

*National Science Foundation
Model Institutions for Excellence*

Expanding the K-16 Pool of Potential STEM Graduates

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AMERICAN
INSTITUTES
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Overview of the Expanding the K–16 Pool Project

Introduction

The Model Institutions for Excellence (MIE) program, initiated in 1994, is a joint venture between the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). The program was designed to increase the number of underrepresented minorities in science, technology, engineering, and mathematics (STEM) through funding to a select group of minority-serving institutions. The MIE program's success has been noteworthy. The STEM infrastructure to support underrepresented minority engagement and success is solidly built at each MIE program site. As a result, the number of STEM bachelor's degrees conferred by each MIE has increased steadily since the program's inception, outpacing the national average of STEM degrees awarded to underrepresented minority students.

However, the pipeline of underrepresented minority students who are successfully prepared to pursue STEM degrees by high school graduation is not as impressive. Research has shown that the pipeline to STEM is particularly narrow for African American, Hispanic American, and American Indian males because they:

- Under-enroll in college preparatory courses in high school despite outperforming their female counterparts on mathematics and science achievement tests;
- Face unique psychosocial barriers to academic achievement; and

- Disproportionately confront institutional barriers to improved academic outcomes in their schools.

While these are separate challenges not addressed by the current MIE program, they are a natural extension of the MIE program's work to ensure an expanded pool of potential STEM matriculates at each higher education institution. Therefore, recognizing these challenges as strategic imperatives, from fall 2004 through fall 2006, the American Institutes for Research® (AIR®) worked with the NSF MIE grantees to expand its distinguished STEM training and recruitment efforts to the K–12 arena by providing technical assistance for the establishment of community-based K–16 partnerships led by the MIE.

Formally named “Expanding the K–16 Pool of Potential STEM Graduates,” the project sought to be a capacity-building initiative and catalyst for a national dialogue on underrepresented minority male achievement. The goal was to develop school, community, and business partnerships to broaden the enrollment of minority students, especially minority males, in STEM at the postsecondary level and to create a partnership model for strategic and sustainable change.

Building K–16 partnerships between Model Institutions for Excellence and K–12 school systems is a natural opportunity to leverage the substantial NSF and NASA investments in these institutions. By developing partnerships, a greater yield or return to these

investments can be obtained by extending the momentum of success that the MIEs have generated for underrepresented minorities in STEM.

In this report, we begin by sharing data and research on the problem of minority male achievement and the narrow pipeline to STEM. We discuss the MIE Program and why it is ideally poised to lead the Expanding the K–16 Pool effort. In the second section of the report, we discuss AIR’s technical assistance approach and partnership development activities over the course of the grant. In the third section, we discuss overall and MIE site-specific program outcomes including the lessons learned by the MIE sites throughout

The national trends are unmistakable. Underrepresented minority males take fewer college preparatory courses—geometry, algebra II, calculus, biology, chemistry, and physics—that prepare them to successfully pursue STEM fields than minority females.

the process of planning a K–16 partnership. In the fourth section, we share the challenges and successes faced by AIR as the technical assistance provider. In the final section, we offer recommendations for future work should NSF choose to continue its support of the Expanding the K–16 Pool initiative.

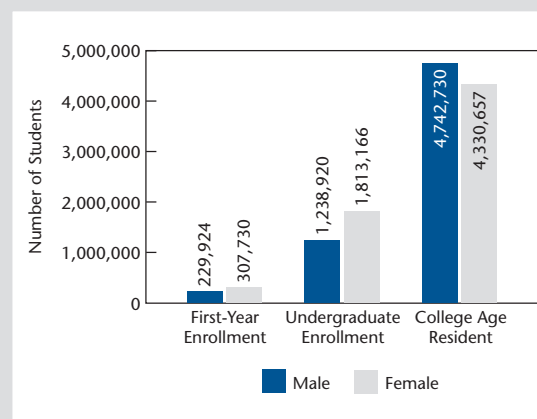
Background

The Problem

Underrepresented minority (i.e., African American, Hispanic American, and American Indian) males are leaking from the pipeline to STEM fields in higher education and beyond. The national trends are unmistakable. Underrepresented minority males take fewer college

preparatory courses that prepare them to successfully pursue STEM fields—geometry, algebra II, calculus, biology, chemistry, and physics—than minority females. Even when minority males take a college preparatory course such as an Advanced Placement (AP) course, they are less likely to take the corresponding AP exam.¹ Further, minority males are less likely than their female counterparts to graduate from high school,² and a lower percentage of minority males take the Scholastic Aptitude Test (SAT) than minority females.³ As a result, underrepresented minority men pursue higher education in lower numbers than minority women, even though they represent a larger percentage of the college-age resident population, as seen in the graph below:

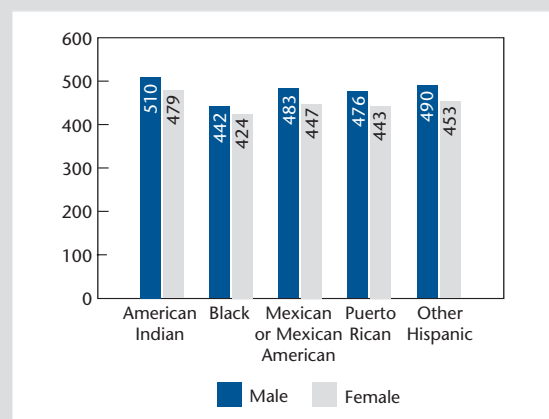
Figure 1. URM Postsecondary Enrollment by Gender, 2000



Source: National Science Foundation, Division of Science Resources Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Fall Enrollment Survey, 1994–2000.

Conversely, nationally as well as in each of the U.S. states and one territory in which an MIE was established in 1994—Georgia, Maryland, Louisiana, South Dakota, Texas, and Puerto Rico—the minority males who do take the SAT generally outperform minority females on mathematics measures on the SAT reasoning test:

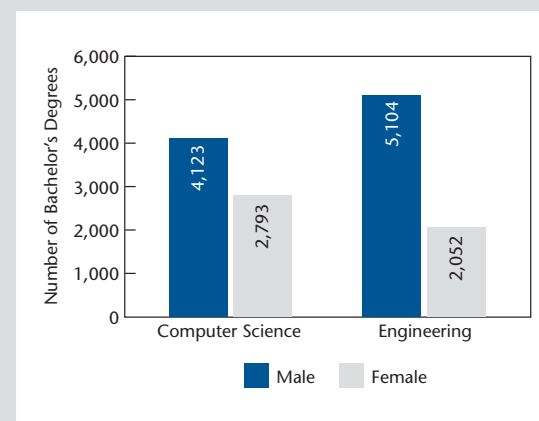
Figure 2. National 2005 SAT Reasoning Test Takers: Math Mean Scores by Gender



Source: http://www.collegeboard.com/about/news_info/cbsenior/yr2005/reports.html

Minority males who pursue higher education are awarded more associate's and bachelor's degrees in STEM fields than their female counterparts overall.⁴ Minority males are particularly successful in pursuing computer science and engineering degrees:⁵

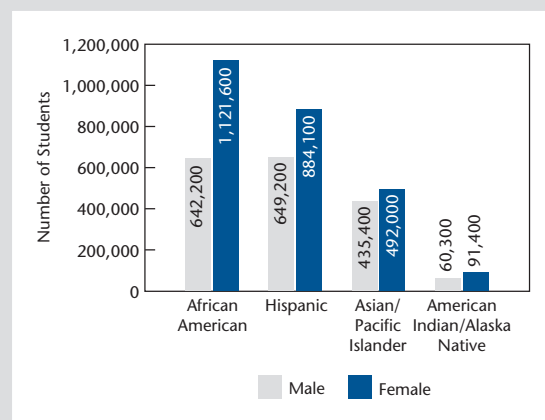
Figure 3. Number of Computer Science and Engineering Degrees Awarded to Minority Students by Gender, 2001



Source: National Science Foundation, Division of Science Resources Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Fall Enrollment Survey, 1994–2000.

This is the case even though across all racial and ethnic groups, minority men enroll in college in lower numbers than minority women:

Figure 4. URM Undergraduate Enrollment by Gender, 2000



Source: National Science Foundation, Division of Science Resources Statistics, special tabulations of U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System, Fall Enrollment Survey, 1994–2000.

These trends suggest that minority males are not incapable or disinterested in attaining and achieving at high levels in STEM fields. Instead, the Expanding the K–16 Pool initiative recognized a number of psychosocial and institutional barriers to improved minority male academic outcomes across the K–16 continuum.

Psychosocial Barriers to Improved Minority Male Achievement

There is a paucity of empirical research on discreet gender, racial, or ethnic disparities in the mathematics and science fields. Much of

the work that has been completed focuses on the teaching and learning of minority students as a whole or is theoretical in nature.

Furthermore, many explanations for the STEM achievement gap in the United States have rested on controversial student deficit models⁶ pointing to such factors as visible minority status, socioeconomic status, learning ability, and self-concept. Racism is primary among these explanatory models. For instance, minorities marked by visible characteristics such as skin color, dress, and hair type that do not closely resemble the dominant culture are not received as well by society and the educational system.⁷

Self-concept is another popular factor cited in the research. Both empirical studies and theoretical works have argued that sociological factors specific to U.S. society prevent minorities from recognizing their potential as students, therefore devaluing the role that academics can play in their lives. For example, psychologist Jason Osborne claims that “disidentification” with school can cause or contribute to poor academic outcomes and decreased motivation to succeed academically. Disidentification reveals itself in a number of ways. Even though any student can experience anxiety in school situations such as concern over appearing unintelligent for giving a wrong answer in class, the burden is particularly great for members of underrepresented minority groups for which negative group stereotypes concerning academic ability prevail. For these individuals, a wrong answer is not only personally damaging, but also confirms the negative group stereotype among their white peers. Osborne claims that African American boys are most likely to become disidentified with academics as they move from one grade level to the next, more

so than any other subgroup.⁸ Similarly, other researchers have argued that minority males are less likely to achieve in school than minority females because of marketplace forces and the socialized expectation that they be the breadwinners:

Who we are is what you buy, display, and consume... The successful linking of icons of male-centered culture—sports and sport figures in particular—to marketed items for identity—sport shoes, jerseys, etc.—is a major innovation. Further, car culture and technology culture (cell phones, computer games, etc.) have also greatly extended the commercialization of what have been historically masculine traits... Male earning power is greater than that of females immediately after high school and thus may exert a disproportionate pull into the labor force for them.⁹

In U.S. society, white and minority males alike are idealized and socialized to be breadwinners. The typical male role is characterized by competitive and aggressive behavior, as well as expectations of economic and social superiority or privilege with strong ramifications for the decisions males make about school and career.

