Title: Bridging the Gap Between Urban and Rural Schools with Technology
V-NECC website: http://marssb.cet.edu/MARSSB_NECC/vnecc2004.html

Authors
Laurie F. Ruberg, Ph.D.
Debbie Reese, Ph.D.
Jennifer Kirby
Victor Hernandez, Ph.D.

Abstract: In spite of recent gains in student scores in mathematics and science achievement tests, national and regional reports indicate that ethnic, racial, and socioeconomic differences persist and the gaps between groups are widening rather than decreasing. In response to these reported inequities, the Mid-Atlantic Region Space Science Broker (MARSSB) program selected postsecondary preservice teacher education as its focus for this research study. The results of a survey conducted with postsecondary education faculty representing minority-serving institutions are reported and compared with the U.S. Department of Education's National Center for Education Statistics data, The aim of this research is to identify how the resources, services, and expertise of the NASA Office of Space Science education program can be used to enhance science, mathematics, and technology education for preservice teacher programs at minority-serving institutions.

Keywords: preservice, science education, mathematics, technology, teaching, space science

Introduction

The Mid-Atlantic Region Space Science Broker (MARSSB) program serves nine states (DE, KY, MD, NJ, NY, OH, PA, VA, and WV) plus the District of Columbia as a regional point of contact for scientists and educators seeking information or involvement in the Office of Space Science (OSS) education and public outreach (E/PO) programs. One of the goals guiding this study is to identify a more proactive role that the MARSSB team could play to facilitate and encourage grades K-16 science, mathematics, and technology teachers to take advantage of space science resources, services, and professional development opportunities.

The MARSSB program is one of seven broker/facilitator programs. The purpose of the broker/facilitator network is to foster the development of programs and services within its region that support NASA Office of Space Science (OSS) efforts to improve science, mathematics, and technology education for K-16 teachers by using space science as a context to promote educational reform and improvement. A national advisory group that includes scientists, program administrators, science educators, and educational researchers guides the NASA space science broker/facilitator program. The educational research team that has conducted formative evaluation of the NASA OSS educational outreach programs since 1996 suggests guidelines for successful space science education outreach strategies (Cohen & Gutbezahl, 2004). According to these guidelines, successful education outreach involves the following five actions: (1) Respect cultural norms and characteristics; (2) Be cognizant of the constraints of regional and local communities within the nation and in the mid-Atlantic area in particular; (3) Facilitate and nurture partnerships between minority and nonminority institutions, [space science] education program developers, professional organizations, and curriculum reform partners; (4) Inform educators of resources available through outreach programs that are interactive and engaging and supported by strong professional development; (5) Provide resources that focus on the science behind the mission; are scientifically accurate, exciting, and accessible; align with educational standards; and are adaptable to multiple curricula and student populations.

The guidelines outlined above provide an organizational framework for the MARSSB team's outreach efforts. However, a closer analysis of the mid-Atlantic region is necessary to develop a more detailed set of objectives, identify target populations for focused outreach, and plan strategies for successful outcomes. Recent national reports regarding classroom instruction (NCES, 2002) indicate that while all communities strive for high standards for student achievement, ethnic, racial, and socioeconomic differences persist, and in some cases the gaps between groups are widening. A recent study of statewide teaching and learning in mathematics and science in West Virginia further documents the disparities between minority and rural groups when compared with national averages. "Ethnic/Racial differences persist across all the assessments. Caucasian American/white and Asian-American/Pacific Islander students perform at higher levels than other ethnic/racial groups (e.g., African-American/black, Hispanic, American Indian/Alaska native)….African-American, Hispanic, and American Indian students continue to perform less well than their white counterparts, and poor students also achieve at lower levels than their wealthier peers" (AEL, 2004).

Based on national and regional reports and interviews with educational leaders in the mid-Atlantic region, the MARSSB team selected postsecondary preservice teacher faculty and rural educators as its two key target populations for space science outreach. The first step in developing a strategy to serve these two populations was to develop a better understanding of the current condition of mathematics and science teaching and educational technology use at minority-serving and rural K-12 and postsecondary institutions in the mid-Atlantic region. While data exist that document the disparity experienced by minority-serving postsecondary and rural K-12 schools, this research is more narrowly focused on finding ways that the resources of the NASA Office of Space Science education and public outreach program can help address unmet needs by applying the resources, services, and expertise it has to offer.

