although one faculty member mentioned that she had learned about the project through the Minority Programs office at her institution. Mentors and Level I students decide beforehand how often they will meet. In general, mentors meet with students at least once or twice a week to help them with their research, although several mentors reported daily interactions with mentees in the lab. A number of mentors mentioned that they also provide LSAMP students with academic advice as well as advice about careers and future directions, including plans for graduate school. Mentors also contribute to the monitoring process by reviewing mentee progress reports and giving feedback to both mentees and the Activity Coordinators. Some mentors said that they had worked with mentees to put together poster sessions and presentations and have presented at conferences and written journal articles with mentees. We queried mentors about the most valuable service that they provided mentees. A good number responded that motivating students and giving them confidence in themselves and in their ability to realize their goals was the most valuable service. Providing students with opportunities to do hands-on research in a laboratory setting was also seen by several mentors as a valuable contribution because it helps students to go beyond the text and better understand the concepts they learn in class. In the words of one of the mentors, "It's something new and it's real, and not just something out of the book." A smaller number of mentors mentioned exposure to graduate level work and national conferences as the most valuable service.

None of the mentors said that they had received formal training to become a mentor, although some mentioned informal methods of training. These usually took the form of conversations with the Activity Coordinator or the Site Coordinator or meetings about what was expected of mentors. Although a few mentors mentioned that they would welcome some formal training, many more suggested that they had been mentoring students for a long time and were quite familiar with the role and responsibilities of mentorship.

Tutoring (all institutions): Peer and faculty tutoring are available to LSAMP participants through the Learning Centers at some of the Alliance institutions, particularly for gate keeping courses. (Although these Learning Centers are funded through the institutions and open to all students, they are utilized by LSAMP students, faculty and staff for student activities such as tutoring and study groups.) Tutors are students who have GPA's of 3.0 and above; many of them are LSAMP participants who receive stipends for their work. (It is estimated that across the CUNY Alliance there are 150-200 LSAMP participants who are either tutors or research assistants.)

Bridging activities (all four-year institutions): Summer bridge programs, usually running six weeks before the start of the academic year, are directed by the campuses themselves with funds provided by LSAMP. The idea behind the Summer Bridge program is to bridge the gap between high school and entry to college. Students participating in Summer Bridge must be attending a CUNY institution in the fall. Some Summer Bridge participants work with faculty on research in their labs and some attend engineering or computer science classes. Participants also receive a stipend of $1,000 for participating. (There is a transfer program, TRACC, run by the School of Engineering at City College for students transferring from community colleges into its four-year Engineering program.)

Academic and personal development workshops (all institutions): The Alliance institutions provide a number of workshops for LSAMP students to help in their academic and personal development. These include skills building seminars that cover abstract writing, presentation skills for research conferences, research skills, and math and science workshops that cover academic content.

Graduate school assistance (some four-year institutions): LSAMP works with other programs like the CUNY Pipeline Program, Project 1000, NACME, JIM, SACNAS, and others to assist participants to enter graduate school. Activities may involve GRE test preparation, dissemination of information on graduate programs, and assistance in completing applications to graduate programs and they may be offered through conferences, workshops, and the Learning Centers.

Conferences (some institutions): LSAMP students attend a variety of conferences, some national and some local. They start out by attending student-level conferences and are then encouraged to go to professional conferences after that. LSAMP students may receive financial assistance to travel to conferences and an average of 31 students per year receive funding to do so.

Dissemination of internship information (all institutions): LSAMP participants receive information about internship opportunities at national labs, the Department of Energy, NIH, NASA, and other sites through seminars and via e-mail and flyers.

Articulation agreements and community college outreach (all institutions): According to the Project Director, the best way to help CUNY students make the transition from two- to four-year institutions is through "curriculum coordination" rather than through the use of articulation agreements. In his view, articulation agreements don't foster a "seamless transition." Curriculum coordination involves the standardization of course offerings at both the community college and senior college levels so that STEM courses offered at community colleges are readily accepted by the four-year colleges, thus simplifying the transfer process. For example, at BMCC the restructuring of its math, chemistry and computer science courses has resulted in either formal transfer agreements with all the CUNY institutions or informal facilitation of the transfer of courses from this community college to senior institutions in the CUNY system. (Not all of this course restructuring can be attributed to LSAMP, however.) Because some of the community colleges in the system were already involving their students in research, when LSAMP suggested that Introduction to Research courses be designed, it was decided that these courses be taught at the community college level for community college students who were interested in a research career.

Some of the other efforts made by the LSAMP to facilitate transfer of STEM students from two-year to four-year colleges have included outreach involving borough- and system-wide meetings to bring together faculty, students and administrators of both community colleges and senior colleges. The RIP and RAP programs (see below) also fosters the collaboration of community college and senior college faculty on research projects. Community college students can do research at senior colleges over the summer as well as work with a community college professor who is doing research.

BMCC has developed an articulation committee and holds open discussions with institutions about their science courses. Also, City College has set up five articulation agreements that are almost complete, that enable community college students to take courses at City College.

Follow up with graduates (Some institutions). Although not all of the Alliance members follow up with their LSAMP graduates after they leave the institution, several do. At a couple of colleges, project staff use graduates as role models for incoming students and share information about successful graduates with these students. One institution brings alumni from the project on campus once a year to participate in, and assist with, an environmental science conference. Another project site contacts graduates to see if they need any help and use follow up information to post bios on past scholars around the office so that current participants can see where past participants have gone.

Program Components (Uncommon)

Yearly research meeting (all institutions): NYC LSAMP sponsors an Urban University Series that is held on a different campus each year where LSAMP participants present their research to CUNY faculty and students. The series also includes relevant speakers and workshops together with an academic/career fair that provides information on graduate programs, internships and career opportunities.

Course restructuring (all institutions): Curriculum restructuring represents a significant achievement for the NYC LSAMP. Course restructuring was a major focus in Phase I of the project with a large proportion of LSAMP funding being used towards this goal. The project leadership began with gatekeeper courses focusing first on mathematics courses and then moving on to chemistry. The project is now working with the Physics Departments and trying to get them to restructure their courses. The process has taken five years and is still ongoing. Seventeen courses on ten campuses have been restructured and the project is documenting withdrawal rates in these courses.

One of the reasons for the success of this effort is that the project did not focus on course content, but instead tackled the delivery of the coursework. Friction, therefore, that might have existed in a large scale curricular reform project was eased. The LSAMP leadership plans to continue its curriculum restructuring efforts in the future with an emphasis on incorporating more hands-on research into the courses. (The Treisman workshop approach was also incorporated into this restructuring of courses.) Another focus has been to involve both four-year and community colleges in this effort.

Faculty research (all institutions): RIP (Research Initiative Program) and RAP (Research Articulation Program) have received funding from NYC LSAMP (as well as other sources) to provide support for community college and senior college faculty collaborative research projects[9]. This funding supports release time for faculty, encourages faculty to do research (thus opening up more research opportunities for students), encourages faculty to obtain funding from additional sources, and encourages collaboration between faculty at community colleges and four-year institutions. Research proposals receive peer review and consideration is given to how many students the faculty propose to include on the research team and whether the collaboration makes sense. Faculty who receive these awards are usually new community college faculty. The institution provides matching funds toward the release time of awardees. Although faculty recipients of these grants are not required to work with LSAMP participants, the Project Director observed that there is at least one LSAMP student working on each award.