Institutional Barriers to Improved Minority Male Achievement

Whatever merit such explanations may have, there is much more compelling evidence to suggest that institutional factors must be at work when underrepresented minority males make decisions about what courses to take in high school and what education and careers to pursue after graduation. Of these factors, the most actionable ones that influence the

STEM pipeline include: (a) low expectations, (b) access to college preparatory work, (c) underqualified teachers, (d) the home–school disconnect, and (e) a lack of role models.

Low Expectations

One of the most striking findings of the Metropolitan Life *Survey of the American Teacher 2000: Are We Preparing Students for the 21st Century?* was that teachers' expectations for their students' postsecondary aspirations were vastly lower than the goals stated by the students themselves. In fact, 71 percent of high school student respondents reported their intentions to attend a four-year college, while teacher respondents believed that only 33 percent of their students planned to attend a four-year college.

Teachers' expectations of their students are highly influential.¹⁰ Minority students are most likely to experience biasing effects of teacher expectations.¹¹ Poor teacher expectations have a detrimental effect on student motivation and achievement.

School guidance counselors have been held responsible for perpetuating low expectations in high schools, as they often are the gatekeepers to the college preparatory track. These counseling issues have been shown to persist in higher education where career counselors have been found to dissuade minority students from pursuing challenging fields.¹² There is a growing division within the school counseling community regarding the appropriate focus of its programs—mental health or academic guidance. Historically, such programs have adhered more closely to the mental health model, but increasing achievement gaps between low-income and

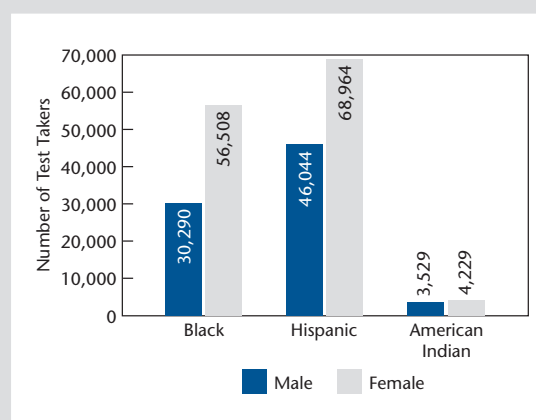
minority students and their more advantaged peers signaled a need for guidance counselors to take on the role as academic advocate and advisor for all students.¹³ This call for a shift in focus runs counter to the role that school counselors have played traditionally in the lives of minority, low-income, and female students, but the fact remains that guidance counselors can play an important role in reducing biases by ensuring that all students have access to appropriate mathematics preparation and timely career guidance and exploration.¹⁴

Access to College Preparatory Coursework

Rigorous course-taking in high school is one of the most reliable predictors of participation and success in higher education.¹⁵ However, the average high school graduate has not been adequately prepared to pursue higher education without the need for remediation.¹⁶ Over time, underrepresented minority students have consistently taken fewer college preparatory mathematics courses than their white and Asian peers. A smaller percentage of underrepresented minority students take geometry, algebra II, or calculus by graduation than Asian and white students.

Underrepresented minority participation in college preparatory science courses is similarly disconcerting, particularly given the evidence that performance in college preparatory courses is the most influential factor in college admissions decisions.¹⁷ Fewer underrepresented minority students take AP examinations in biology, chemistry, and calculus.¹⁸ Of the minority students who take AP examinations, women participate in greater numbers:

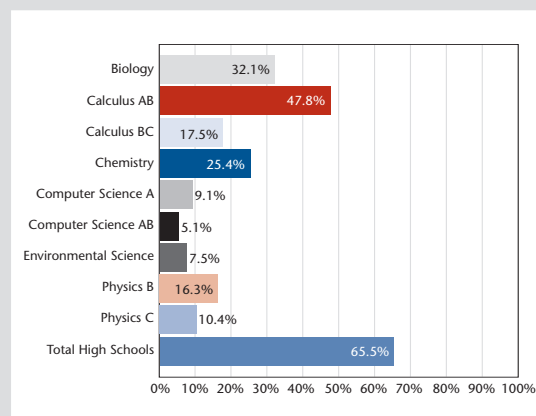
Figure 5. URM Students Taking an AP Exam by Gender, 2004



Source: The College Board, AP 2004 National Summary Reports. http://www.collegeboard.com/student/testing/ap/exgrd_sum/2004.html.

This is largely because of access inequalities. Many high schools do not offer AP courses:

Figure 6. Percentage of U.S. High Schools Offering AP Courses by Subject, 2004

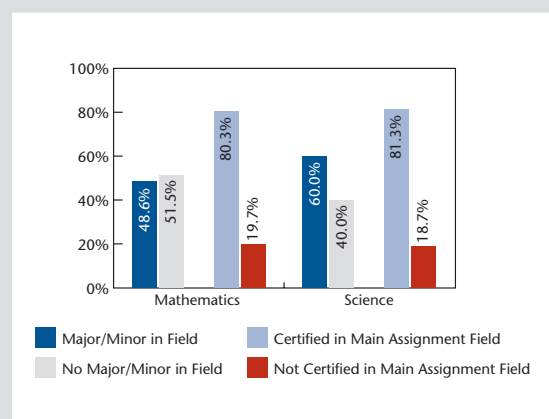


Source: The College Board, Exam Data: 2004, <http://www.apcentral.collegeboard.com>

Underqualified Teachers

Underrepresented minority students preparation in STEM fields is also hampered by their disproportionate assignment to underqualified teachers. Although the majority of middle school mathematics and science teachers are certified, roughly half of middle school mathematics and science teachers did not major or minor in their main assignment field:

Figure 7. Percentage of Qualified Middle School Mathematics and Science Teachers, 1999–2000

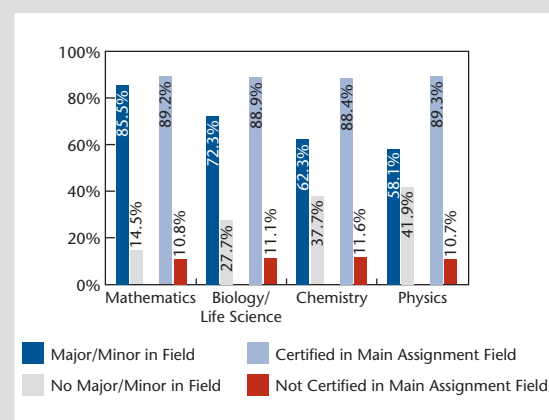


Source: U.S. Department of Education, National Center for Education Statistics. (2004). Qualifications of the public school teacher workforce: Prevalence of out-of-field teaching, 1987–88 to 1999–2000, NCES 2002–603 Revised by M. McMillen Seastrom, K. J. Gruber, R. Henke, D. J. McGrath, & B. A. Cohen. Washington, DC.

At the high school level, there is a particular shortage of chemistry and physics teachers who majored or minored in the subjects they teach. Although high school teachers are better qualified to teach mathematics and the life sciences than middle school teachers, with more receiving bachelor's degrees in their

main assignment field, roughly half of all physical science teachers did not major or minor in the subjects they teach:

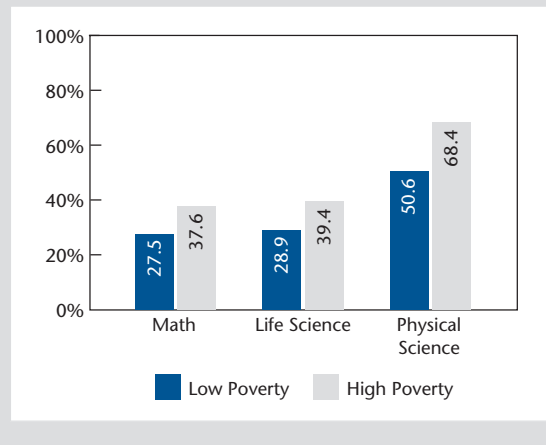
Figure 8. Percentage of Qualified High School Mathematics and Science Teachers, 1999–2000



Source: U.S. Department of Education, National Center for Education Statistics. (2004). Qualifications of the public school teacher workforce: Prevalence of out-of-field teaching, 1987–88 to 1999–2000, NCES 2002–603 Revised by M. McMillen Seastrom, K. J. Gruber, R. Henke, D. J. McGrath, & B. A. Cohen. Washington, DC.

These out-of-field teachers work disproportionately in high-poverty schools.¹⁹ In fact, classes in high-poverty secondary schools are 77 percent more likely to be assigned an out-of-field or inexperienced teacher than are classes in low-poverty schools.²⁰ The problem is especially acute in the physical sciences where the majority of teachers in low- and high-poverty schools alike are underqualified:²¹

Figure 9. Percentage of Out-of-Field Public School Teachers in Mathematics and Science by Poverty Enrollment, 1993–1994



Home–School Disconnect

Cultural differences influence academic achievement in school.²² Therefore, traditional curricula may hurt students more than not by further highlighting the separateness and differences of people of color.²³ Moreover, traditional school curricula promote white, middle-class ideals rather than embracing the ideals of the country’s various cultures. Lack of parental involvement in school and curriculum design further perpetuates the home–school disconnect.²⁴

Lack of Role Models

While the previously mentioned factors affect underrepresented minority students as a whole, other factors may explain variations in achievement among males and females. In addition, high school student retention is strongly influenced by disciplinary action, which is taken out disproportionately on certain groups of students, such as those who demonstrate an adversarial attitude toward

school and teachers. As stated previously, disidentification with academics reveals itself in various ways. Prominent among these is the “cool pose”—a ritualized approach to masculinity that allows African American males to cope with a difficult or unpleasant environment. Cool pose is characterized as an outward show of fearlessness and detachment to counter ill-feelings such as damaged pride and diminished self-confidence.