Conceptual Framework

In a discussion of race and ethnicity in educational research, Gutierrez and Rogoff (2003) propose that teachers and researchers should be guided by what they refer to as "repertoires of practice"—suggesting that educators and researchers keep in mind that individuals and communities change. They advise that those studying minority and other ethnic and/or socioeconomic subgroups should "neither attribute static qualities to cultural communities nor assume that each individual within such communities shares in similar ways those practices that have evolved across generations" (Lee, 2003, p. 4).

With this watchfulness in mind, the MARSSB team developed a collaborative relationship with proactive educator groups providing professional development programs, such as the NASA/Norfolk State University Preservice Teacher Program (PSTP) and the Appalachian Rural Systemic Initiative (ARSI). Both groups serve their constituent populations with professional development opportunities designed to address disparities with emphasis on math, science, and technology curriculum innovations and strategies to improve student achievement in these areas.

Investigating the technology/resource gap that exists for minority-serving institutions and rural teachers may be best understood by applying the ecosystem metaphor presented by Zhao and Frank (2003), who propose an "organic, dynamic, and complex response" (p. 810) to the issue of technology/resource adoption that allows consideration of cognitive, social, organizational, technological, and psychological factors. Taking an ecological approach to exploring the patterns of use and integration of educational technologies and related curriculum resources is consistent with the model proposed by Gutierrez and Rogoff (2003). Using a multidimensional framework is also an integral part of the NASA Office of Space Science education and public outreach model of suggested practice (Cohen & Gutbezahl, 2004) as described earlier.

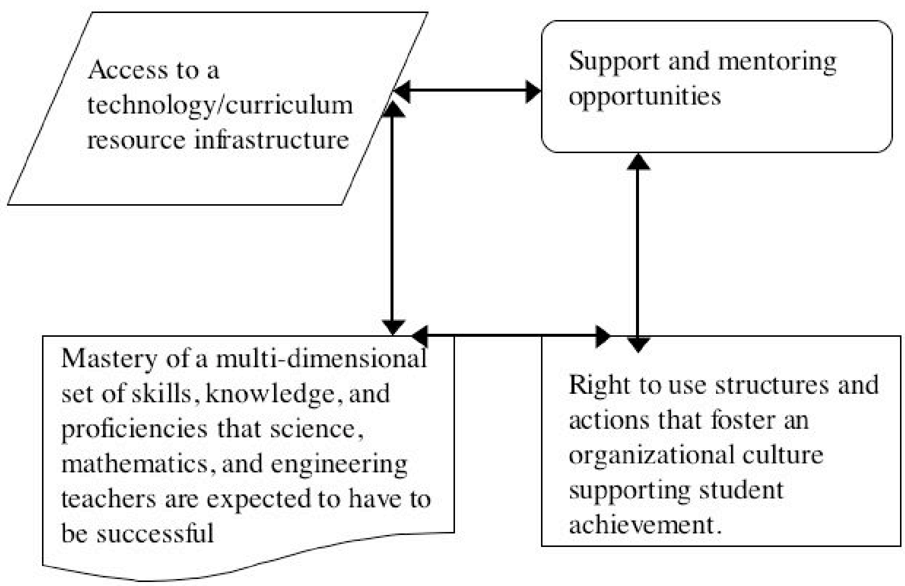


Figure 1. Ecological variables that impact science, technology, and mathematics teaching and learning at the K-12 and postsecondary levels

Based on the considerations presented, four themes were proposed to provide a framework to guide the survey design and analyses. Each of the four themes portrays an ecological variable that impacts science, technology, and mathematics teaching and learning at the K-12 and postsecondary levels. The four themes (as shown in Figure 1) used to assess factors that impact science, mathematics, and technology teaching and learning are:

1. Access to a technology/curriculum resource infrastructure that is in place and available to all faculty and students regardless of ethnic or racial background, geographic location, or socioeconomic status (Barnett, 2000).
2. Support and mentoring opportunities that are available to faculty throughout their careers (Fox & Hackerman, 2003).
3. Mastery of a multidimensional set of skills, knowledge, and proficiencies that science, mathematics, and engineering teachers are expected to have to be successful, including (a) knowledge of and enthusiasm for the subject matter, (b) familiarity with a range of appropriate pedagogies, (c) skill in using appropriate tests, (d) ease in professional interactions with students within and beyond the classroom, and (e) active scholarly assessment to enhance teaching and learning (Nathan & Petrosino, 2003).
4. Right to use structures and actions that enable collective efficacy (Goddard, Hoy, & Hoy, 2004) and that play an important role in fostering an organizational culture supporting student achievement.