Teaching assistantships (City College): City College LSAMP students who have been an LSAMP Research Assistant for at least one semester and are attending college full time are eligible for Undergraduate Teaching Assistantships in math and science courses. These assistantships pay a stipend or provide course credit.

Most Important Features

The research experience component of the project was cited as the most important feature by most of the Activity Coordinators who responded to this question. They identified this feature as the most vital because it allows students to learn approaches and techniques in their field, interact with faculty and others in a research setting, and gain presentation skills. The collaboration among different

[9] According to the Louis Stokes New York City Alliance for Minority Participation's Program Effectiveness Review (October 29, 2002) NYC LSAMP has awarded a total of 45 faculty RIP/RAP awards.

institutions, especially the community college aspect of this collaboration was also cited by one of the Activity Coordinators as the most important feature. This aspect of the project, which was seen as crucial for getting students from community colleges through the pipeline and on to graduate school, was described as "beautiful." For the project as a whole, the five most important features of the NYC LSAMP project identified by the Project Administrator were the undergraduate research and mentoring components; LSAMP services offered through the Learning Centers (tutoring, workshops, and other activities); support for participant attendance at conferences (that resulted in external contacts for LSAMP students); and the collaborative nature of the Alliance.

Project Implementation

Factors Affecting Implementation

Main Factors Facilitating Implementation

Activity Coordinators and other project administrators were asked about the main factors that facilitated the implementation of NYC LSAMP. Responses cited effective project components, such as a strong research component that entices students to stay in the project; the availability of financial assistance, which alleviates the need for students to work while attending school; and the provision of evening classes that allows students who work during the day to attend classes. Other factors included the recognition on the part of the institution that there is a need for minority scientists and the willingness of institutional personnel—from chancellors and provosts to faculty—to assist and support the project. One respondent mentioned that the location of the project within an advantageous setting (a Center within the institution) was helpful. Others mentioned a particular individual, such as a previous Activity Coordinator, a Site Coordinator, a president, a dean, or faculty, who has been instrumental in fostering project success. One respondent noted that word of mouth by students was very effective in influencing other students to become involved in the project. The fact that Activity Coordinators are graduate students was cited as being useful to the project because they can act as role models for participants and, in the words of one Activity Coordinator, "show... participants what they can become and do."

Main Implementation Challenges

Asked about the biggest challenges they have had to face in implementing the project, Activity Coordinators and other project administrators and faculty identified several. Two challenges mentioned by most of the respondents were those of recruiting students and getting faculty involved in the project. In some cases respondents noted that the project is not very visible on campus and that may account for recruitment and faculty involvement difficulties. In other cases the most effective recruitment methods were stymied by institutional regulations regarding confidentiality of student records. For example, one of the Activity Coordinators mentioned that recruiting would be greatly facilitated by a review of student transcripts, but that the project was forbidden access to these records. A barrier to recruitment that several respondents identified was the program requirement that participants be U.S. residents or citizens. One Activity Coordinator explained that there were many "wonderful" foreign students in big cities such as New York. He realized, however, that given the current political climate, extending LSAMP to foreign students might be a difficult subject to bring up.

Getting faculty interested and involved in the project posed a challenge for several partner institutions. Some respondents felt that faculty did not become involved because, in the words of one respondent, "That is just not something that they want to do." Faculty who were involved in the project remarked that lack of time was a deterrent to faculty participation because mentoring takes a lot of time and faculty members have so many conflicting demands on their time. Time also poses a problem for students, who have families and may work. Another challenge that interviewees mentioned was ineffective Activity Coordinators or Site Coordinators. At one site, previous Activity Coordinators were described as having been "weak." A possible explanation for this may be that Activity Coordinators lack clout because, in the words of one of the Coordinators, "we're just students and students will always be students; we're not faculty and we're treated that way." At another site, the Site Coordinator was described as not being "very involved." Another challenge mentioned by a few respondents was the poor preparation of participants when they first enter the project. Faculty said that entering students must, in some cases, be taught basic tasks such as keeping a notebook, what an experiment is, and how to design an experiment. They commented that helping students overcome these difficulties was very time consuming and, as one mentor commented, faculty members do not receive release time for mentoring.

Lessons Learned

Activity coordinators along with the project's principal investigators were asked about the lessons that they learned while implementing LSAMP. Many of the Activity Coordinators interviewed could not offer responses because they had not been working with the project very long. However, the Principal Investigators did mention an important lesson they learned while restructuring courses at the lead institution. They mentioned that while course restructuring can be a daunting and often political task, they found it much easier to gain institutional support by focusing on modifying course delivery instead of modifying course content. One of the PIs said that by deciding to concentrate on teaching methods they were able to avoid any "friction" that might exist when trying to do a large-scale curriculum revision. One Activity Coordinator spoke about how she should have been stricter in requiring that all participants attend project meetings, and added that in the future she would try to "stay on them a little more." Another Activity Coordinator noted that she has learned that one needs to be very savvy about their institution in order to carry out all the administrative duties of her job. She told of the challenges of procuring registrar data, and how she has had to be very resourceful in tapping into various channels to get what she needs.

How Smoothly Does the Project Run?

Several participants and faculty mentors at member institutions were queried as to how efficiently the project was implemented at their institutions. The vast majority agreed that the project ran smoothly. A student at one of the community colleges observed that LSAMP did a good job of keeping students motivated and helping them maintain their GPAs. A number of students at other institutions commented that they were notified in a timely manner about meetings and workshops through e-mail, although participants at one of the institutions were quick to point out that the efficiency of project implementation depended a good deal on the Activity Coordinator. Students at only one particular institution expressed dissatisfaction with the way their LSAMP project was run. They felt that there was little communication among participants and between participants and project staff. Freshmen and sophomores at another institution complained of the project's having "too many requirements" and "too many meetings." They commented that sometimes they were given little advance notice about meetings. (Interestingly, the juniors and seniors in this project, who participated in a separate focus group, did not voice these concerns and seemed generally quite pleased with the project's operation.)

Faculty were generally very pleased and impressed with the efficiency with which LSAMP operated on their campuses. One mentor remarked, "I think it's very efficient...It has a lot to do with the way in which the administration and faculty have embraced the project." Another commented that compared with similar programs, LSAMP was well run and the administration was very good. There were just two complaints from faculty mentors. A group of mentors at one institution expressed the desire to have more guidance about what was expected of them as mentors and what the project's rules were regarding mentors. One of them explained, "As a mentor, I didn't know about the rules and guidelines." A mentor at another institution complained of a "paperwork problem" with the project around paying bills that caused payments to a supplier to be delayed for six to seven weeks. This faculty member also felt that the project's reporting requirements (student reports, for example) were excessive and placed an unfair burden on participants.

Collaboration among Partner Institutions

The NYC LSAMP makes a point of not using the term "lead institution" but rather "central office" or "administrative center" to refer to City College because it aims to foster an equal partnership among the institutions. Project staff members at the partner institutions feel that the project is run well and "equitably," that information is "well distributed," and that there are attempts "to make things as open as possible." Cross campus collaboration is enhanced by the Research Initiation Program (RIP) and Research Articulation Program (RAP) which offer awards to senior college and community college faculty members collaborating on a research project, and which involve LSAMP undergraduates. Moreover, there are instances in which the Alliance has also assisted faculty members from one institution to access and share equipment from a partner institution, and assisted students in procuring research experience and mentorship from faculty at a partner campus. There are also opportunities through LSAMP for high school students and community college students to engage in faculty-mentored research at a four-year Alliance institution.