Traditional school curricula neglect the contributions of people of color, encouraging stereotypes about the absence of minorities in academia and specific careers. The multicultural curricula typically implemented in schools are inadequate because they examine the contributions of disadvantaged groups separately from the primary curriculum (e.g., Hispanic History Month).

The absence of Latino teachers in schools is also problematic. Latino males are more likely than Latino females to be tracked into remedial courses and, consequently, are more likely to take on an adversarial stance toward teachers.²⁵ Latinos are three times more likely to be suspended from school than Latinas, more likely to be referred for special education than Latinas, and erroneously viewed as gang members by teachers and counselors than Latinas.²⁶ Such disproportionate disciplinary action frequently becomes cause for suspension and expulsion, increasing the likelihood that an underrepresented minority male’s academic career will be cut short. As a result, Latino males participate in smaller numbers in college preparatory courses. In fact, “African American males are expelled from school at twice the rate of white students, and although African Americans are 13 percent of all monthly drug users, they are 55 percent of those convicted of drug possession, and 74 percent of those sentenced to prison for possession. Students convicted of a

drug offense have been made either temporarily, or permanently, ineligible for federal college loans and grants by the Drug Free Student Loans Act of 1998. For those in prison, access to Pell Grants was terminated by law in 1994.”²⁷

Factors such as these—inexperienced teachers, lack of culturally relevant curricula, and access to the college preparatory track affect all underrepresented minority students. As stated previously, there is insufficient empirical research on the gender-by-race achievement gap in STEM fields. However, what little we do know about why underrepresented minority males are less prepared than underrepresented minority females to pursue STEM careers is clear. Not only do minority males

Whereas African American females have plentiful role models in schools, higher education, and the workplace to look to for guidance and support, lack of underrepresented minority male role models, particularly as teachers, is one of the most compelling barriers to academic achievement for adolescent minority males.

face the aforementioned hurdles, but they are also more likely to drop out of high school and/or not enroll in college because they face the following psychosocial and institutional challenges:

- Lack of male role models in schools and business;
- Disproportionate disciplinary action including suspension and expulsion;
- Disproportionate pull of the labor force;
- Lower teacher expectations of underrepresented minority male achievement evidenced by the consistent awarding of lower grades, more criticism, less praise, and less attention;

- Stronger peer pressure to disassociate with school and studying; and
- Disproportionate assignment to special education classes.²⁸

The Proposal

To address the problem of the narrow pipeline to STEM, in fall 2004, The McKenzie Group (now merged with AIR) received funding to help leverage the experience and expertise of the MIE program. The MIE program, initiated in 1994, is a joint venture between NSF and NASA. The program was designed to increase the number of underrepresented minorities in STEM through funding to a select group of minority-serving institutions. Four NSF-funded and two NASA-funded MIE sites received long-term funding for infrastructure development in STEM education and individual support to recruit and retain minority STEM students. The six MIE programs include: (1) Bowie State University, Maryland (2) the Oyate Consortium (composed of Oglala Lakota College, Sitting Bull College, and Sisseton-Wahpeton College located in South and North Dakota); (3) Spelman College, Georgia; (4) Universidad Metropolitana, Puerto Rico; (5) University of Texas at El Paso; and (6) Xavier University of Louisiana.*

Bowie State University

Bowie State University is the oldest Historically Black College/University (HBCU) in Maryland. Founded in 1865 as the Baltimore Normal School, it progressed into a four-year program and migrated into the University of Maryland system in 1988.

* The following descriptions of each MIE were adapted from the “Creating and Maintaining Excellence: The Model Institutions for Excellence Program” report.

As a public university, Bowie admits about 50 percent of its applicants. The majority of students at Bowie State are nontraditional students who have not conventionally been known to pursue STEM majors or careers. Rather, local students who are interested in pursuing such careers have traditionally attended one of the two area research universities in the University of Maryland system.²⁹ Appropriately so, Bowie has focused its MIE program on the enrollment and preservation of STEM students.

Bowie is funded by NASA and is directed by Dr. Elaine Davis. Student enrollment is more than 5,000 and consists primarily of nontraditional commuter students from Prince George's County, Maryland. During the early 1990s, before MIE funding was initiated, the number of students enrolled in STEM majors had essentially leveled off. Bowie's STEM faculty have nearly doubled in the past 11 years. Currently, Bowie State comes in as the number one university in the production of African Americans with master's degrees in computer science and information sciences with 19 undergraduate degree programs.

Oglala Lakota College

The Oyate Consortium is an association among three tribal colleges in South and North Dakota (Oglala Lakota College, Sitting Bull College, and Sisseton-Wahpeton College). All of the colleges within the consortium were founded during the 1970s. The colleges service Native American students from the Pine Ridge, Standing Rock, and Lake Traverse (Sisseton) reservations as well as non-Native

Americans from the surrounding area. Pine Ridge is the second-largest Indian reservation in the country. Due to this large geographic area, there are 12 remote education centers making Oglala Lakota College a decentralized campus.³⁰

The average student age in the consortium is 29, the majority of whom are female with children. A vast majority of students receive some sort of financial aid. A large number of students score 30–40 percent below the state average on standardized tests in mathematics and science, which triggered the need to create college-level and developmental courses that would prepare entering freshmen students for the demands of mainstream, college-level courses.

At the inception of the MIE program in 1995, the consortium had a dearth of experienced staff to teach STEM courses at the college level. Furthermore, none of the colleges in the consortium supported STEM degree programs. The straightforward goal of the MIE program was to “create an opportunity for science, engineering and mathematics education,” which then did not exist.³¹ The three schools put together educate nearly 2,000 students, many of whom attend on a part-time basis. The Oyate Consortium, funded by NSF and directed by Stacy Phelps, offers onsite and distance education.

Spelman College

Spelman College has been nationally recognized for its strong science programs even

prior to receiving MIE funding. Approximately one third of its students were pursuing STEM fields at the start of MIE funding. Spelman has a long history of receiving financial support from foundations, private donors, and government agencies. As such, Spelman's application for MIE funding explicitly stated that it wanted to focus on enhancing its STEM program facilities and methods to retaining students instead of focusing on its already outstanding recruitment strategies of STEM students. Founded in 1881, Spelman College has established a national and international reputation as an elite institution among private liberal arts colleges. Spelman is one of only two HBCUs exclusively for women.³²

Student support is the primary strength of Spelman's MIE program, as evidenced by its particularly student-centered curriculum. Spelman is renowned for its academic programs and the leaders it graduates. As a member of the Atlanta University Center (the largest consortium of HBCUs), Spelman boasts more than 25 possible majors as well as coursework in prelaw and premedicine sequences. Spelman College is funded by NASA, directed by Dr. Albert Thompson, and managed by Jermaine S. Duffie.

Universidad Metropolitana

Universidad Metropolitana (UMET) is a private university in San Juan, Puerto Rico. Established in 1980, UMET is one of four institutions in the Ana G. Mendez University System. The university serves primarily Puerto Rican female students; the female-to-male student ratio is more than two to one. A great number of UMET students yield from low-income households and are first-generation

college students. UMET is largely a commuter school, and more than 90 percent of students receive some form of financial aid. The majority of the students at UMET are first-generation college students who have not given serious thought to pursuing careers as engineers and scientists. The UMET MIE is funded by NSF and Dr. Jaun Arratia is the director and principle investigator. The MIE program at UMET emphasizes undergraduate research and curriculum development. A principal initiative that exemplifies this aim is an 8-week summer internship that affords undergraduate students the opportunity to work with world-class scholars at major research institutions worldwide.³³

The University of Texas at El Paso

The University of Texas at El Paso (UTEP) was founded in 1914 as the Texas State School of Mines and Metallurgy. Since then, more than 76,200 students have graduated through the School of Mines and Metallurgy at UETP. Now a public doctoral granting institution, UTEP has nearly 19,000 students with the college of engineering comprising nearly 13 percent of the student population, and the college of science accounting for 8 percent of the student body.

UTEP is located along the Texas-Mexico border. A vast majority of students are commuters, more than 80 percent of students have financial responsibilities, and most students are working to pay their way through college. More than half of UTEP students receive need-based financial support. Most students are first-generation college students, meaning they often are unsatisfactorily equipped for college. Consequently, the MIE program was designed to help science and

engineering students thrive academically, foster learning within and across disciplines, and engage students in undergraduate research. UTEP is the second-largest Hispanic majority university and the largest Mexican-American University in this country. Primarily a commuter school, a vast majority of students (82.3 percent) are natives of El Paso County. The remaining are mostly from other parts of Texas, Southern New Mexico, and northern Mexico. Seventy-one percent of UTEP students are Hispanics of U.S. origin and the remainder are international students, the majority of whom live in Ciudad Juárez.³⁴

According to data collected in the 1990s, although the university's first-year retention rates in the Colleges of Engineering and Science (approximately 70 percent) were higher than the general university's retention rate (approximately 66 percent), the six-year graduation rate has been lower than the university-wide rate. To boost graduation rates, UTEP decided to focus on STEM student retention by increasing the per-year retention rate of this demographic by 10 percent and, in effect, increasing by twofold the number of STEM degree recipients.³⁵ UTEP is funded by NSF with Dr. Ben Flores as the MIE director.