The structure of the questionnaire and analysis is designed to address the following questions: How do our samples of postsecondary faculty and K-12 teachers compare with national population characteristics for postsecondary faculty and K-12 teachers? How do postsecondary faculty specializing in preservice education at minority-serving institutions compare with national indicators for postsecondary faculty and K-12 teachers? Are there common needs and strengths that science and math educators at postsecondary and K-12 institutions share? And finally, based on the feedback from the faculty sample, what does the data suggest as possible strategies for broker/facilitator intervention?

Methodology

Based on the four themes for organizing data described above, a survey instrument was development by the MARSSB group in conjunction with the Center for Educational Technologies® research team. The survey instrument was developed by selecting and adapting questions from preexisting national and international educator instruments. The sources for survey questions as well as data comparison include the West Virginia Department of Education, the U.S. Department of Education's National Center for Education Statistics (NCES), Testing International Mathematics and Science Skills (TIMSS), and Appalachian Educational Laboratory's Eisenhower Regional Consortium for Mathematics and Science Education. Questions specifically addressing space science E/PO resources and services were added.

The survey was originally developed for use with the NASA/Norfolk State University Preservice Teacher Program (PSTP). The PSTP hosts an annual conference that draws preservice faculty from more than 71 institutions. The target audience for the PSTP professional development services is faculty and students at minority-serving institutions. By working with the PSTP staff, we distributed survey forms to one faculty representative from each postsecondary institution attending the 2004 PSTP conference held Feb. 12-14 in Alexandria, VA. With encouragement from the PSTP director, we received 54 completed surveys representing 54 different institutions. Survey data were designed to gather data for the 2002-2003 academic year. The postsecondary faculty survey consisted of 40 questions (with multiple subitems) and required about 20 minutes to complete. This survey was administered in print form. A copy of the postsecondary preservice faculty survey is available online at http://www3.cet.edu/OSS_faculty.

The postsecondary faculty survey was adapted and given to K-12 teachers attending an ARSI-sponsored professional development workshop. The adapted survey for rural K-12 science and mathematics teachers contains 51 items. It requires between 15 and 20 minutes to complete. This survey was administered online in a computer lab at the close of a face-to-face workshop. At this writing, only 14 teachers have completed this survey. For this reason, this paper will focus on the postsecondary faculty data in the discussion of results and analysis. The rural teacher sample consisted of teacher-leaders recruited for the ARSI program for math and science reform efforts. Highlights of possible trends in the rural K-12 teacher data will be mentioned in the context of the analysis. More extensive analysis of rural in-service teacher repertoires of practice will be conducted as more data is collected. The K-12 teacher survey is available online at http://www3.cet.edu/OSS_Teacher.

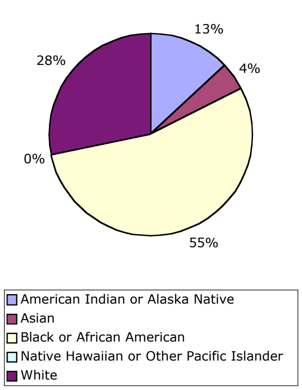
[**NOTE:** We encourage postsecondary and K-12 faculty attending the NECC conference to share their feedback by completing the online survey. The V-NECC version of this paper as well as a brief introduction to both surveys is online at http://marssb.cet.edu/MARSSB_NECC/vnecc2004.html.]

Results and Discussion

Data collected from the MARSSB survey research are presented within the context of the four themes identified in the conceptual framework section. The four themes will be used to organize and compare the environment of science, mathematics, and technology teaching skills and experiences for the postsecondary educators. The first section provides a summary of demographic background information regarding the 54 postsecondary faculty advisors who completed the MARSSB survey.