The monthly meetings held at different levels within the project are cited as a primary mechanism by which the Alliance facilitates collaborative decision-making among partners. In the words of one Activity Coordinator, the meetings allow for "the exchange of information on lateral and vertical levels." According to the PI, the monthly steering committee meetings bring together vice presidents and the like from all the partner institutions to have "a very frank and open discussion of the challenges" that they face. The committee tackles such topics as which grants the project will apply for, and how to involve a wider range of people in the review of participant applications. At a recent steering committee retreat, participants worked in small groups to address various areas of the Phase III proposal to NSF.

There is also a monthly meeting for Activity Coordinators, chaired by one of the Project Administrators, in which attendees discuss common issues, ask questions, and hear news and announcements by the project's central office. Activity Coordinators seem to value these meetings because they enable them to learn about new opportunities and offerings such as conferences, speakers, summer programs, and so on. These meetings also help the Activity Coordinators to bond and share difficulties and success stories. The Activity Coordinators appreciate being included in the process and being taken seriously. A number of the Activity Coordinators are themselves graduates of LSAMP and are currently pursuing graduate studies. Being an LSAMP Activity Coordinator has yielded a network of like individuals with whom they can relate and turn to for support. Interviewees also spoke about the collaboration that occurs between Alliance partners when students transfer from one partner institution to another. Typically in these instances, the Activity Coordinator at the old institution will contact the Activity Coordinator at the new institution to assist students with transfer and to facilitate students' LSAMP application there.

Institutions within the Alliance also work together to bring about the annual NYC LSAMP conference. In addition to this, LSAMP Activity Coordinators at partner institutions within the same borough also collaborate in the planning of a borough-wide LSAMP conference with campuses taking turn hosting every year. These events are important for not only do students get to learn about research in their field, present their work, and network with others, but also graduate school representatives are there to recruit. The Alliance also co-sponsors and organizes The Urban University, a series of conferences and lectures, which brings together faculty, institutional administrators, LSAMP staff members, and both LSAMP and non-LSAMP students from the various partner schools. There are also instances in which a

LSAMP sponsored activity such as a GRE preparation workshop held at one partner campus might be open to students at the various partner institutions. Also, the central office conducts site visits to the partner institutions to see what the conditions are, and to talk to students about their experiences. According to one Activity Coordinator, "this means that they [student participants] get to be part of the process rather than something that happens to them."

Interviewees feel that the collaborative relationship among partner institutions is working well, and that an assortment of benefits stem from this collaboration including increased student exposure to the greater STEM community; expanded range of activities and offerings through shared resources and efforts; and, greater understanding among and support for project staff members. LSAMP students are said to get exposed to what is "beyond the borders of their school" as they interact with students and faculty from other institutions. As the Activity Coordinator at one community college pointed out, the cross-campus collaboration allows their students to observe research occurring elsewhere, especially at the senior colleges, and to meet potential mentors, while enabling others to see that their students are "competent and well-prepared," and engaged in "sophisticated work." Students get to see "the bigger picture of how research is communicated," according to one Site Coordinator, and "they begin to realize that what they are doing is pretty good." The collaboration among partner institutions has also led to the sharing of ideas, which has reportedly allowed Activity Coordinators to become "much more knowledgeable" and thus serve as a better resource for students. Through learning about what works at other institutions, project staff members become more aware of what is effective in terms of the recruitment and retention of students, and how to get more mentors involved. When asked about problems encountered in collaborating with partners, most interviewees stated that none were encountered. The most often mentioned issue was that of distance, which poses difficulties for participants to attend meetings or to do research at another school.

LSAMP Participants

Profile of Participants

Characteristics of Typical Level I Participant

Activity Coordinators and faculty were asked to profile the typical Level I student on their campus who participated in the NYC LSAMP. The most frequently used descriptor for these students was "highly motivated." They were also described by faculty and staff alike as being willing to go the extra mile. For example, some phrases used by respondents to describe participants were the following: They wanted "to go beyond the coursework," were willing to "take some risk and to spend extra time," were "dedicated to putting in the time and effort," and "want to do more than just come to class." In addition to being motivated and hard workers, LSAMP participants in the CUNY Alliance were seen as excelling academically, having more confidence than other students, having a high degree of initiative, and being more mature, enthusiastic, goal-oriented, and level headed. They are also seen as "leaders" in the student community, according to one faculty member. A few of the faculty members were not able to respond to this question because they were not able to distinguish LSAMP students from all other students. Only one faculty respondent felt that LSAMP students at his or her institution did not seem very different from non-LSAMP participants in terms of work or study habits.

Preparation for Coursework

Asked whether NYC LSAMP participants seemed prepared to do the required work in their courses, faculty members were in general agreement that they were. Several faculty members added that

LSAMP students were better prepared than their peers, although one professor remarked that LSAMP students were no different from other students. A faculty member commented, "Right now, they are in the top section [of their classes]. It used to be the reverse, once upon a time." (A few faculty members were not able to respond to this question because they could not identify NYC LSAMP students in their classes.)

All faculty who responded to the question felt that NYC LSAMP students had been appropriately placed in their classes. Indeed, some felt that LSAMP students were more likely to be appropriately placed because they received better advising. According to one faculty member, they have "more interaction with knowledgeable advisors" and they get placed "pretty well." Another faculty member explained, "You don't have that with AMP students [taking an inappropriate level course]."

Main Strengths and Main Problems Encountered

In identifying LSAMP participants' main strengths, faculty repeated their characterizations of the typical LSAMP student. Motivation was a strength mentioned by several of the respondents, as was the willingness to go the extra mile. In the words of one faculty member, LSAMP students are "quite serious and sincere about what they're doing." Several professors also cited these students' self-discipline, commitment to goals, drive to succeed, eagerness to learn, and focus. As one faculty member observed, "I think the AMP program helps them define their goals as well as giving them guidance, the tools, and the financial support to achieve them. Staying in a research program is a huge commitment of time and effort and many of my AMP students have shown that they are more than capable of maintaining that commitment."

Faculty members were asked about the main problems encountered by LSAMP participants in their classes. Although most said that these students did not have academic problems because they were usually good students, several mentioned "life problems" associated with coming from economically challenged backgrounds. For example, financial issues were mentioned frequently, especially in terms of making it necessary for participants to work, even though students receive stipends from the program. The LSAMP research stipends do help, even though some students must take other jobs to fully support themselves. According to one faculty member, the stipend offered through tutoring and research is a good way of keeping students focused on schoolwork because it makes obtaining a job less of a necessity. Other "life problems" that faculty brought up included family responsibilities. One professor mentioned that a student had a son as well as a mother with a serious illness and needs to spend time with both. Another faculty member said that like most of the student population at that college, some of the LSAMP students were not that well prepared for college work. A professor at a different institution said that like other students LSAMP participants have difficulties with exams and that the project helps by providing academic peer tutoring in introductory math and science courses. Faculty respondents also mentioned that the project supports LSAMP students by assisting them in building a community in which LSAMP students form study groups and give one another advice about what classes to take.

Participants were asked about difficulties they had encountered as a STEM major at their institutions. Some mentioned the "life problems" described above by faculty such as balancing schoolwork, research, and a job. Students also cited difficulties with coursework as well as problems with accessing courses. One transfer student from a technical community college mentioned that the first year was a "nightmare" but he was able to make the adjustment. Students felt that because LSAMP research schedules are flexible, students can take time off for studying and then make up the research hours later. At one institution, however, LSAMP students said that they did not approach NYC LSAMP for help if they needed assistance with coursework. At all other institutions, students either received help from NYC LSAMP services such as tutoring or they said that they did not experience any difficulties. At one institution, students complained of difficulties caused by a limited course schedule and the fact that there were no summer courses, but they felt that NYC LSAMP could not help with these problems.