Xavier University of Louisiana

Xavier University in New Orleans, Louisiana, is the only U.S. university that boasts both a historically Black and Catholic tradition. In 2004, the University hosted approximately 4,100 students, 35 percent of whom were from in-state, with the remaining students hailing from more than 40 states and 20 foreign countries.³⁶

Xavier aimed to expand on an already accomplished program by targeting recruitment, student retention, and transition activities. MIE funds were used mainly to boost the number of freshmen students pursuing STEM majors and to recruit current students who had yet to embark on graduate study. Funds were also allocated to increase the rate of retention, graduation, and graduate school placement or employment in STEM fields. A primary emphasis of Xavier's MIE program rests on student support. In August 2005, Xavier University suffered severe infrastructural damage to its facilities in the wake of Hurricane Katrina. Since then, the leadership of the MIE program has shifted as students, faculty, and staff work together to regain solidarity and rebuild campus life activities. Currently directed by Dr. Tanya McKinney, Xavier University's MIE funds are allocated by NASA.

The MIE Value-Add

In its original proposal to support these institutions, AIR received funding to complete six activities:

- Activity 1: Identify up to 30 participants from around the country representing the MIE as well as the K–16 STEM research, policy, and practitioner communities to participate in a national workshop.
- Activity 2: Develop a series of research-based workshop discussion papers.
- Activity 3: Develop an agenda for a national workshop.
- Activity 4: Convene a national workshop during which participants define challenges in recruitment of high school

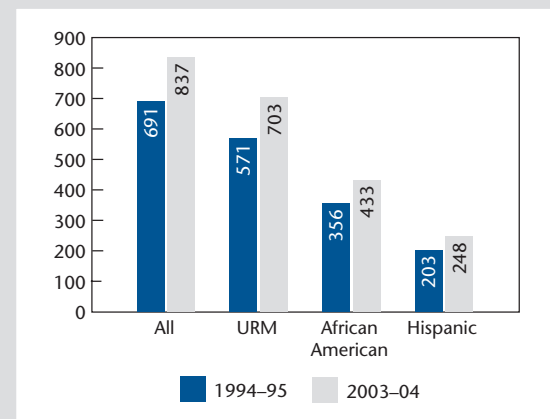
students prepared and motivated to pursue STEM fields; learn about exemplary minority-serving, pre-college programs and models; develop a strategic plan for implementing STEM partnerships between MIE, local secondary schools, and community colleges; and complete an assessment of the resources needed to implement such an initiative.

- Activity 5: Prepare postworkshop discussion and concept papers.
- Activity 6: Provide implementation support to four MIE sites and one non-MIE site to pilot the strategies developed during the national workshop.

The MIE is well-suited to lead this effort. Compared to large universities, minority-serving institutions have more effectively narrowed the gaps related to underrepresented minority and female student participation and persistence in STEM majors. One possible explanation for these institutions' success is their tendency to adopt an apprenticeship model of education whereby they enable close interaction between faculty and students.³⁷ Tribal colleges have been especially successful with American Indian students largely because they are community-oriented; they embrace and incorporate tribal traditions and values into the curriculum.³⁸ With roughly 50 percent of all minority college students attending a community college, tribal college, or HBCU,³⁹ it is understandable why K–16 partnerships that have strong working relations with these types of institutions have made impressive gains. Indeed, the MIE program's success has been noteworthy.

The number of STEM bachelor's degrees conferred by MIE has increased steadily since the program's inception—outpacing the national average of STEM degrees awarded to underrepresented minority students.

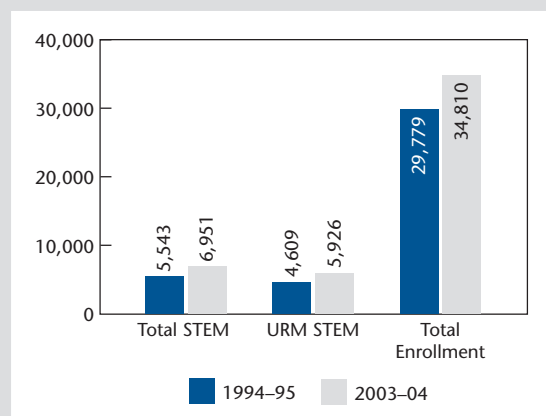
Figure 10. STEM Bachelor Degrees Conferred at MIE Sites (change from AY 1994–95 to AY 2003–04)



Source: Kim, J. J., Crasco, L. M., & Leavitt, D. J. (2005, December). MIE Fact Book 2004. Systemic Research, Inc.

Furthermore, components of MIE's model for success can be reasonably extended to the K–12 arena. According to a review of MIE programs conducted by AIR, there are seven shared characteristic program components: (1) recruitment and transition initiatives, (2) student support, (3) undergraduate research, (4) faculty development, (5) curriculum development, (6) physical infrastructure, and (7) graduate and science career initiatives.⁴⁰

Figure 11. Undergraduate Total and STEM Enrollment at MIE Sites (change from AY 1994–95 to AY 2003–04)



Source: Kim, J. J., Crasco, L. M., & Leavitt, D. J. (2005, December). MIE Fact Book 2004. Systemic Research, Inc.

The most relevant and scalable of these components are the MIE's pre-college initiatives. Recruitment and transition services prepare matriculating students to succeed in college and introduce students to STEM disciplines and careers. Training aids elementary, middle, and high school teachers in improving their content knowledge and teaching ability; introduces young students to the STEM world through hands-on activities (e.g., science fairs, Geographic Information Systems (GIS) mapping); and bridges the transition from high school or community college into college or university (e.g., summer orientation programs).

The AIR technical assistance team and MIE program directors also believe that aspects of other MIE model components can serve as a

replicable framework for improving student access and preparation for STEM careers prior to high school graduation. These imitable components include:

- *Student support*, which refers to social, financial, and academic assistance to STEM students such as peer mentoring, tutoring, and scheduling “cohort” programs in which a small group of students may take some or all core subjects together;
- *Undergraduate research*, which provides opportunities for students to become directly involved in STEM-related research;
- *Faculty development*, which seeks to improve the recruitment, retention, and professional development of STEM faculty;
- *Curriculum development*, which involves efforts to align curriculum with accepted content standards and the development of courses that are relevant to the marketplace, the community, and the student population;
- *Physical infrastructure*, which refers to upgrading and maintaining facilities and equipment; and
- *Graduate and science career initiatives*, which include activities designed to facilitate admission and retention in STEM graduate programs and/or careers.

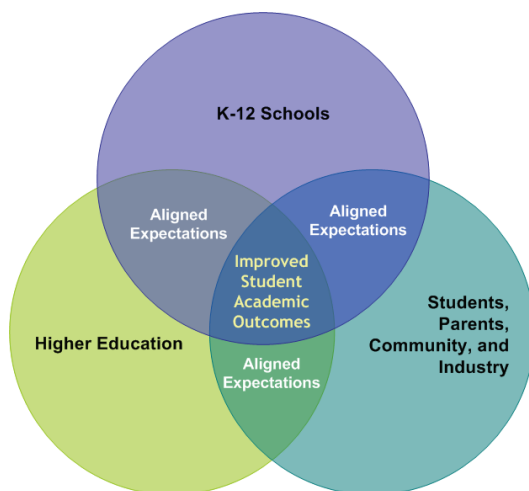
Technical Assistance Activities

Theory of Action

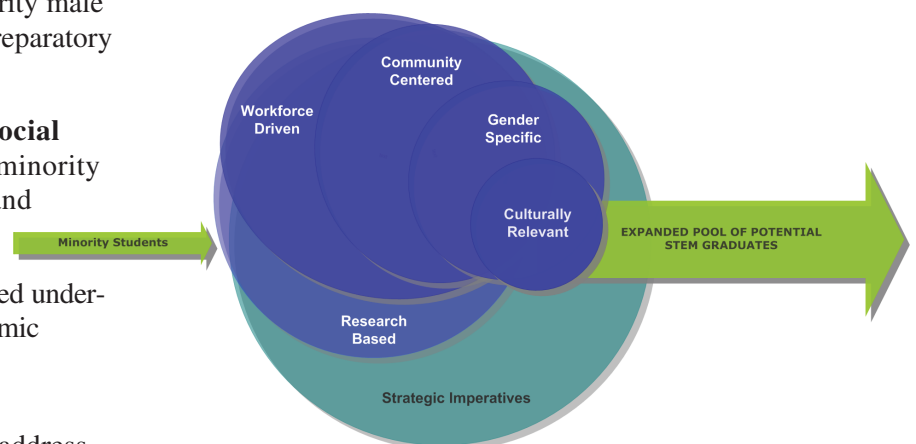
In light of the aforementioned research on gender disparities within racial and ethnic groups, the Expanding the K–16 Pool initiative recognized three strategic imperatives:

- Reverse underrepresented minority male **under-enrollment** in college preparatory courses,
- Eliminate the unique **psychosocial barriers** to underrepresented minority male academic achievement, and
- Remove the disproportionate **institutional barriers** to improved under-represented minority male academic outcomes in schools.

This project sought to strategically address each barrier through the development of targeted K–16 partnerships led by each MIE site. Fundamentally, K–16 partnerships are



voluntary collaborations, often characterized as networks between K–12 school systems and postsecondary institutions established to improve student achievement with support from parents, industry, and community members.



Aligned with the project’s three strategic imperatives, AIR and the MIE program envision the establishment of sustainable K–16 partnerships that are: (1) driven by empirical research on teaching and learning in STEM and on the instructional needs of minority student populations; (2) motivated by workforce needs; (3) built on community support, values, resources, and expertise; (4) mindful of the traditionally differential treatment, experiences, and needs of male and female students in schools; and (5) grounded in culturally relevant learning environment design principles.

Accomplishments

Since the grant start date in 2004, AIR completed all but the proposed implementation support activities. Highlights include the activities discussed in the following section.

