Report on Course and Curriculum Changes in Math and Science Partnership (MSP) Programs

Change and Sustainability in Higher Education (CASHÉ)

June 2006

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Introduction and Overview

The National Science Foundation's Math and Science Partnership (MSP) grants support innovative programs that are designed to improve K-16 student achievement in mathematics and the sciences. One of the goals of the MSP program is to foster systematic change within institutions of higher education (IHEs) in order to improve the teaching and learning of mathematics and science at all levels of education. MSP projects work to improve the quality of current and future STEM (science, technology, engineering, and mathematics) faculty and teachers through institutional changes that include course and curricular innovations, the development of new pathways for K-12 STEM teacher preparation, and professional development for STEM faculty and teachers. The Change and Sustainability in Higher Education (CASHÉ) project, housed at the University System of Maryland, is conducting a three-year study that seeks to document curriculum transformation, faculty engagement, and sustainable change among IHEs that are involved in MSP projects. The major focus of this study is on ways in which MSPs have engaged STEM higher education faculty in focusing on the quality of STEM undergraduate education, strengthening their teaching practices, and expanding the scope of their work to encompass a K-16 perspective, including the improvement of K-12 STEM education and the preparation of future teachers.

While there is a substantial body of literature that focuses on change in higher education (see Kezar, 2001, and Kezar & Eckel, 2002, for a synthesis of theory and research) and the nature of school-university partnerships (Greenberg, 1991; Timpane & White, 1998; Verbeke & Richards, 2001; Wallace, 2003; Wiseman & Knight, 2003), few studies focus specifically on curricular change in the context of these relationships. Under the auspices of the CASHÉ project, this current report attempts to bridge this gap by concentrating on changes in higher education courses and programs (both STEM and teacher preparation) that are made in the context of a collaborative MSP relationship.

During this first phase of the study, the CASHÉ project team conducted an analysis of MSP-supported curricular initiatives within a subset of MSP projects from across the nation that reported significant changes among partner IHEs. The findings suggest that course and curricular changes have occurred across the MSP programs, that the majority of these changes are in certification and professional development programs for pre-service and in-service K-12 STEM teachers, and that there is an emphasis on the development of new pathways for the preparation

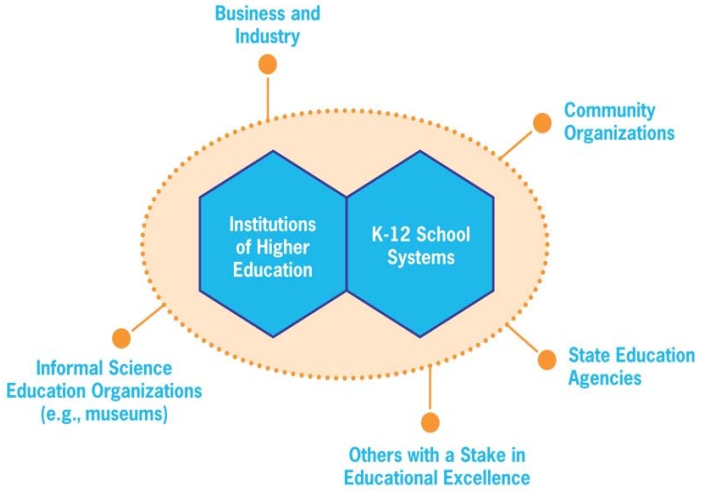
of future K-12 teachers in the STEM disciplines. The data also suggest that these changes are occurring at the local level rather than the institutional level, involving individual faculty members who are engaged in specific MSP-supported activities (as opposed to department-wide initiatives or collaborative teams). This report offers a summary of the study's methodology, data, findings, and implications in these areas.

The second phase of this study, which will begin in Fall 2006, will use case study methodology to examine the extent to which STEM faculty are actively engaged in these curricular innovations, the relationship between STEM faculty and teacher education faculty in these efforts, the institutional reward structures that support or hinder their participation, and the broader impact of MSP-related initiatives on STEM undergraduate courses and programs among participating IHEs.