Participant Experiences with LSAMP

<u>*How Students Learned about LSAMP*</u>

Asked how they found out about LSAMP, the majority of students in our focus groups said that they had heard about the program through their professors. A large number also found out about LSAMP through staff in other pipeline programs on their campuses. A smaller number saw flyers advertising the project or heard about it from friends and classmates. At one of the Alliance institutions where the former Activity Coordinator had been particularly active, a number of students said that this individual had recruited them.

Transfer students in the focus groups at four-year institutions were asked whether they had been involved in LSAMP in their community colleges. All the transfer students (four) at one of the institutions said that they had been involved in NYC LSAMP at their community colleges and, of these, three had been involved in research at the community college level. Of the other three transfer students—one at one institution and two in another—none had heard of LSAMP at their community colleges, even though they had attended Alliance community colleges.

<u>*Expectations of LSAMP*</u>

NYC LSAMP students who participated in focus groups were asked why they had applied to the project. As might be expected, responses varied widely, but the majority of students cited the opportunity to obtain research experience as the principal drawing card. Additional reasons given for applying to the project included, networking, developing communication skills (writing reports and making presentations), having mentors, getting tutoring and developing academic skills. Some students mentioned that they were unsure of what major to pursue and wanted to learn more about the sciences as an option, while some spoke of wanting to use research experience to get into graduate school. A few noted that receiving funds was a factor that attracted them to NYC LSAMP.

Asked whether their expectations had been met, most answered in the affirmative. Indeed, several responded that their expectations had been exceeded. Several students said that the time spent in doing research had been worthwhile. One participant commented that she had never expected to have the opportunity to attend so many conferences or connect with students on other campuses. Another participant, a community college transfer, recounted his experience as the sole community college participant in an LSAMP conference where he made several graduate school contacts. The experience really encouraged him "to keep up with research." Through his contacts, he was able to secure a long-term research opportunity at an out of state university. A few participants, all of whom attended the same institution, said that their expectations had not been entirely met. A couple of these students spoke of expecting a more structured introduction to research that did not materialize. They described their situation as "sink or swim" where students were left "to do your own thing." A student at another institution was disappointed at not having more opportunities to travel outside of New York City.

<u>*Participant Access to LSAMP Services*</u>

Students discussed the ease with which they were able to obtain services offered by LSAMP. At most of the institutions, students said that they had not had any problems with LSAMP services. They felt that they could approach the Project Director and the Project Administrator directly and obtain help from them if necessary. At one institution, however, participants complained that they had not even met the Activity Coordinator. They felt that this staff member was not very responsive to their requests for services and said that they had had to resort to contacting the LSAMP office at the lead institution for assistance. Students at another college said that it was difficult to get to activities at the other Alliance institutions and commented that all Alliance-wide activities should be held at the lead institution. Participants at the same college said that the scheduling of meetings by LSAMP sometimes interfered with studying. At another college, a few students expressed that they had a difficult time approaching faculty members to find a mentor.

Student Ratings of LSAMP Services

Focus group participants were asked which services provided by NYC LSAMP were most helpful. The most frequently cited in this category was the research experience provided by the project. Several of the students who mentioned this added that the funds they received to do research were also helpful. One student commented that he used to have to balance working full-time with doing research. Now, he says, receiving funds to do research "is phenomenal, a beautiful thing." Other students, in citing their research experiences as most helpful, mentioned that hands-on research reinforces scientific learning, that they learn to write research reports, and that it is good preparation for graduate school. Having a mentor was the second most frequently mentioned service. As one student commented, having access to someone who can "break down" the information you're learning is valuable. Many students mentioned the opportunity to attend conferences, network, and present research papers as being the most helpful services provided by NYC LSAMP. One of the students observed that going to conferences has made her more comfortable in communicating with others and has given her self-confidence. Another student mentioned the networking benefits of attending conferences. Students also felt that the assistance and support that they received in the form of workshops to help them write abstracts, make presentations in public, write research papers and prepare for graduate school were invaluable. A few students mentioned tutoring as being most helpful because the tutors were well prepared.

Focus group participants seemed to have a more difficult time identifying LSAMP services that were not useful to them. The most frequent response to our request to identify LSAMP services that were "not really helpful" was "everything helps." Students added that they would like to receive even more LSAMP services. The participants at one institution, however, felt that the services are not as helpful as they might be because the Activity Coordinator is not doing his job. As one of the participants remarked, "It seems that we're the AMP coordinator." At other institutions, students commented on the need for the following: an improved GRE prep course, increased exposure of undergraduate students to graduate students, and more accessible mentors. The yearly application process for the LSAMP project was thought to be redundant, with students commenting that they were asked many of the same questions again each semester despite the fact that much of the information requested had not changed. Students suggested that it might be more useful if, after the first application, they simply submitted their research abstract and a follow-up report at the end of each semester in subsequent years.

Project Effectiveness and Impact

Staff Perceptions of Project Effectiveness and Major Successes

Activity Coordinators at the visited Alliance sites were asked about the effectiveness of the project's strategies and approaches in meeting the needs of the target population. Generally, they felt that these were very effective. Some pointed to the level of support that the project has generated among the faculty and administration as a sign of the project's success. One Activity Coordinator commented that the faculty and administrators at her institution have "embraced the program." Other respondents talked about project success in terms of the results it has generated. In the words of an Activity Coordinator, "More students have joined the program and are planning to go on to graduate school."

Activity Coordinators and some administrators were asked what they considered major successes of NYC LSAMP. Responses cited the project's track record of increasing the number of minority students in STEM majors; getting minority students to experience scientific research; and facilitating networking. A respondent at one of the community colleges identified the project's success in facilitating course articulation in the sciences between two- and four-year colleges. She commented, "We have been able to have conversations with other campuses and say, 'you are not accepting transferability of Calculus because you say it is not a lab science. Well, we think it is a lab science because we are doing x, y, and z.'"

Impact on Students

There is a general feeling among the interviewees that this NYC LSAMP project has had a very positive impact on student participants. Many perceive that LSAMP participation has increased student motivation, interest, and confidence in STEM; engaged students in critical professional development activities; and positively affected student persistence in the STEM pipeline as well as their preparation for graduate studies. A high number of faculty members and students believe that NYC LSAMP participation facilitates STEM degree attainment because it enables students to do better in their coursework. As one faculty member explained, when students participate in research, they become more "motivated" in their studies because "They know why they're learning something" and they come to see how their course knowledge is relevant. Another faculty member observed that being in the program motivates students: "they're very proud of their participation and want to complete the program. It increases their ties to the faculty and this tie helps keep them in school and engaged." The motivation of NYC LSAMP students appears to be undergirded by the high expectations of those running the project as evidenced by student comments about how "they expect you to go further," and how LSAMP has pushed them to go farther than they otherwise would have gone.

The project also enhances persistence through financial support of students. Were it not for LSAMP, many of the students would otherwise be working off campus in jobs that are not related to their schoolwork. One participant told how she didn't have to work four jobs last summer because she was paid a stipend for her research work. A Site Coordinator estimated that about half of the students doing research at his institution would not be doing so if it were not for the LSAMP project. By working as a research assistant or tutor, LSAMP students are able to stay on campus to pursue activities that complement their academic studies. As one student explained, it is a "relief not to have to look for an outside job or reschedule work to study for exams."