Activity 2: Develop a Series of Research-Based Discussion Papers

AIR developed and distributed two concept papers at the April 2005 NSF-MIE planning workshop. The first, *The Pipeline to STEM: Expanding Possibilities for Minority Males*, is a literature review of the research on gender-by-race disparities in STEM achievement and attainment. The second paper, *Effective Partnerships and Programs for URM Males: Expanding the K–16 Pool of Potential STEM Graduates*, discusses the key features of exemplary STEM partnerships and programs with minority male foci.

Based on feedback from MIE principal investigators and project directors, we revised the April concept papers into a K–16 Partnership Resource Guide to serve as a framework for the implementation support phase of the project. The guide explores implications for each MIE site as it continues its work promoting diversity in STEM disciplines at the K–12 level by offering a research-based framework, adaptations of proven templates and worksheets (see sample graphic below), research, resources, and models of effective approaches for tackling each of the aforementioned stages. The guide is organized around ten essential steps for establishing a sustainable program as evidenced by exemplary K–16 partnerships in the research literature: (1) articulate partnership mission, vision, and values; (2) identify partnership stakeholders; (3) assess needs; (4) establish mutual goals; (5) manage uncertainty and change; (6) build support; (7) develop a strategic action plan; (8) define the partnership; (9) implement the plan; and (10) evaluate, reflect, and refine the partnership.

Goals and Objectives Worksheet

Strategic Imperatives	Needs Assessment and Gap Analysis Outcomes	Target Goals
Reverse URM male under-enrollment in college preparatory courses	<ol style="list-style-type: none"> 1. 2. 3. 	<ol style="list-style-type: none"> 1. 2. 3.
Eliminate the unique psycho-social barriers to URM male academic achievement	<ol style="list-style-type: none"> 1. 2. 3. 	<ol style="list-style-type: none"> 1. 2. 3.
Remove the disproportionate institutional barriers to improved URM male academic outcomes in schools	<ol style="list-style-type: none"> 1. 2. 3. 	<ol style="list-style-type: none"> 1. 2. 3.

Activity 4: Convene Workshop

In April 2005, AIR and a group of MIE project directors convened a two-day planning workshop with local and national experts on minority student achievement, STEM education, and K–16 partnerships. During this meeting, participants: (a) discussed the disappointing state of K–16 minority student education overall with a focus on factors that inhibit rigorous course-taking in the mathematics and sciences necessary for STEM enrollment in college among minority male students; (b) shared strategies used by the MIE and other national initiatives to strengthen K–12 preparation and increase college enrollment in STEM fields; and (c) developed an action plan for the format and substance of a follow-up meeting designed to provide MIE programs with the opportunity to develop K–16 partnership strategies to expand the pool of STEM graduates.


In October 2005, AIR convened a second national workshop hosting 80 individuals. This follow-up meeting, the Expanding the K–16 Pool National Workshop, brought together teams of MIE project directors and select stakeholders. The objectives of this national workshop were for each MIE team to: (a) apply lessons learned from exemplary gender-specific and minority-specific STEM partnerships and programs to the design of K–16 partnerships targeting minority male achievement in STEM; (b) develop a strategic action plan to be enacted over the 2005–2006 academic year; (c) identify immediate next steps to establish the proposed K–16 partnership; and (d) identify and share implementation support needs with the NSF MIE program director and AIR technical assistance team.

Activity 5: Prepare Post-Workshop Discussion and Concept Papers

AIR prepared and distributed proceedings from the October 2005 NSF MIE Expanding the K–16 Pool Workshop. The proceedings provided panel session summations (see sample graphic below); bulleted highlights from every presentation; and the PowerPoint slides, presentation hand-outs, supplementary materials, and readings provided by speakers.

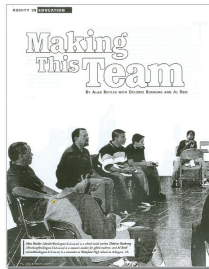
Workshop Proceedings 23

Delores Bushong, Al Reid, and Alan Beiliter, Cohort Program



The Cohort at Wakefield High School in Arlington, VA, is a program to increase the number of minority male students in Advanced Placement (AP) classes. The goal is to prepare academically capable Black and Latino male students for AP level work through enrollment in gifted, intensified, and advanced level courses.

Presentation Highlights



Delores Bushong

- The Cohort Program at Wakefield High School in Arlington County started seven years ago. The school is 44% Hispanic, 26% black, 17% white, and 10% Asian. The program started after a school-wide discussion about minority achievement and the realization that Hispanic students were not enrolled in STEM programs at Wakefield. The Cohort Program works with ninth grade males, getting them into Advanced Placement classes and providing support throughout the years. Support includes weekly lunchtime meetings and other opportunities include taking two math classes a semester in the 10th grade.
- While there is no system yet in place pairing Wakefield to institutions of higher learning, it would be beneficial to develop a network (such as POSSE) where students could attend college as a cohort. These students would attend college together and have support systems in place once they get there. The high school students have made it clear that they would like to attend programs only if they qualify for them.

Al Reid

- The maze of high school and the path for the boys in the Cohort Program is made easier when the weeds are matted down to make a visible path. This is done both by staff and other Cohort members. The program recognizes the importance of male role models. There is also a fostering of a "need to belong" to a group that embraces positive ideals. This is vital to the students who have accepted the challenge of taking academic risks. The relationships are supportive and not punitive, thus once you earn your seat in the Cohort you never lose it.


Alan Beiliter

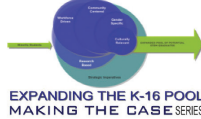
- Critical parts of effective relationships include: 1) consistency of the relationship, 2) frequency of meetings, and 3) a commitment to being honest. Honestly is reinforced in the weekly meetings through discussions that "stay in the classroom." Topics covered include single-parent families, academic issues, and the equity of education at the University of Michigan.

October 10 – 11, 2005 • Wardman Park Marriott • Washington, DC

Expanding the K–16 Pool of Potential STEM Graduates

We also developed Making the Case, a series of research briefs and data round-ups written to compel a national dialogue on minority male achievement across the K–16 continuum. Completed issue briefs include *Why Are Minority Males Leaking From the Pipeline to STEM? Research on Gender Disparities and a Way Out of the Wilderness: The Promise of K–16 Partnerships*. Completed data round-ups include *Are Minority Males Measuring Up to Minority Females on the Pipeline to STEM?*





Are Minority Males Measuring Up to Minority Females on the Pipeline to STEM?

This product is part of the Making the Case series of Issue Briefs and Data Round Ups developed to compel a national dialogue on minority male achievement across the K-16 continuum.

The Expanding the K-16 Pool project is a **national capacity-building initiative**. Our goal is to develop school, community, and business capacity to broaden the enrollment of minority students, especially minority males, in science, technology, engineering, and mathematics at the post-secondary level and to create a national partnership model for strategic and sustainable change.

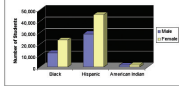
Talking Points

Underrepresented minority males:

- Take fewer college preparatory courses
- Take fewer AP examinations
- Are less likely to graduate from high school
- Are less likely to pursue higher education and job
- Routinely score higher on the SAT in math
- Earn more STEM associate's and bachelor's degrees than their female counterparts

AP Examinations

Even when minority males take a college preparatory course such as an Advanced Placement (AP) course, they are less likely to take the corresponding AP exam¹:




AP Course	URM Males	URM Females
Biology	~15,000	~25,000
Chemistry	~10,000	~20,000
Physics	~5,000	~15,000

These courses traditionally include geometry, algebra II, calculus, biology, chemistry, and physics.

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Outcomes

In conjunction with the aforementioned technical assistance activities, each MIE site took considerable steps toward establishing meaningful partnerships with their local school systems. The outcomes described here were derived from responses to the MIE Project Director Questionnaire (see Appendix A) administered during summer 2006. The questionnaire asked each MIE Project Director to describe and assess the activities that resulted from MIE engagement with K–12 partnerships during the 2005–2006 academic year.

Bowie State University

Bowie State is engaged to a certain capacity with secondary teacher training and with senior-level students anticipating college entrance. Bowie also has identified the BSU Summer Bridge Program as a potential partnership to improve student learning.

Oglala Lakota College

Oglala Lakota College (OLC) has developed several initiatives focused on K–16 partnership building. The first is a teacher training in STEM fields. Two training programs were implemented in summer 2006, the first of which focused on developing school-wide science fairs, ethnomathematics,** and an environmental science curriculum. The second training program was aimed at implementing a NASA-based curriculum entitled SEMAA (Science, Engineering, Math, Aerospace Academy) and a robotics curriculum set. The second partnership is a collaboration

between the state of South Dakota and the Oceti Sakowin Education Consortium in conjunction with 24 elementary and secondary schools across the state. The program is titled Gaining Early Awareness & Readiness for Undergraduate Programs (GEAR UP). The focus of South Dakota GEAR UP is to work with Native American students and their families starting in the seventh grade to prepare them for college academic rigor.

Oglala also has been able to take advantage of other programs and opportunities to expand its offerings to their K–12 students. In particular, there are teacher training opportunities in STEM areas, grades 7–12 student-focused programs for college readiness, STEM curriculum enrichment, and informal education outreach efforts focused on STEM-related areas. Oglala is targeting fiscal efforts directly to partner schools, providing STEM curriculum and training efforts. There will be sustained efforts to continue expanding the partnership with target schools in lieu of short-term training efforts that have generally yielded short-term results.

Spelman College

The MIE partnership with Dr. Lisa Egbuonu-Davis and the Pfizer's Women's Health/Health Initiative has created the Spelman College Peer-to-Peer Initiative. The Peer-to-Peer Initiative was designed to provide a developmental program for certain groups of Spelman students (and others in the Atlanta University Center (AUC)). The program offers community outreach to K–12 students and makes

** Ethnomathematics is the study of mathematics that considers the culture in which mathematics arises. The goal of ethnomathematics is to contribute both to the understanding of culture and the understanding of mathematics, but mainly to the relationship between the two.

science a fun and exciting topic to learn for students who are at a vital developmental stage. Currently at the local level, this pilot plans to eventually develop into a regional program.