Background of Survey Participants

Figure 2. *Racial/ethnic background of preservice faculty sample. Ten percent of all respondents indicated that they were Hispanic or Latino.*



The postsecondary faculty was a diverse group representing historically black colleges and universities, tribal colleges, and some majority-serving institutions. As Figure 2 shows, by far the majority of faculty participants were

Black (55%). Overall ten percent of the participants identified themselves as Hispanic or Latino. Consistent with national indicators (NCES, 2001), the rural K-12 teacher group was not racially or ethnically diverse. Most of the faculty (70 percent) reported that teaching was their primary area of responsibility. Thirty percent of the faculty surveyed teaches elementary education, four percent teach secondary school education, 22 percent teach both elementary and secondary education, and 20 percent teach other subjects or don't teach. It was important for this study to confirm that the majority of the faculty completing the survey were involved in preservice teacher instruction.

Theme 1. Access to a technology/curriculum resource infrastructure that is in place and available to all faculty and students regardless of ethnic or racial background, geographic location, or socioeconomic status

Based on NCES (2000) data, we were interested in how the postsecondary faculty responses compared with national patterns of K-12 teachers in regard to access to a technology/resource infrastructure. In the NCES (2000) report on teachers' use of technology, teachers in high minority and high poverty schools used computers or the Internet less frequently than teachers at schools with less than 6 percent minority enrollment and low poverty levels. "For example, 57 percent of teachers in schools with less than 6 percent minority enrollments used computers or the Internet for Internet research compared with 41 percent of teachers in schools with 50 percent or more minority enrollment" (NCES, 2000). How does the postsecondary faculty compare with the minority-serving K-12 teacher reports?

The MARSSB survey asked participants about their access to technology and curriculum resources in several ways. Faculty members were asked to rate their facilities/resources at their institution. While 41 percent and 36 percent respectively reported that their access to teaching and research assistants was either fair or poor, 57 percent and 55 percent respectively reported that their personal computer facilities/support and centralized computer facilities and support were either excellent or good. Sixty-three percent reported that their access to the Internet was excellent to good; 50 percent rated their technical support for computer activities as excellent or good; and 53 percent rated their audiovisual equipment as excellent or good. This shows that a majority of the faculty viewed their access to computer, Internet, and audiovisual technologies as good to excellent. This is consistent wit NCES data that shows that availability to personal computers and the Internet has grown dramatically, "For example, Internet access in public schools increased by 60 percentage points between 1994 and 1999, from 3 percent in 1994 to 63 percent in 1999" (Williams, 2000).

Since this study is particularly interested in finding out how the resources, services, and expertise of the NASA Office of Space Science education program can be used to enhance science, mathematics, and technology education for preservice teacher programs, one of the survey questions asked faculty to describe how they were currently obtaining space science resources for their classroom instruction. We found that the NASA Education Resource Centers were the most popular method for distributing NASA curriculum resource materials. This may reflect the fact that a NASA Education Resource

Center is conveniently located to faculty on several of the college campuses. The NASA portal was the second most popular resource and was used by 18 percent of the faculty. The online space science NASA CORE, NASA Spacelink, and resource directory were also used by faculty to access curriculum materials, but were accessed by only five to 15 percent of the faculty respectively.

The researchers were also interested in faculty reports regarding what NASA science, mathematics, and technology curriculum resources they used. The most popular materials sited by faculty were the NASA web sites for educators and NASA Web Quests (Web Quest definition: An inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet.) Sky lab and MU-SPIN (Minority University Space Interdisciplinary Network) resources were the next most popular resources. The Internet was also a popular way to access space materials such as images, lessons, etc. NASA was also considered a useful resource for space science textbooks, resource web sites, hands-on activities for teacher education courses, and Earth system science products.

Areas where the minority-serving postsecondary faculty sampled differed most from the K-12 rural educators sampled are in ratings of basic research equipment/instruments (K-12 teacher ratings are higher), laboratory/research space and supplies (K-12 teacher ratings are higher), personal computers (postsecondary faculty ratings are higher), Internet connections (postsecondary faculty ratings are higher), and technical support for computer activities (postsecondary faculty ratings are higher).

Below is a summary of responses to the open-ended question regarding perceived barriers to using space science as a context for teaching and learning in science, mathematics, and technology content areas. As Table 1 shows, the most commonly reported barriers were lack of knowledge of space science content and lack of support staff and materials.