There is also a general feeling among the interviewees that LSAMP has kept students on the STEM track by providing academic support through tutoring, guidance on course selection, and "helping students realize that research is a valued career." According to one faculty mentor who believes that the most important thing participants derive is access to career advice, "they [LSAMP students] get higher quality advice about what to do when they graduate and how to be a professor. The students and parents don't know…They have no idea of the structure of academia and other careers." The program is said to help students to "see opportunities," and to "focus in" on goals and ways of achieving them.

Interviewees not only credited LSAMP for cultivating students' awareness of and interest in graduate school, but also for better preparing them to compete for graduate school entry. In the words of one faculty member, "the program grooms students to do well and to go further. It provides them with an "edge" through the research experience. They are a step ahead of others who don't have that." Students seem to be aware of this, as demonstrated by those who spoke about how in the sciences one is "better off" by gaining "hands-on experience," and how having research experience distinguishes them from other graduates. An Activity Coordinator explained that those LSAMP participants who are looking to go to graduate school stand "a better chance of getting in with the research experience, especially in the CUNY system."

The LSAMP program affords many students the opportunity to attend and present at conferences, and for some, the chance to co-author papers and to publish—experiences which participants recognize help prepare them for graduate school. As one faculty mentor explained, "the experience of having done original research and presented it gives them the stature they need when they're applying for graduate school or another position." Moreover, it is not only the experience that is important, but also the confidence that is instilled in students. Students seem to recognize this fact. One student reported that going to conferences and giving presentations has allowed her to become more comfortable with communicating with others and thus boosted her confidence. Other students discussed how they are not nervous about graduate school because they have experienced a taste of research and know what to expect.

For some participants, LSAMP has played a pivotal role in their lives. One student recounted how as a community college student he presented at a LSAMP conference. After the presentation a professor from City College who was impressed by him encouraged him to transfer to a four-year institution. While he had a number of institutions to choose from, he chose to transfer to City College because he wanted to remain involved with NYC LSAMP. Another student spoke about having had a "very bad" undergraduate experience in which she has encountered prejudice as a black woman in science. She spoke, for instance, about being frustrated by faculty members who were surprised that she could pass their class. She stated that what has allowed her to complete her science degree in four years is the thought that after class she had research and a faculty mentor to turn to—"someone who would say 'you can do it.'" She feels that LSAMP has really made a difference in her life, and that it has made her "hungry to go further."

A number of students recounted the lasting benefits of such NYC LSAMP supported activities as conference attendance, which exposes students to research, graduate students, and peers and faculty from other institutions. One faculty member recalled accompanying a LSAMP student to a conference that was designed to help students prepare for graduate school. The student reportedly went in with "her eyes wide open" and "received tools that she needed for graduate school." She has been awarded a full scholarship by Berkeley to study computer science. Had it not been for NYC LSAMP, according to her faculty mentor, they never would have found out about this type of opportunity.

Impact on Institutions

Participation in the Alliance appears to have impacted partner institutions in multiple ways, including increasing institutional capability for talent development, and bringing about a change in institutional culture with greater emphasis on undergraduate research opportunities and minority participation in STEM. Foremost among the benefits that program participation has yielded for institutions is the increase in both minority and non-minority STEM enrollment and STEM degree attainment. From 1992 to 2002, STEM minority enrollment grew from 4,216 to 6,963, while STEM non-minority enrollment grew from 3,195 to 7,702. Meanwhile, during the same period, STEM degrees awarded to minority students almost doubled from 404 to 761; for non-minority students it increased from 775 to 1,276[10]. Another important impact on partner institutions is the course restructuring and course development that have taken place. The effect of this is far-reaching as both LSAMP and non-LSAMP

[10] Data cited in NYC LSAMP 2001/2002 Annual Report.

students enroll in these revised gatekeeper STEM courses. CUNY enrolled over 18,534 students in the LSAMP institutionalized or restructured courses during academic year 2001-2002[11].

Alliance wide and borough wide LSAMP sponsored conferences have drawn a lot of enthusiasm, and their success has inspired some individual institutions to hold their own research expositions. Such LSAMP offerings enhanced the ability of institutions to cultivate student talent. A senior official of the CUNY system, who quizzed students about their presentations at the NYC LSAMP conference he attended, spoke about coming to the realization that "even if they don't all become scientists, these will be really bright individuals who will be better prepared to take on life in the 21st century."

Senior officials at one institution report that the project has led to an "obvious change in culture" in the math and science departments on that campus, and that it has "created a friendly competition" among departments to get more minority students involved. And, because the president of the institution has recently awarded the Department of Physical, Environmental, and Computer Science a "Center of Excellence" designation, this will motivate other departments like Business and Liberal Arts to follow suit. The PIs also spoke about how the project has led Alliance institutions to place a greater focus on affirming the equal opportunity clause. As the PI's explained, it has helped partner institutions to see that it is not enough to say they believe everyone should have equal opportunity for jobs, but now they see the need to make an effort to actually affirm it.

Interviewees also reported a change in the institutional culture insofar as more professors are recognizing the possibility of including research as part of the undergraduate experience. One Site Coordinator explained that at his institution, where the provost's signature is required on all research grants, the provost has been promoting the inclusion of undergraduates in research projects. At another institution it is reported that more faculty are working to "build on the momentum of getting more minority students involved," and are doing so through their grant writing efforts. A senior official of the CUNY system who has been involved with LSAMP in the past couple of years explained that he has noticed that people have begun to think of LSAMP as "a permanent part of university life." He feels that he has witnessed "an evolution in thinking" because at the last meeting "the room was filled with representatives from all the partners and there was the feeling that this is a university wide effort."

Institutional Support and Institutionalization

Each of the six Site Coordinators felt strongly that their respective institution has been "very supportive" of the NYC LSAMP project. When asked about institutional resources used to support the LSAMP project, Site Coordinators often cited their own time as each holds a full-time administrative position, and yet devotes significant time to overseeing the project at their institution. Other forms of support mentioned include release time for some faculty to mentor students in research or the redesign of courses, office space for the Activity Coordinator and/or project, secretarial support, and food and supplies for LSAMP events. Several spoke about how the president of the institution supported it from the beginning, and continues to promote it. One Site Coordinator described how his institution is supportive in "huge" ways, as LSAMP students are treated as "stars," and both student and faculty participants receive recognition for their work.

Institutionalization has begun within the Alliance, though it appears to be further along at some institutions than at others. A "turning point" occurred between the end of Phase I and the beginning of

[11] Data cited in NYC LSAMP 2001/2002 Annual Report.

Phase II when the Alliance's governing board, recognizing that LSAMP "is not just a project," formulated a LSAMP Institutionalization Policy Commitment Statement. The academic deans from each of the 16 partner campuses undertook actions toward institutionalization. Products of these efforts include the institutionalization of the LSAMP Central office, the positions of Project Administrator and Campus Activity Coordinators, and the restructured gatekeeper courses. Moreover, LSAMP has facilitated the brokering of articulation agreements between community colleges and four-year institutions to ease the transfer of students from two-year to four-year institutions within the CUNY system.