AUC students serving as minority role models contribute to advancing academic opportu-

Spelman College has been expounding on other partnership projects in the K–16 system through the activities of their Chemistry Club. The Chemistry Club provides up to 20 additional tutors on a volunteer basis. Staff from the new Kennedy Middle School are convening to pool together resources for its successful implementation.

— S. Jermaine Duffie,
Project Manager

nities for underrepresented minority students. Peer-to-Peer internship students introduce community youth to the diversity of career options afforded to STEM degree seekers. Interns also gain a competitive edge on graduate school applications by being distinguished from applicants with less community service. Peer interns also are available to provide students with supplemental instruction in certain academic areas vital to student growth and devel-

opment, such as core basic skills in mathematics, reading comprehension, and writing, and an emphasis on the importance of self-discipline and respect for authority.

In order to ensure partnership-building success in the K–16 arena, Spelman has moved its post-pilot program for additional funding from Pfizer to the nearby Kennedy Middle School. Pfizer will now be working with Spelman to further develop and implement this initiative.

Universidad Metropolitana

The partnership with the Department of Education has afforded UMET the opportunity to bid on proposals to institutionalize the pre-college program at UMET and its sister institutions, Universidad del Este and Turabo University. Other national and international research institution partners include Santa Clara University, Carnegie Mellon University, Consejo Superior de Investigaciones Científicas (CSIC) in Spain, Massachusetts Institute of Technology, Rensselaer Polytechnic Institute, and the Nanyang Technical University in Singapore. Additionally, the NASA Jet Propulsion Laboratory allowed UMET to send 78 students to its facility for summer research internships in 2006.

The MIE program has been essential in building partnerships with new institutions, especially those interested in producing the pipeline to graduate school for students seeking STEM degrees. UMET has secured relations with Baylor College, Arizona State University, and RPI to open a pathway for underrepresented minorities from Puerto Rico to attend graduate school.

Universidad Metropolitana (UMET) has succeeded in establishing partnerships with the Department of Education of the Commonwealth of Puerto Rico through the Alliance for Education Office and high schools of the Metropolitan Area of San Juan, Puerto Rico. With these partnerships, UMET has consolidated our pre-college program, the Saturday Academy and the Summer Adventure Training impacting over 450 grades 10, 11, and 12 high school students since October 2005.

— Dr. Juan Arratia, UMET
Director and Principal Investigator

The University of Texas at El Paso

Dr. Ben Flores has closely participated with the faculty from the Department of Education, UTEP School of Public Health, and administrators and teachers from eight local school districts in partnership-building efforts. He also has been working closely with the American Association of University Women to promote equity in education for girls and women. The MIE program at UTEP is active in outreach to minority students in its Women in Science and Engineering (WiSE) program, which participates in projects involving K–12 outreach. The coordinator and members hosted the Expanding Your Horizons™ conference for area middle school girls to encourage the pursuit of STEM careers.

Dr. Flores, along with the college of education dean, department of education faculty, and Canutillo Independent School District administrators, has put forth a proposal to the NSF under the Graduate Fellows K–12 Program. This program will promote and utilize computer science and computer and electrical engineering concepts in the K–12 classrooms facilitated by graduate students in these fields. Staff also actively participate in the Mother/Daughter—Father/Son Conference to encourage the pursuit of higher education to area middle school students and their parents. Members also give Think College Now presentations to area middle and high school students through budgeting exercises.

Another proposal submitted by Dr. Flores and the college of education dean and faculty proposes to introduce an alternative teaching certification option for students in engineering who wish to pursue teaching certification

alongside their engineering degree. A similar effort already exists in the College of Science.

In order to strengthen partnership building in the K–16 arena in a synergistic fashion, the MIE program at UTEP has built a strong relationship with the department of education and has expanded on current extant relations with various local K–12 school districts and the local community.

Xavier University of Louisiana

In the aftereffects of Hurricane Katrina, the levee system around Orleans Parish was ruptured, causing Lake Ponchartrain to flood the city. Xavier University was engulfed in more than nine feet of water, which damaged the MIE offices located in the Norman C. Francis Science Building Annex. Much vital MIE documentation and equipment was lost, however some notes on previous MIE communication with K–16 schools were recovered and will serve as the foundation for future MIE preparation.

“This academic year has been very difficult not only for MIE but for other Xavier University K–16 programs. For example, the Summer Science Academies were limited this summer, while some K–16 programs such as the EpsAR Summer Bridge Program... was forced to cancel operations due to a lack of public school personnel in the area. It is hoped that these programs will be linked together with Xavier as soon as possible.”

— Dr. Tanya McKinney,
Xavier MIE Director

Due to this system-wide disaster, most Orleans Parish Public Schools (OPPS) were taken over by the State of Louisiana Board of Secondary Education (BESE), which is now operating 20 public schools. The original

OPPS system has been able to preserve six of these schools. Both the BESE and OPPS systems also empowered many independently-run charter schools. Many of these schools are loosely partnered, while others are independently governed. Other charter schools were managed by local universities such as Tulane and the University of New Orleans, which are now governed as lab schools. Orleans Parish parochial and private schools were also devastated by the hurricane and many still have not been able to reopen. Currently, New Orleans has more than 12 discrete school systems that require a solidified plan for interaction. Given the nature of the catastrophe, the schools understandably experienced a severe lack of personnel, faculty, and staff in preparation for the opening of the August 2006 school year.

As a result of the aforementioned incidences, Xavier has been unable to pursue partnership-building endeavors in this academic year and is revising its program design for the upcoming year. The unfortunate series of events of the 2006 school year have not allowed for the coordination with local area schools either; however, plans are being stabilized for the upcoming year. In spite of the recent state of affairs, Xavier University is dedicated to the MIE program and hopes to restore the necessary components of the program at its earliest convenience.

Lessons Learned

Challenges

In discussing the activities and outcomes of each MIE site since the October 2005 Expanding the K–16 Pool National Workshop, it is evident that each MIE site has

encountered a series of obstacles and triumphs in its respective partnership-building efforts. Many of the challenges that the institutions face are generalizable and expected, whereas others are unique to the specific infrastructure and geography of each MIE.

The issue of minority student recruitment and retention (particularly that of male students) is an underlying challenge that many of the institutions have been grappling with since the MIE's inception. UTEP's college of engineering continues to struggle with this issue, in addition to challenges with female recruitment. The MIE staff at Spelman take a slightly different approach on the issue of student retention in that they believe that providing a combination of both male and female intervention is most effective. Since the work force is multigendered and multicultural, a combination of the two intervention approaches will expose younger males to young females, working together in a professional manner. Younger males also tend to display more maturity around the female tutors, which allows them to be even more receptive to the males as they do not want the older male tutors to appear more mature. A similar stumbling block that UMET foresees is establishing an additional pipeline effort to impact minority males given that their institution, comparable to Spelman, is predominantly female. In order to focus in on the issue of boys, UMET's male student population also needs to be made aware at an early age of the opportunities and challenges available in STEM fields at the university. UMET also realizes that in order to change the gender equation, the issues of minorities in STEM must be tackled at the middle and high school levels.

Another apparent challenge of forging sustainable K–12 partnerships with school districts is that UTEP’S colleges of science and engineering must delve beyond simply utilizing K–12 outreach activities to recruit students into the department. Some of the administrative challenges Spelman College has been dealing with include aligning student schedules with curriculum development given the intense course load experienced by STEM students (e.g., coursework, labs, research, etc.). A stronger working relation between these two bodies must be developed in order to ensure a vested interest in sustained partnership building. Likewise, in order to broaden the sustained partnerships that have been fostered in STEM fields to other areas of the institution, UMET is currently identifying key leaders committed to supporting student successes.

MIE programs also must secure funding for additional resources. The MIE initiative at Bowie has worked with the public school systems and STEM faculty of neighboring counties for several years, however it is anticipated that once a firm plan has been formulated and approved by the administration, additional resources may be required. Similarly, staff at UMET have requested additional resources in the area of proposal writing to secure funds to advance the strategic partnerships that have formed since the October 2005 conference.

Overcoming logistical burdens has been another challenge with many of the MIE programs. Some of Spelman’s administrative issues include the general alignment of schedules and curriculum development due to the intense course load encountered by STEM students (e.g., courses, labs, research, etc.).

Spelman College also has identified the need for a stronger support system for teachers to account for staffing changeovers and to eliminate communication lapses that occur as a result of the rigors and responsibilities of the school day. A vast majority of the schools that Oglala has targeted for partnership building have experienced many restructuring problems based on the No Child Left Behind (NCLB) legislation. Since many of these potential partner schools have been classified as not meeting adequate yearly progress (AYP), this has added to partnership-building constraints for Oglala. Given that the resources and attention of their partner schools are focused on very specific areas, Oglala also is required to design programs that address these priorities. While initially challenging, this also ensures that Oglala is engaged in dialogue with its partner schools, which will eventually lead to stronger partnership as the schools are able to see their interests as genuinely vested.

One of the unique challenges specific to the MIE program at Oglala is its large geographic and rural area. Most of Oglala’s target schools operate as independent school districts so agreements and programs must be negotiated with each individual institution, which can be difficult given the large distance between schools. Engaging in a dialogue with the schools to determine what will meet their needs and the needs of their students is another crucial step to effective partnership building for the Oglala MIE program staff. It is imperative that higher education institutions engage in a dialogue in order to gain a full understanding of what can be done and what is needed. This presents a challenge for higher education institutions but has the

potential to lead to a sustained partnership as it fosters a sense of honesty and credibility among the partnership district schools. Comparable to some of the challenges that Oglala has been experiencing in implementing its MIE program, UMET has also faced similar obstacles in ensuring the availability of resource information and sustained dialogue among students and faculty members.