Table 1. Barriers to using space science as a context for teaching and learning

(17%)	Lack of knowledge of space science (by teacher)…Funding for training and retraining of teachers…As an elementary teacher the barrier--not "specializing" in any content area. The content knowledge is lacking…Familiarizing classroom teachers with the resources available and how they can use them at the level they teach (especially K-3)…Material is at a high level
(13%)	Lack of support staff and materials… equipment availability and cost
(6%)	Accountability w/standardized testing…Existing emphasis on meeting national and state standards for accreditation purposes (NCATE, PDE, ISTE, NAEYC)… Not related Praxis or INTASC students
(4%)	Myths commonly held by individuals that math and science are extremely difficult (if not impossible) content areas as academic majors…fear of content
(4%)	My assignment is math… not included in any pre-service teaching program
(1%)	Time…limited number of hours for teaching science content in the teacher education program

Theme 2. Support and mentoring opportunities that are available to faculty throughout their careers

In a recent report that synthesized relevant research in teaching pedagogy and practice, Fox and Hackerman (2003) suggested that formative evaluation in the form of ongoing informal feedback from students and colleagues can encourage a continuous cycle of growth and professional development. They further suggested that this kind of formative evaluation strategy should be applied across departmental programs and not just to individual faculty members. This section looks at survey items that asked about participants' broad range of professional development experiences and preferences for ongoing, informal feedback as well as structured professional development programs.

Table 2. Professional development workshops faculty representatives have attended during the 2002/2003 academic year.

During the 2003 academic year have you participated in professional development in any of the following?	*Yes*
a. Space science content?	14.8%
b. Science pedagogy/instruction?	46.3%
c. Science curriculum?	42.6%
d. Integrating information technology into science?	55.6%
e. Integrating science with literature?	37%
f. Integrating science and mathematics?	48.1%
g. Improving students' critical thinking or inquiry skills?	72.2%
h. Science assessment?	37%

As Table 2 shows, 72 percent of the faculty participated in professional development activities that addressed improving students' critical thinking or inquiry skills. Integrating information technology into science was the next most frequent professional development topic. The rate of 14.8 percent for participation in space science is consistent with the faculty responses that point to lack of space science knowledge as the greatest barrier to using space science as a context for teaching and learning.

Although the K-12 survey sample size was too small for a true comparison, an informal comparison of responses showed interesting similarities and differences between the faculty and teacher responses. Most noteworthy are the differences between professional development experiences in science curriculum (c.), integrating information technology (d), and science assessment (h) where K-12 teachers report more frequent professional development exposure to these subjects. The data suggest that postsecondary faculty and practicing teachers are exposed to different kinds of professional development experiences. One of the postsecondary faculty participants wrote as a comment to their survey form that "I would like to be able to attend the weeklong professional development opportunities that NASA offers to preservice students and in-service teachers."

Theme 3. Mastery of a multidimensional set of skills, knowledge, and proficiencies that science, mathematics, and engineering teachers are expected to have to be successful including: (a) knowledge of and enthusiasm for the subject matter; (b) Familiarity with a range of appropriate pedagogies; (c) Skill in using appropriate tests; (d) Ease in *professional interactions with students within and beyond the classroom; and (e) Active scholarly assessment to enhance teaching and learning.*

Expert teaching is a complex achievement that according to Shulman (1987), Nathan & Petrosino (2003), and Fox and Hackerman (2003) is comprised of expertise in multiple domains, including curriculum subject matter, student behavior and development, and pedagogy. This theme looks at five dimensions of the complex skills, abilities, and expertise of teachers: knowledge of the subject matter; (b) familiarity with appropriate pedagogies; (c) skill in using appropriate tests; (d) ease in interacting with students; and (e) involvement in scholarly endeavors.

The survey asked postsecondary faculty and teachers to describe their principal field or discipline of teaching, area of research, and postsecondary major or main area of study. The two tables below summarize this information for both groups.