Project Evolution and Future Plans

The Co-PIs feel that the Alliance has evolved, though its mission and goals have remained the same. Four institutions have joined the CUNY Alliance since the inception; now all the CUNY colleges participate with the exception of the John Jay College of Criminal Justice. Three new standing committees (Agency-Industry, Transitions, and Research and Teaching) have been created under the steering committee. Having members of these new standing committees be people from various Alliance partner institutions is was one way by which the Co-PIs strive to enhance the sense of ownership by each of the campuses, and to devolve power to steering committee members and eventually back to the campuses. Also, there has been a growing emphasis on institutionalization because the PIs want to make the project institutionally sustainable and not dependent on the personality of the individuals running it.

In preparing for when NSF funding ends, the CUNY Alliance has begun efforts to procure external funding. The Chancellor has directed that the fundraising arm be within the Office of the Dean for Institutional Research, which is putting together proposals to court funding for LSAMP and other projects. Sources of additional funding mentioned by Site Coordinators include funds from industry, funds raised by a newly introduced technology fee paid by students, and the possibility of tapping into alumni support. The PIs feel that in the case of certain partner institutions, some of the additional funds procured would not have been possible without LSAMP. As explained by one of the PIs, "It's like when you apply for a job and you can't get one without experience. In some institutions, unless you have research activities going on, there's no kernel for growth." She goes on to explain that several of the partners have been successful in generating large amounts of funding for their math workshop activities, which stem from the course restructuring and related activities sponsored by LSAMP.

Recommendations

While there were acknowledgments about the central office's great communication efforts, some faculty said that they would like to see more guidance on the mentorship aspect (e.g., guidelines for what faculty mentors and student participants ought to be doing or a handbook on mentorship) and clearer articulation of project rules. Some faculty mentors suggested that there should be an annual meeting of all NYC LSAMP mentors, as well as a gathering for faculty mentors per institution. At an institution where students are largely responsible for approaching a professor with whom they would like to work with, students suggested a group session in which students can meet with faculty members who are involved with LSAMP to learn more about research opportunities. Moreover, some students would also like to see more networking between LSAMP and other programs in the school (e.g., the City College Fellows Program). Some students mentioned the need to expand recruitment efforts, for example, by bringing in prospective participants to tour labs and setting up a LSAMP information table at high school fairs. At one school, faculty expressed a desire to get students involved with LSAMP and research at an early stage such as when they take introductory math classes, versus when they take calculus, so as to have a better chance of sustaining student interest in STEM.

Students at one site recommended that a more thorough screening procedure be in place for hiring an Activity Coordinator because they had noticed "uneven" performance by the three people who had occupied that position in recent years. An Activity Coordinator at another site stated that the project would be improved by "more uniformity" in the level of commitment shown by Activity Coordinators across the Alliance, and that Site Coordinators should be high-level university personnel who possessed enough clout to be effective. Paying the mentors was the suggestion of another Coordinator, who felt that this practice would encourage more faculty members to become involved. Finally, given New York City's large immigrant population, a common request is that the program should expand the eligibility pool to include qualified international students rather than limiting participation to U.S. residents and citizens.

APPENDIX F. Summative Evaluation Tables

Table F-1. Undergraduate GPA

	LSAMP Participants			National Comparison	
	All	*By Gender*		Underrepresented Minority	White and Asian
		Male	Female		
Weighted N	1,414	718	696	36,234	272,557
GPA Range (% Distribution)					
3.75-4.0	12.5	11.7	13.4	4.7***	11.4
3.25-3.74	38.9	36.7	41.2	22.8***	31.0***
2.75-3.24	38.8	40.4	37.2	48.4*	43.3*
2.25-2.74	8.3	9.2	7.3	21.2***	12.6***
LT 2.25	1.5	2.0	0.9	3.0	1.6

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Note: No statistical significance in gender difference at a p=.05 level or better.

* Significantly different from LSAMP, p=.05

** Significantly different from LSAMP, p=.01

*** Significantly different from LSAMP, p<.0001

Table F-2A. LSAMP participants' coursework post-Bachelor's

	LSAMP Participants			National Comparison	
	All	*By Gender*		Underrepresented Minority	White and Asian
		Male	Female		
Weighted N	1,422	721	701	36,234	272,557
Post-Bachelor's Coursework (% of all respondents)					
Have Taken Courses	78.9[a]	76.5	81.3*	62.1***	61.6***
Haven't Taken Courses	21.1	23.5*	18.7	37.9***	38.4***
Degree Sought (% of all respondents)[b]					
No Specific Degree	4.4	4.3	4.7	9.1*	9.6***
Bachelor's	3.0	2.8	3.4	2.1	2.6
Master's	42.6	44.3	40.6	26.4***	28.7***
PhD	9.7	8.8	10.1	4.5**	6.0**
Professional	13.6	10.4	17.2***	14.8	9.4**
Other	5.7	5.9	5.2	5.4	5.4

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: a When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 1.9 percentage points; b When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of .7 percentage points (min=0.2; max=1.7).

* Significantly different from LSAMP or other gender group, p=.05

** Significantly different from LSAMP or other gender group, p=.01

*** Significantly different from LSAMP or other gender group, p <.0001

Table F-2B. Graduate degrees pursued, by degree level and field of study

		LSAMP Participant	National Comparison	
		All	Underrepresented minority	White and Asian
Table Summary	**Number Pursing Grad Degrees**	**937**	**16,529**	**120,273**
	% of total sample	*65.7* [a]	*45.6******	*44.1******
	In a STEM field	***540***	***7,179***	***59,965***
	% of total sample	*37.9* [b]	*19.8******	*22.0******
	In a non-STEM field	***377***	***8,919***	***55,422***
	% of total sample	*26.4* [c]	*24.6*	*20.3******
One Dimensional Distributions: Degree Type and STEM Status	**Degree Level (%), regardless of degree subject** [d]			
	Masters	64.7	57.8	65.1
	Doctorate	14.7	9.8	13.6
	Professional	20.6	32.4**	21.3
	Degree Subject (%), regardless of degree type [e]			
	STEM	57.7	43.4**	49.9**
	Non-STEM	40.1	54.0**	46.1*
	Missing	2.2	2.6	4.1*
Two Dimensional Distribution: Degree Type *within* STEM Status	**STEM Degree Type (%)** [f]			
	Masters	72.4	80.0	74.0
	Doctorate	19.4	15.4	23.1
	Professional	8.2	4.5	2.9*
	Non-STEM Degree Type (%) [g]			
	Masters	52.6	37.9*	54.2
	Doctorate	8.7	5.8	3.9*
	Professional	38.7	56.3**	41.9

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: [a-c] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, values change by the following percentage points: [a] 2.6, [b] 1.6, [c] 0.8; [d-g] When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of [d] 0.3 points (min=0.1; max=0.5), [e] 0.3 points (min=0.2; max=0.5), [f] 1.3 points (min=0.7; max=1.9), [g] 2.5 points (min=0.4; max=3.7).

* Significantly different from LSAMP, p=.05

** Significantly different from LSAMP, p=.01

*** Significantly different from LSAMP, p<.0001

Table F-2C. Broad fields of study pursued at a graduate level by LSAMP graduates

	Weighted N	Percent
Field of Graduate Study- Post Bachelor's		
Engineering	236	25.7
Life and Related Sciences	155	17.0
Physical and related sciences	79	8.6
Computer and Math Sciences	70	7.6
Total- S&E Fields	*540*	*58.9*
Health Professions (inc. MD)	178	19.4
Business	103	11.2
Social and Related Sciences	7	0.8
Other Non-S&E Fields	88	9.6
Total - Non-S&E Fields	*376*	*41.0*

Source: LSAMP graduate survey database (UI).