Given the unique situation surrounding Xavier University as a result of Hurricane Katrina, it is not surprising that the largest challenges Xavier faces are infrastructure redevelopment and personnel recruitment, much like the vast majority of the public, private, and parochial schools in the New Orleans area. As such, Xavier is unable to fully participate in extracurricular outreach at present. In order to resume partnership-building efforts with the local K–12 school system,

Xavier University will first need to reassess its role in the rebuilding process once local infrastructure has been restored.

Successes

Amidst the various challenges each MIE program has confronted in its partnership building endeavors, each institution, with the understandable exception of Xavier, also has experienced promising successes that encourage future and further growth in minority student recruitment in STEM fields at the K–16 level.

Expansion of the partnership-building model into the K–12 arena has been a great success among many of the MIE programs. Bowie State is planning a mathematics academy to assist elementary, middle, and secondary level students. It is hoped that this will

Matrix of MIE Institutional Successes

MIE Sites	Successes
Bowie State University	<ul style="list-style-type: none"> ■ Mathematics Academy ■ BSU Summer Bridge Program
UTEP	<ul style="list-style-type: none"> ■ Activities to introduce engineering into the K–12 arena ■ Inclusion of large and small El Paso districts in partnership building efforts ■ Successful partnerships with the American Association of University Women and Women in Science and Engineering (WiSE) program in retaining female students in science fields ■ Mother/Daughter—Father/Son Conference encourages the pursuit of higher education
Oglala	<ul style="list-style-type: none"> ■ Teacher training in STEM fields ■ Training to implement NASA-based curriculum entitled SEMAA (Science, Engineering, Math, Aerospace Academy) ■ Robotics curriculum set ■ South Dakota GEAR UP grant
UMET	<ul style="list-style-type: none"> ■ Pre-college program at UMET and sister institutions ■ UMET Summer 2006 Research Interns sent to NASA Jet Propulsion Laboratory ■ Secured partnerships with Baylor College, Arizona State University, and RPI for UMET graduate students
Spelman	<ul style="list-style-type: none"> ■ The Spelman College Peer-to-Peer Initiative ■ Post-Pilot Program with Kennedy Middle School funded by Pfizer

greatly enhance the mathematics performance of students overall, and for those entering college. Additionally, the program will be used to assist students already enrolled at Bowie. Similarly, UTEP is developing activities that introduce the college of engineering principles into the K–12 arena. Another success UTEP boasts is its inclusion of a variety of large and small rural districts in El Paso County in its partnership.

Minority retention and recruitment within the STEM education fields has been one of the original aims of the MIE since its inception. As a vital component of any partnership-building effort, UMET takes pride in its successful partnerships that have impacted and been proven to retain females in the field of science.

Future Work Planned

Amidst the various challenges and successes experienced by each MIE institution, five of the six MIE project directors outlined a series of anticipated partnership-building activities that they sought to accomplish. A majority of the MIE programs also requested specific assistance from the AIR staff in implementing these planned activities. The activities described below are derived from MIE project director responses to the Expanding the K–16 Pool Questionnaire (see Appendix A).

Oglala Lakota College

Oglala Lakota College has expressed interest in applying for additional resources to aid with their support of the K–16 partnership-building model. Oglala has requested assistance from AIR in creating a link with specific

organizations that may provide future funding and partnership opportunities.

Spelman College

Faculty/administration at Spelman have expressed interest in applying for additional resources to aid with implementation support. If granted, this funding would be used to secure more tutors and faculty liaisons as an incentive for tenured faculty to assist science teachers in developing science-related activities. Additional funding would be distributed among the co-directors for Outreach and Public Relations and toward the development of a tracking/scholarship program, which would create incentives for prospective students.

Future STEM work at Spelman College would give Peer-to-Peer interns access to additional career preparation services, which are currently provided by MIE and the Office of Science, Engineering, and Technical Careers (OSETC). In addition to stipend support services, it is hoped that OSETC will sponsor training workshops and other enrichment activities and developmental programs in several scientific disciplines to promote the critical thinking skills necessary for higher level administration positions among the intellectual and scientific communities.

Additional STEM work would revolve around boosting parent involvement and student interventions at the elementary and preschool levels as research has shown that parental commitment in the early developmental stages of the child's life (zero–five years) may promote strong learning behaviors.

As partnership-building activities flourish at Spelman College, AIR staff will continue to

provide suggestions for best strategies for implementation, as needed. In the interim, Spelman desires to gain support from the NSF in sustaining and expanding its current partnership with Kennedy Middle School.

Universidad Metropolitana

UMET has requested resources in the domain of proposal writing in order to secure funds to enhance the partnerships it has fostered since the October 2005 national workshop.

Pending sufficient funding, UMET has proposed that the MIE program be institutionalized at Sistema Universitario Ana G. Méndez (SUAGM). The partnership building paradigm would eventually be consolidated and expanded at the pre-college, college, and graduate school level at SUAGM, which comprises UMET's two sister institutions, Universidad del Este and Universidad del Turabo. UMET hopes to partner with federal agencies and obtain state support in order to sustain the expansion activities of the MIE model at SUAGM.

The University of Texas at El Paso

UTEP has requested that AIR staff provide ongoing advice regarding the advancement of STEM activities in the K–12 arena, particularly because UTEP would like to focus on creating a STEM-oriented curriculum aligned with existing K–12 activities. While UTEP has already made attempts to secure monies to implement some MIE program and college of education activities, additional funding is being sought to foster future partnership-building efforts with the K–12 system.

Xavier University of Louisiana

Given the unique circumstances surrounding Xavier, its MIE staff will better be able to assess Xavier's specific technical assistance needs after program goals are revised to reflect the changing school system and needs. In terms of future STEM work at Xavier, the university is in the process of launching the BIO 2010 initiative, which will encourage an interdisciplinary approach toward teaching STEM disciplines. BIO 2010 aims to emphasize MIE-associated principles such as interdisciplinary teaching, faculty development, and student research opportunities. Funding for this endeavor will be sought from both public and private agencies.



Evaluation of Technical Assistance Activities

Challenges

Throughout the course of work with the MIE sites, the AIR team experienced a number of challenges to providing technical assistance efforts. While these challenges did not necessarily diminish the quality of the assistance offered, they did serve to impede its nature and efficiency. The following section outlines a few of the main logistical and structural challenges that hindered the progress of technical assistance to the MIE's programs.

Incentives

Overall, it was often difficult to elicit active participation from the MIE programs due to the absence of a concrete incentive for the institutions. Partnership building was perceived as a burden on the MIE programs since there was a lack of extrinsic motivation; none of the institutions received any additional funding for their cooperation. It was also difficult to obtain buy-in from senior staff and decision-makers at some of the MIE sites, which contributed to a lack of a shared vision. Inconsistent leadership hindered the sites' potential for building and maintaining effective partnerships.⁴¹

Another challenge was acknowledging the time it takes to establish mutually trusting relationships between the institution and the intended partner organizations. Undoubtedly, strong partnerships require a serious time commitment in order to effect meaningful

results.⁴² At the time this report was written, it was too premature in the partnership-building stage to determine whether the MIE sites were able to cultivate such meaningful partnerships with their intended institutions.

Additionally, providing technical assistance was not a service that was directly delineated in the original grant with NSF. It was later listed as an activity in the proposal, and thus was carried out accordingly by the AIR team on a somewhat ad hoc basis.

Dissemination

Although the MIE sites received funds for dissemination activities, these funds had already been designated for carrying out acknowledged work in the original proposal. Consequently, partnership-building activities were outside the scope of designated work.

Local MIE Infrastructure

AIR staff also encountered difficulties in dealing with the local infrastructure of the individual MIE sites which, for the most part, served to impede active participation in the program. For example, response time was often quite lengthy despite repeated contact efforts by AIR staff. It is speculated that this lapse in communication and response time is a direct result of the above mentioned perception of burden carried by the MIE project directors.

Current MIE Focus on Underrepresented Minority Males

The challenge of boosting underrepresented minority male participation and graduation rates in STEM is not a new concern. Rather, the challenge lies in scaling up the existing efforts of the MIE sites in the face of dwindling funding. In some of the MIE sites, existing partnerships could align with existing programs that already focus on assisting underrepresented minority males. For example, Bowie State University has expressed interest in creating a mathematics academy to assist elementary, middle, and secondary level students. This K–12 partnership activity provides an excellent venue for Bowie to upscale its efforts to hone in on the issue of underrepresented minority males within the K–12 pipeline to STEM. As Oglala currently hosts a majority female student population, the dearth of male students could present an excellent opportunity to work toward securing a GEAR UP grant, which would ensure funding for future work focusing on increased male student enrollment. Demographically, UMET shares a similar student make-up to Oglala and could also benefit from additional funding to focus on underrepresented minority males.

In other cases, a partnership focusing specifically on underrepresented minority males could spur new work for that particular MIE institution. For Spelman College, this could entail forming a partnership with its brother institution, Morehouse College, in a collaborative effort to target underrepresented minority males. Additionally, if funding for

Spelman’s anticipated tracking/scholarship program was granted, this would create the opportunity to provide a monetary incentive for minority male students interested in pursuing STEM careers.

Although partnership-building efforts at Xavier are currently undergoing rebuilding efforts, a future area of underrepresented minority focus on STEM lies in the potential partnership of launching the BIO 2010 initiative with an emphasis on MIE-associated principles, such as student research opportunities targeted especially toward low-income, minority male students.

Additional general concerns surround the appropriateness of focusing partnership building solely on minority male achievement, making it difficult to secure federal funding for a cause so specific and gender based.

Successes

During their tenure as technical assistance providers, the AIR staff also experienced a number of successes in terms of furthering the MIE’s partnership-building endeavors. These milestones are a testament to the commitment and sincerity of the efforts of the AIR team and the MIE institutions.