Table 3. Summary of postsecondary faculty discipline, area of research, and major area of study

	Principal field or discipline of teaching	Principal area of research?	Post-secondary major or main area of study
Biology	5.08%	1.79%	8.33%
Physical Science	1.69%		
Geography			
Computer Science	1.69%	1.79%	1.67%
Health Science			
Mathematics	6.78%	5.36%	6.67%
Physical Education			
Reading and Language Arts	1.69%	5.36%	10.00%
Teacher Education	33.90%	48.21%	15.00%
Education – General	11.86%	10.71%	8.33%
Education – Elementary Level	23.73%	10.71%	13.33%
Education – Secondary Level	3.39%	1.79%	5.00%
Other: ___________	8.47%	10.71%	30.00%
NA	1.69%	3.57%	1.67%

Table 4. Summary of faculty licensure and/or certification

Area of License/Certificate	*Faculty*
Elementary Level	44.4%
Secondary Level	24.1%
Science Specialization	9.3%
Math Specialization	5.6%
Reading and Language Arts	9.3%
Art and Music Specialization	5.6%
Technology Education Specialization	1.9%
Vocation Specialization	0
Gifted Specialization	1.9%
Special Education	5.6%
Other: ___________	14.8%
NA	3.7%

As Table 3 shows, the most common (33.9%) principal field or field of teaching discipline for faculty was teacher education. Eight percent of the faculty had a postsecondary major in biology, Two percent majored in computer science, seven percent in mathematics, ten percent in language arts, fifteen percent in teacher education, thirteen percent in elementary education, and thirty percent majored in other areas not listed. Table 4 shows that 44 percent of the faculty surveyed were certified to teach elementary education and 24 percent were certified secondary level teachers. This rate reflects the focus of this NASA/NSU PSTP which is elementary and middle school science and mathematics teaching.

Based on Indicator 32 published by NCES (2002), we would expect that "about half of secondary teachers in public schools majored in an academic subject and about 4 out of 10 majored in an academic subject area in education…. Among elementary teachers, an average of 24 percent majored in an academic subject, 18 percent in a subject area specialization in education, 45 percent in general education, and 13 percent in some other education specialization (e.g., special education, curriculum and instruction, or educational administration) for their graduate or undergraduate degree."

For secondary teachers, nearly twice as many (49 %) majored in an academic subject, 38 percent in a subject area specialization in education, 7 percent in a subject area specialization in education, 7 percent in general education, and 6 percent in some other education specialization. The percentage of preservice faculty who majored in an academic subject in their postsecondary education is 26 percent. This figure is consistent with the national average (24 %) for elementary teachers when the secondary certification group with a higher rate of academic majors is considered.

To understand faculty familiarity with a range of pedagogies, the survey included questions that ask teachers to describe some of their instructional practices, classroom teaching strategies, and types of resources used. Table 5 shows the rate of alternative resources used. The use of supplemental material is of great interest in this study because this shows that the faculty is familiar with bringing in non-text-book materials as part of their classroom instruction. With extensive use of supplemental materials and web resources, this may be a way for space science curriculum offerings to be incorporated—especially in the science classes.

Table 5. Resources used for classroom instruction

Resources	***Science***	***Math***	***Technology***
Textbook	44.4%	33.3%	16.7%
Supplemental material	40.7%	29.6%	20.4%
Guest speakers	22.2%	18.5%	9.3%
Field trips	20.4%	11.1%	11.1%
Web resources	33.3%	25.9%	24.1%

The survey asked faculty to describe what kind of assessment techniques, strategies, and media tools they were using for science, mathematics, and technology courses. Faculty use of student evaluations is highlighted here to show how assessment techniques vary across curriculum. Generally, use of alternative teaching and assessment strategies happened first in science classes and less often in mathematics and technology classes. This may show the bias of the groups selected or may reflect increased professional development opportunities in science education.

Table 6. Assessment

	Science	*Mathematics*	*Technology*
e. Type of Assessment Used			
Did you use student evaluations of each other's work?	33.3%	25.9%	16.7%

Table 7 provides a summary of postsecondary faculty responses to the series of questions about web site usage shows areas where faculty are comfortable using the web for instructional purposes. A NCES (2003) study of teachers' use of technology reports that teachers who spend more time in professional development activities were generally more likely than teachers with less time in these activities to describe themselves as "well prepared or very well prepared" to use computers and the Internet for instruction. This suggests that with appropriate professional development activities, more teachers would feel confident enough to make use of the web for more instructional activities. This is an area for further investigation.