Table F-2D. Percent of students pursuing graduate degrees

Overall and by undergraduate grade point average

	LSAMP Participant	National Comparison	
	All	Underrepresented minority	White and Asian
Weighted N	1,414	36,234	272,557
All Students	65.7[a]	45.6***	44.1***
By Undergrad GPA[b]			
3.75-4.00	77.7	47.0*	68.4
3.25-3.74	71.3	57.0*	52.5***
2.75-3.24	61.5	51.1	35.4***
2.25-2.74	46.5	20.1**	32.3
LE 2.24	**48.9**	48.9	32.5

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: [a] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 2.6 percentage points; [b] When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of 3.2 percentage points (min=1.1; max=5.5).

* Significantly different from LSAMP, p=.05

** Significantly different from LSAMP, p=.01

*** Significantly different from LSAMP, p<.0001

Table F-3A. Percentage of LSAMP participants who completed graduate degrees at time of survey
Of all respondents

	LSAMP Participants			National Comparison	
	All	*By Field of Study* STEM	Non-STEM	Underrepresented Minority	White and Asian
Weighted N	1421	361	267	36,234	272,964
Completed Graduate Degrees	44.7[a]	25.4	18.8	19.7***	17.7***
Degree Type (% completing degree)[b]					
Master's	29.7	20.0	9.4	12.9***	12.3***
PhD	4.0	3.5	0.5	0.2***	1.0***
Professional	11.0	1.9	8.9	6.6	4.5***

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: Table excludes 0.5% of LSAMP graduates w/ missing field of study info;[a] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 4.1 percentage points;[b] When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of 1.4 percentage points (min=1.0; max=2.0).

*** Significantly different from LSAMP, p<.0001

Table F-3B. Percent of completed degrees in a STEM field, by degree type

	LSAMP Participants		National Comparison			
	All		Underrepresented Minority		White and Asian	
	STEM	Non-STEM	STEM	Non-STEM	STEM	Non-STEM
Weighted N	361	267	3070	4081	24,494	23,922
% of all respondents	25.4[a]	18.8	8.5***	11.3***	9.0***	8.8***
All Graduate Degrees (%)	57.5[b,+]	42.5	42.9*	57.1*	50.6*	49.4*
Degree Type (%)[c]						
Master's	68.5	31.5	64.0	36.0	63.6	36.4
PhD	87.5	12.5	100[1]	0	100[1]	0
Professional	17.6	82.4	0	100	3.7	96.3

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: [a] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 2.9 percentage points;[b] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 1.2 percentage points;[c] When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of 1.8 percentage points (min=1.2; max=2.5);[1] Compared to the LSAMP underlying N of 32, numbers in these cells have very small underlying Ns (unweighted): Minority, 1 degree; White and Asian, 17 degrees.

[+] Significantly higher than Non-STEM, p<.0001. National URM and National White & Asian: No significant difference between STEM/Non-STEM.

* Significantly different from LSAMP, p=.05

** Significantly different from LSAMP, p=.01

*** Significantly different from LSAMP, p<.0001

Table F-3C. Distribution of graduate degree type completed at the time of the survey

	LSAMP Participants			National Comparison	
	All	*By Gender* Male	Female	Underrepresented Minority	White and Asian
Weighted N	635	304	331	7,150	48,416
% of all respondents	44.7[a]	42.2	47.2	19.7***	17.7***
Distribution of Additional Degrees (%)[b]					
Master's	66.5	69.4	63.7	65.4	69.2
PhD	9.0	9.3	8.6	1.1***	5.7
Professional	24.6	21.1	27.8	33.5	25.2

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: [a] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 4.3 percentage points; [b] When analyzed for the restricted LSAMP group, percentages reported in this distribution change by an average of 1.2 percentage points (min=0.1; max=1.8).

No significant gender differences in degree type completed.

*** Significantly different from LSAMP, p <.0001

Table F-3D. Top fields of study for completed graduate degrees

	Weighted N	Percent
Engineering	162	25.5
Health Professions (Inc. MD)	145	23.1
Life and Related Sciences	103	16.5
Business	59	9.4
Physical and related sciences	52	8.5
Computer and Math Sciences	44	6.9
Misc. Non-STEM Degrees	63	10.0

Source: LSAMP graduate survey database (UI).

Table F-3E. Pipeline of graduate degree seekers, as of May 2002

	Weighted N	% Completed	% Still Taking Courses	% Not Taking Courses	% of Degree Seekers Completed+In Courses
All Grad Degrees	937	59.9	20.9	18.3	80.8
Degree Type					
Master's	606	60.5	16.7	21.4	77.2
PhD	138	35.9	46.1	17.4	82.0
Professional	193	74.6	16.3	9.1	90.9

Source: LSAMP graduate survey database (UI).

Table F-4. Likelihood of LSAMP participants taking future courses
Of those who had not taken additional coursework post-Bachelor's

	Overall		By Gender	
	Weighted N	Percent	Male	Female
Very Likely	164	54.9	56.6	52.7
Somewhat Likely	105	35.8	35.4	36.5
Very Unlikely	27	9.2	8.1	10.8

Source: LSAMP graduate survey database (UI).
Note: Table excludes 3% missing due to item non-response.

Table F-5. Reasons Cited for *not* taking classes since receiving Bachelor's degree

	LSAMP Participant	National Comparison	
	All	Underrepresented minority	White and Asian
Weighted N	279	13,732	104,779
Percent of total sample	19.6	37.9	38.4
Responded "Yes" (*percent*)			
Had a job, needed to work	76.1	58.4**	59.7***
Had achieved educational goals (at least temporarily)	58.1	59.1	73.5**
Other financial burdens	47.7	32.0**	28.6***
Needed a break, tired of going to school	45.1	28.2**	28.9***
Had to stop due to family responsibilities	34.0	24.9	15.4***
No longer certain of the field of study you wanted to pursue	22.3	16.8	12.6**
Moved, could no longer take courses at the school were attending	20.7	9.6*	4.1***
Waiting for the next term to start	7.8	2.9	1.6**
Other reason	20.9	4.1***	6.6***

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).
* Significantly different from LSAMP, p =.05
** Significantly different from LSAMP, p =.01
*** Significantly different from LSAMP, p <.0001

Table F-6A. Job relatedness to STEM degree, within broad field of work

	Weighted N	Percent distribution
All Jobs	1277	100
Broad Field of Work (NSF Categories)		
Computer and Math Scientists	140	11.0
Life and Related Scientists	75	5.9
Physical and related scientists	47	3.7
Engineers	341	26.7
Non-S&E Occupations	675	52.9

Source: LSAMP graduate survey database (UI).

Note: Table excludes 10% due to item non-response.

Table F-6B. People working in STEM fields
All Respondents

	LSAMP Participant	National Comparison	
	All	Underrepresented minority	White and Asian
Weighted N	1,280	36,234	272,460
Job is in a STEM Field			
Yes	47.1[a]	49.2	51.9*
No	52.9	50.8	48.1*
Job is in STEM or Medicine			
Yes	61.8[b]	62.3	61.9
No	38.2	37.7	38.1

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

Notes: Table excludes 5% of LSAMP with missing job information; 5% (Raw N=29) of restricted LSAMP group has never worked; [a] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 1.8 percentage points; [b] When the analysis is restricted to LSAMP participants with a comparable lapse between graduation and survey, this percentage is reduced by 2.3 percentage points.