Capacity Building

The October 2005 Expanding the K–16 Pool National Workshop encouraged the MIE sites to reexamine the notion of male achievement and capacity building and gear their partnership efforts accordingly.

Expanded Scope of Work

Throughout the course of work with the five MIE sites, AIR staff have provided services that reach above and beyond what was outlined in the original proposal of technical assistance activities.

Perhaps the largest success that the AIR team experienced was in the outstanding implementation of a second NSF MIE Expanding the K–16 Pool National Workshop in October 2005, which hosted more than 75 individuals. As an activity that went beyond the scope of the original proposal outline, the conference was noteworthy in its ability to assist the MIE teams in thinking about and addressing the issues of male achievement and capacity building.⁴³

The evaluation feedback regarding the Expanding the K–16 Pool National Conference was encouraging and indicated that the participants were generally pleased with the content of the team sessions, the support provided by the AIR staff, and the availability and resourcefulness of the facilitators. An additional Workshop Proceedings document was created, which contained presentation highlights from all of the attending speakers and their corresponding partnership-building materials from the NSF MIE

Expanding the K–16 Pool Workshop. The Proceedings contained panel session summaries, PowerPoint presentations, workshop handouts, and supplementary readings. This document was distributed to all attending MIE team members and to those staff not in attendance of the October 2005 workshop.

In addition to the convening of the national workshop, another noteworthy success was the production and dissemination of additional resource materials containing STEM achievement and attainment data to better serve the MIE project directors. Two issue briefs—*A Way Out of the Wilderness: The Promise of K–16 Partnerships*, and *Why Are Minority Males Leaking From the Pipeline to STEM? Research on Gender Disparities*—were widely distributed during the NSF Joint Annual Meeting in March 2006.

Other additional activities completed by the AIR team include a presentation at the NSF Division of Human Resource Development, Joint Annual Meeting in March 2006, outlining the accomplishments of each MIE team. The team also served as facilitator for the UTEP MIE Pathways to Success in STEM Education Planning Workshop in March 2006. In response to feedback on the concept papers prepared for the April 2005 Planning Workshop, the AIR team developed a K–16 Partnership Resource Guide.

Recommendations for Future Work

Should the NSF choose to continue or expand the programmatic activities initiated during the Expanding the K–16 Pool project period, AIR recommends the following activities:

Provide Onsite and Virtual Technical Assistance

On the basis of implementation support needs identified by each team at the 2005 national workshop, conversations with each MIE team’s facilitator after the workshop, as well as ongoing conversations with the MIE team leaders, we recommend that the Expanding the K–16 Pool partnerships be provided with the following implementation support for each team as needed for a period of two to three years: facilitate onsite meetings or Web conferences concerning the identification of stakeholders; aid in revision of mission and vision statements, needs analyses, communication plans, and actionable strategies for managing uncertainty and change; provide strategic action planning; draft funding proposals; identify support staff; and monitor program design.

Develop a Resource Database

We recommend the development of a Web-accessible Expanding the K–16 Pool resource database to support grant writing and program design. The database would include:

- Exemplary gender-specific and minority-serving STEM partnerships and programs

- Effective partnership models
- Effective STEM teaching and learning practices, curricula, resources, and experts
- STEM achievement and attainment data, charts, and PowerPoint slides
- Funding opportunities

Develop and Implement an Expanding the K–16 Pool Communication Strategy

As stated above, one of the goals of the Expanding the K–16 Pool initiative is to “serve as a catalyst for a national dialogue on minority male achievement across the K–16 continuum.” However, no formal plan for accomplishing this goal was defined or executed either in the original proposal or since the program’s inception. We recommend that should support for the initiative continue, that the MIE programs receive support to develop and implement a communication strategy to publicize the Expanding the K–16 Pool initiative both locally and nationally. Communication activities may include submitting articles on the link between minority male achievement in STEM and K–16 partnerships to academic journals such as the American Educational Research Journal and trade magazines such as Education Week. Other activities may include presenting Expanding the K–16 Pool partnership work at local and national conferences such as the annual meeting of the National Council of

Teachers of Mathematics (NCTM) and convening biannual Web conferences, open to the public on such topics as principles of culturally relevant curriculum development and successful, gender-specific STEM programs. Growing support among the nonprofit, business, and foundation communities will be a key feature of this strategy to assist the MIE teams in their efforts to fund their respective Expanding the K–16 Pool partnerships.

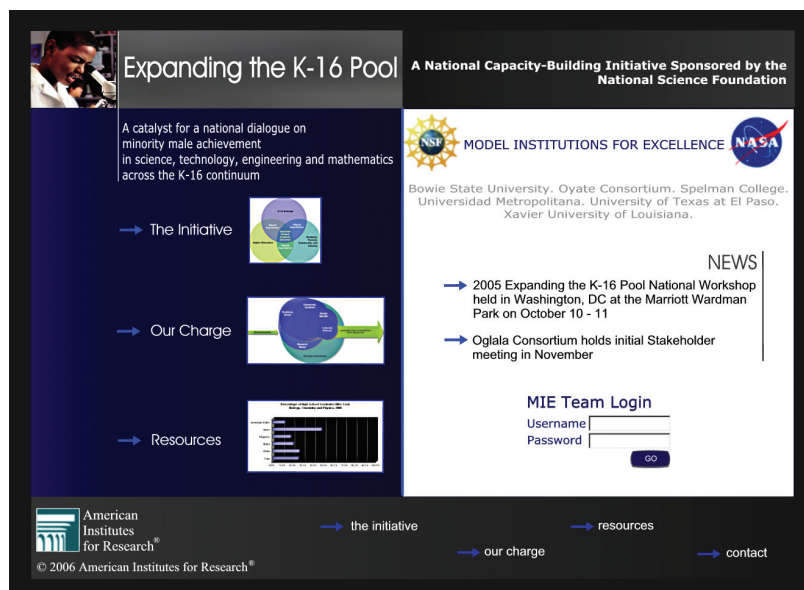
Develop and Launch an Expanding the K–16 Pool Web Site

To assist with the aforementioned technical assistance and communication efforts, we recommend the development of an Expanding the K–16 Pool Web site. The site should highlight both public and private sectors.

The public sector section might include information on the (a) MIE program; (b) the Expanding the K–16 Pool initiative and evolving partnership model; (c) news and events; (d) research briefs, data charts, and graphs on such topics as K–16 partnerships and the minority pipeline to STEM; (e) publications such as the AIR evaluation of the MIE program; (f) tools such as the K–16 Partnership Resource Guide produced by AIR; and (g) links to additional resources produced by partner organizations such as the SERV Diversity Center, Institute for Higher Education Policy, and Systemic Research.

The private sector section would only be accessible to participating institutions and partner organizations via password protection. It might feature: (a) a calendar of MIE team events such as leadership team meetings, onsite technical assistance visits, and grant deadlines; (b) a discussion board to facilitate communication and knowledge sharing between MIE teams; (c) a Web conference launch pad; and (d) collaborative workspace for each participating institution where site-specific information would be posted, such as a team’s mission statement, strategic action plan, contact information, and meeting notes.

The following graphic is provided to illustrate how the home page of this Web site might look:



Convene Follow-Up Expanding the K–16 Pool National Workshops

AIR has received numerous requests from MIE team members to reconvene the Expanding the K–16 Pool National Workshop held in October 2005 so that teams may share their progress and lessons learned. This workshop could serve as an opportunity for teams to learn from experts on research-based, culturally relevant, community-based curriculum development as well as effective K–12 teaching and learning practices in STEM.

Identify and Establish a National Advisory Committee on Minority Male Achievement

In consultation with the NSF program officer and project consultant, A. Wade Boykin, we recommend that a National Advisory Committee on Minority Male Achievement be established to lend credibility and provide guidance for Expanding the K–16 Pool partnerships. AIR suggests that the MIE teams identify eight individuals to sit on a national advisory committee on minority male achievement. Such noteworthy individuals might include professor and activist Pedro Noguera and Schott Foundation President Rosa Smith. The committee would meet several times a year and serve as a resource to the Expanding the K–16 Pool partnership teams throughout the implementation period and help shape workshop agendas.

Convene a National Dissemination Conference on the Expanding the K–16 Pool Model and Minority Male Achievement

To encourage the development of more Expanding the K–16 Pool partnerships and

further encourage a national dialogue on minority male achievement across the K–16 continuum, AIR recommends that the program convene a national dissemination conference on the Expanding the K–16 Pool model and minority male achievement in October 2008. This conference would be open to the public.

Leverage NSF PAEMST and PAESMEM Programs as Resources for Partnership Building

The NSF’s Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) program recognizes exemplary, highly qualified K–12 teachers of mathematics and science for their contributions in the classroom and to their profession. NSF’s Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM) honors individuals and institutions that have increased and/or broadened the participation rates of underrepresented minorities, women, and people with disabilities in STEM across the K–16 continuum. The awardees of these programs represent a growing network of exceptional mentors. AIR recommends that the Expanding the K–16 Pool initiative establish formal communication channels with PAEMST and PAESMEM awardees so that they might serve as resources for the project directors of Expanding the K–16 Pool partnerships. PAEMST awardees might, for instance, serve as consultants working one-on-one with partnership staff to design after-school STEM enrichment curricula and summer institute professional development program content.

- 5.) Through this MIE K–16 partnership-building endeavor, what are some of the lessons learned that can be passed on to other institutions wishing to expand their STEM programs to their (male) minority students?

- 6.) What technical assistance do you need to assist your institution in implementing the goals your team set at the October 2005 meeting?

K–16 Challenges/Obstacles

- 1.) What specific challenges and obstacles prevent building K–16 partnerships at your institution?

- 2.) Would you be interested in applying for additional resources to aid with implementation support?
 - 2a.) What would the nature of any future STEM work look like for your MIE program?
How do you propose organizing funding/collaboration?

Endnotes

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