Table 7. Instructional use of web sites

	Science	*Mathematics*	*Technology*	*NA*
f. Web Site Usage for Instruction				
(1) To post general class information (i.e., syllabus and office hours)	29.6%	22.2%	22.2%	22.2%
(2) To post information on homework assignments or readings	31.5%	24.1%	24.1%	20.4%
(3) To post practice exams/exercises that provide immediate scoring	9.3%	9.3%	3.7%	27.8%
(4) To post exams or exam results	3.7%	5.6%	3.7%	24.1%
(5) To provide links to other information	22.2%	14.8%	18.5%	22.2%
(6) To access NASA web sites	14.8%	5.6%	5.6%	18.5%

The NASA Office of Space Sciences offers a range of opportunities for K-12 teachers and postsecondary faculty to be involved in scholarly activities such as research, curriculum development, or professional development training for other teachers. A set of questions examined whether and to what extent postsecondary faculty and K-12 teachers have been involved in these scholarly enhancement activities offered by NASA. Responses showed that 40 percent of the postsecondary faculty participants were not aware of these opportunities; 22 percent were familiar with these opportunities. However, only seven percent of the respondents have submitted proposals; four percent have been part of a team that was awarded funding from a proposal submitted; two percent were either a principal or co-investigator on a proposal; none of the respondents have served on proposal review panels, and 28 percent of the respondents would like to have the opportunity to serve on a review panel. These data suggest areas for providing more information and access to allow greater participation in this scholarly and/or research activities.

To find out how faculty are spending their time between teaching, administration, research/scholarship, professional growth, and education outreach and community service, participants were asked to estimate the percentage of time they spent on these activities and then to indicate the percentage of time that they would prefer to spend on these activities. The data showed that on average, faculty are spending 51 percent of their time on undergraduate teaching and 46 percent on graduate/professional (inservice) teaching; on average they would prefer to spend 47 percent of their time on undergraduate teaching and 43 percent on graduate/professional (inservice) teaching. Faculty spends on average 42 percent of their time on administrative duties; on average they would prefer this to be 38 percent of their time. Faculty spends 44 percent of their time on research and on average would prefer to spend 42 percent of their time in this area. The preferred and actual time spent are closest in the area of professional growth where faculty report an average of 43 percent of their time on actual and would prefer to spend 42 percent of their time on average in this type of activity. Faculty spend on average 44 percent of their time on outreach/service activities and on average would prefer this to be closer to 40 percent of their time.

Thus, faculty would like to decrease their time spent in teaching, administrative duties, and outreach/service more than other areas. This data suggests that the faculty surveyed in this sample is looking for ways to lighten their workload. As Table 8 shows, forty-four percent of the faculty respondents were involved in professional research, writing, and/or creative work during the 2002/2003 academic year.

Table 8. Faculty engaged in research and development activities

Categories of professional work	*Percentage who selected this category*
Basic Research	20.37%
Applied/Policy oriented	5.56%
Literary/Performance/Exhibition	1.85%
Program/Curriculum development	44.44%
Other	3.70%

Theme 4. Right to use structures and actions that enable collective efficacy and that play an important role in fostering an organizational culture supporting student achievement.

Self-efficacy (Bandura, 1993) refers to a belief in one's capacity to organize and execute the courses of action required to produce given attainments, such as smoking cessation, adherence to exercise and diet programs, sports performance, and most importantly for this context, academic achievement. Self-efficacy, instructional efficacy, and collective efficacy are all related constructs that reflect a social cognitive theory to explain the dynamical relationship between individual beliefs, performance, and organizational behavior. Goddard, Hoy, and Hoy (2004, p. 7) propose that "the most compelling reason for the recent development of interest in perceived collective efficacy is the probable link between collective efficacy beliefs and group goal attainment…. Teachers' beliefs about the collective capability of their faculty vary greatly among schools and are strongly linked to student achievement." Teachers' perceptions of collective efficacy also provide a way to characterize a school's culture. Collective efficacy beliefs encourage certain behaviors while constraining others.

Unfortunately, none of the survey questions directly address collective efficacy construct. However, a few questions from the survey are analyzed in this section to provide some information regarding individual actions that reflect a cultural environment compatible with collective efficacy. The questions that ask respondents to rate the level of contribution, quality, information, and contribution of the space science product used in their work suggest an institutional climate favoring collective efficacy because use of the space science materials is a voluntary action. When the faculty reports that they have selected and used alternative material for their classroom teaching, this shows that they are actively seeking materials, content, and processes that will add value to their offerings for their students. The review of these materials is also at a level that asks participants to consider how a space science resource they used the most impacted their classroom culture.