* Significantly different from LSAMP, p=.05

Table F-6C. Job relatedness to highest degree, reasons for working outside of degree field

All Respondents

	LSAMP Participant	National Comparison	
	All	Underrepresented minority	White and Asian
Weighted N	1,322	33,057	250,610
Relatedness of Degree to Job (%)			
Closely Related	64.7	59.1	61.0
Somewhat Related	25.9	25.9	25.5
Not Related	9.5	15.0*	13.5**
Reasons Why Working Outside of Degree Field			
Weighted N	126	4,960	33,832
Pay, Promotion Opportunitites			
Yes	53.5	43.2	48.0
No	41.3	56.8	52.0*
Missing	5.2	0.0*	0.0*
Job Location			
Yes	42.7	50.7	46.1
No	50.8	49.3	53.9
Missing	6.5	0.0*	0.0*
Change in Career or Professional Interests			
Yes	40.0	40.1	39.0
No	56.1	59.9	61.1
Missing	3.9	0.0*	0.0*
Working Conditions			
Yes	38.9	47.4	45.0
No	54.6	52.6	55.0
Missing	6.5	0.0*	0.0*
Job in Highest Degree Field Not Available			
Yes	30.3	44.2	48.7**
No	63.2	55.8	51.3
Missing	6.5	0.0*	0.0*
Family-Related Reasons			
Yes	18.8	13.2	16.4
No	74.6	86.8	83.6
Missing	6.5	0.0*	0.0*
Other			
Yes	21.6	11.4	5.3***
No	55.5	88.7***	94.7***
Missing	22.9	0.0***	0.0***

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

* Significantly different from LSAMP, p=.05

** Significantly different from LSAMP, p=.01

*** Significantly different from LSAMP, p<.0001

Table F-7. Professional Activities
All Respondents

	LSAMP Participant	National Comparison	
	All	Underrepresented Minority	White and Asian
Weighted N	1,406	36,234	272,460
Number of Professional SocietyMemberships (%)			
0	39.8	47.7*	49.1***
1	23.5	26.3	25.8
2	22	16.1*	17.1**
3	9.6	7.1	4.8***
4-9	5.1	2.8	3.3*
Attended Professional Society Meetings (%)			
Yes	42.7	43.2	44.9
No	55.1	56.8	55.0
Missing	2.2	0.0***	0.2***

Sources: LSAMP graduate survey database (UI) and NSRCG longitudinal file (NSF).

* Significantly different from LSAMP, p=.05

** Significantly different than LSAMP, p=.01

*** Significantly different from LSAMP, p <.0001

Table F-8A. How helpful was LSAMP in terms of...

	5	4	3	2	1
	Extremely Helpful		--		Not Helpful
Earning a Bachelor's degree in STEM	36.4	31.6	20.9	4.5	6.6
Completing College	31.9	28.8	22.3	8	8.3
Attending Graduate School[1]	26.6	21.3	20.2	9.3	22.6
Attaining a Post-College Job[2]	19.4	16.1	18.6	9.8	18.6

Source: LSAMP graduate survey database (UI).

Notes: [1] Of those attending graduate school only; [2] Excludes 5% who have not held a full-time job and 12% that were missing.

Table F-8B. Participation in LSAMP Activiities: Overall and by Key Outcomes

	All	Pursuing Grad Degrees		Pursuing STEM Grad Degrees		Completing Grad Degrees		Completing STEM Grad Degrees	
		Yes	No	Yes	No	Yes	No	Yes	No
All (N)	1371	901	470	530	841	622	749	355	1016
All (percent)	100	65.7	34.3	38.7	61.3	45.3	54.7	25.9	74.1
Academic Support									
Peer Study Group	35.8	35.4	36.6	33.6	37.2	35.4	36.2	33.1	36.8
Skills Building Workshop	34.2	35.6	31.6	35.9	33.1	36.0	32.7	38.6*	32.7
Summer Bridge	24.2	26.8**	19.3	25.8	23.2	27.6**	21.4	28.9*	22.6
Tutoring	28.0	27.4	29.1	24.9	29.9*	26.7	29.0	24.2	29.3
At least one Academic Support Activity	62.1	63.0	60.4	60.8	63.0	63.8	60.7	63.4	61.7
Professional/Work Experience									
Research with Faculty	49.1	53.6***	40.3	56.1***	44.7	54.3**	44.7	59.9***	45.3
Mentorship Program	39.8	40.1	39.4	37.6	41.2	40.8	39.0	37.9	40.5
Research Internship	29.2	31.6**	24.6	33.9**	26.2	30.4	28.2	35.2**	27.1
Career Awareness Activities	37.2	38.4	34.8	37.2	37.1	41.6**	33.5	42.4*	35.4
At least one Professional/Work Experience Activity	79.9	81.2	77.4	82.8*	78.0	80.9	79.0	83.9*	78.5
Graduate School Support									
Graduate School Admissions Support	18.7	23.4***	9.8	25.5***	14.5	24.7***	13.8	28.8***	15.2
GRE Training	12.4	14.4**	8.5	17.3***	9.3	12.8	12.0	16.1*	11.1
At least one Graduate School Support Activity	25.0	30.4***	14.7	34.5***	19.0	31.1***	19.9	36.2***	21.1
Other LSAMP	12.5	13.9*	9.9	13.4	12.0	15.2**	10.3	13.8	12.1
Mean Number of LSAMP Activities	3.09	3.27**	2.74	3.28*	2.96	3.30**	2.91	3.45**	2.96
standard deviation	*(3.00)*	*(3.07)*	*(2.83)*	*(3.07)*	*(2.96)*	*(3.14)*	*(2.88)*	*(3.17)*	*(2.93)*
Did not participate in any of the LSAMP activities	8.0	7.2	9.5	6.6	8.9	6.8	9.0	4.3	9.3**
Mean Number of Years in LSAMP	2.15	2.28***	1.92	2.23	2.11	2.34***	2.00	2.31*	2.10
standard deviation	*(1.78)*	*(1.82)*	*(1.65)*	*(1.80)*	*(1.76)*	*(1.79)*	*(1.75)*	*(1.77)*	*(1.78)*

Source: LSAMP graduate survey database (UI)

Notes: Respondents with missing information about participation in LSAMP activities are excluded from the table (4% of LSAMP participants). A test of item non-response bias indicates that missing values are distributed evenly within outcomes.

* Significantly higher, p=.05

** Significantly higher, p=.01

*** Significantly higher, p<.0001

Table F-9. Demographics and program outcomes: Community college starters versus traditional students

	Community College Starter	
	Yes	No
Weighted N	103	1196
Gender		
Male	63.0***	48.8
Female	37.0	51.2***
Ethnicity		
Native American/Pacific Isl.	6.7	5.0
Black	39.5	59.0***
Hispanic	53.8***	36.0
Mother's Education		
LT High School	24.4***	15.5
HS Grad	27.7	26.8
Some College	21.0	20.4
College Grad	15.1	19.4
Some Grad or Above	11.8	17.8*
Undergraduate GPA		
3.75-4.0	12.6	12.1
3.25-3.74	42.0	39.1
2.75-3.24	33.6	38.8
2.25-2.74	10.1	7.8
LT 2.25	1.7	1.4
Enrolled in STEM Graduate Studies		
Yes	32.5	38.7
No	64.2	59.3
Missing	3.3	2.0
Completed STEM Grad Degree		
Yes	20.2	26.3
No	79.0	73.7

Source: LSAMP graduate survey database (UI).

* Significantly higher, p=.05

** Significantly higher, p=.01

*** Significantly higher, p<.0001

THE URBAN INSTITUTE
Program for Evaluation and Equity Research (PEER)