The percentage of faculty participants who have experience using NASA space science materials is small, but those who do use NASA materials consistently rate them as having a significant impact on their instruction. Faculty also rated the quality and value of the NASA materials highly. When faculty participants were asked what additional and/or new NASA space science resources they would like to have for their preservice teachers, they responded with a variety of requests specific to their teaching interests. Here is an abbreviated summary of their recommendations: (1) Classroom activities for college teachers; (2) Activities that incorporate methodologies; (3) …resources other than the web sites. The college prep math teacher is incorporating the math techniques learned at NASA Conference in Abstract Math; (4) Videos, hands-on NASA materials, more lessons on PowerPoint templates, more tech, and all poster lessons posted on the web; (5) Resources that can be used in elementary and middle school classrooms -Kits, CD-ROMs, videos, etc.; (6) More hands-on materials; face to face workshops, and web-based interaction; (7) …have the NASA mobile unit to visit our campus; (8) I understand that there is a book on using GIS in the classroom--a similar web site would get more teachers using GIS.

Implications

The survey data analysis points out several areas where the postsecondary faculty and K-12 teacher groups differ. In terms of access to technology/ resources the data show that K-12 teachers rate their research equipment and laboratory space and supplies higher than the postsecondary faculty. On the other hand, postsecondary faculty rated their access to personal computers, technical support, and Internet connections higher than the K-12 teacher group. These technology/access issues would be worth investigating in more detail as relationships are built with specific faculty and teacher groups.

Media preferences for professional development and informal follow-up activities were similar with both groups preferring face-to-face (64%) as their first choice, print or web-based material as their second/third choice, and visits to other teacher's classroom for observation as both groups' fourth choice. The K-12 teacher group shows a somewhat higher preference for classroom visits than the postsecondary faculty.

Data regarding the professional development experiences show more variation across the two groups and suggest that postsecondary faculty and K-12 teachers are exposed to different professional development topics. The K-12 teachers are attending more professional development programs that address content and assessment issues. The postsecondary faculty are attending more professional development that address integrating science and language arts. This observation needs to be examined in the context of a larger sample size. The MARSSB team has, however, received requests from teachers within the ARSI network for more information regarding integrating science with literature.

Analysis of theme three issues (mastery of a multidimensional set of skills, knowledge, and proficiencies that science, mathematics, and engineering teachers are expected to have to be successful) suggests that both groups have similar needs for professional development offerings that are designed to suit the multidimensional set of skills that teaching requires. Teachers need professional development that considers the subject matter relevancy, appropriate pedagogies, assessment tools, student interactions, and opportunities for scholarly advancement within the context of the program. While addressing all these factors cannot always be accomplished in one setting, both groups suggest that they are open to print and/or web-based follow-up to face-to-face meetings.

The fourth theme that addresses collective efficacy provides a potent reminder that a technology/resource infrastructure, professional development program, and a master set of teaching skills, knowledge, and proficiencies are strongly influenced by the school cultural climate. In the context of looking for ways to improve teaching and learning among minority-serving and rural institutions, consideration should also be given to how teachers can be given opportunities to influence instructionally relevant decisions. Offering this kind of collective decision-making encourages teachers to “exercise organizational agency” (Goddard, Hoy, & Hoy, 2004). In the analysis of this component, a few questions seemed somewhat relevant and are described. The process of assessing the collective efficacy of a school or university department can work in tandem with the process of keeping a watchful look for cultural identify and learning differences. “Consolidate ecological systems approaches that attempt to understand human goal-direct behaviors and emergent goals in the context of people’s participation in patterned activities across settings” (Lee, Spencer, & Harpalani, 2003).

What does analysis of the faculty survey data suggest as possible strategies for intervention? Perhaps the greatest value of this survey research process is the reflection that the process inspires (Sun, 2000.). The development of a successful education and public outreach strategy for all groups requires that MARSSB team members meet with teachers and administrators to define what constitutes ‘success’ in their efforts to integrate space science resources and educational technology tools into the teaching and learning processes. Perhaps the most important outcome from this needs assessment study is to develop descriptive indicators that show where particular schools are now and a picture of where they want to be in the near future.

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