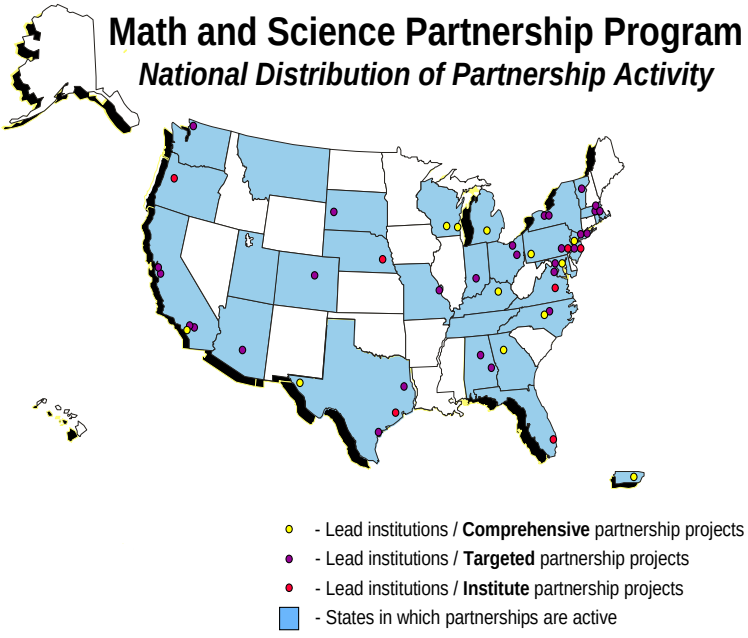
Background and Context

The MSP program is an important initiative from NSF and the broader scientific community that addresses the urgent need to improve STEM education in the 21st century and expand the pipeline of students majoring in STEM disciplines. The MSP initiatives recognize that in order to prepare the next generation of STEM professionals, we must have scientifically, technologically, and quantitatively literate K-12 teachers who are able to prepare the next generation of college students. These needs are likewise substantiated in several recent national reports (e.g., *A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education; Before It's Too Late: A Report to the Nation from the National Commission on Mathematics and Science Teaching for the 21st Century; Learning for the Future: Changing the Culture of Math and Science Education to Ensure a Competitive Workforce; Tapping America's Potential: The Education for Innovation Initiative; To Touch the Future: Transforming the Ways Teachers Are Taught*). At the same time, shortages of qualified K-12 STEM teachers are well-documented, a crisis that is expected to continue in the foreseeable future (Curran, Abrahams, & Manual, 2000; Gerald & Hussar, 2003; U.S. Department of Education, 2000, 2002). Thus, MSP projects operate in a collaborative research and development environment that seeks to increase the number of new, highly proficient STEM teachers through innovative teacher preparation programs, to improve the quality of the current STEM teacher workforce through professional development, and to enhance the quality of

STEM education within IHEs for all students. Central to the success of the MSP programs are strong partnerships among K-12 school systems and IHEs that facilitate linkages to other key stakeholders on the local, state, and national levels. (See Figure 1.) Such initiatives are grounded in the recognition that the "nature of school and university partnerships has changed so that collaboration now represents a real opportunity to make systemic change and improvement" (Verbeke & Richards, 2001). Several NSF Research, Evaluation, and Technical Assistance (RETA) projects are currently studying the dynamic nature of such collaborations among MSP partnerships (e.g., Kingsley, O'Neil, & Usselman's Alternative Approaches to Evaluating STEM Education Partnerships).



In 2002, NSF funded its first cohort of MSP projects. There are currently 48 MSPs across the nation. (See Figure 2.) Twelve are designated as comprehensive projects that engage IHEs and the entire K-12 spectrum. Twenty-eight are designated as targeted projects that engage IHEs and specific grade levels (i.e., elementary, middle, or high school). The remaining eight are institute partnerships that focus on content and leadership. By design, the five key features of all MSP projects include: (1) challenging STEM courses and curricula; (2) enhancement of teacher quality, quantity and diversity; (3) partnerships among STEM faculty at all levels; (4) evidence-based course and curricula design; and (5) institutional change and sustainability.



Methodology

In November 2005, NSF charged the CASHÉ project team to study a subset of the MSPs to analyze the nature of curricular changes within IHEs that were reported as outcomes from their involvement in the project. Twenty-four MSPs were identified by NSF program officers as offering particularly promising examples of institutional change. The CASHÉ project team collected data on 21 of these projects in the form of annual reports, internal and external evaluation summaries, and other project materials. These data were categorized and archived and serve as the basis for the current study.

A profile of the 21 participating projects is shown in Table 1. These partnerships represent a cross-section of 11 targeted, 8 comprehensive, and 2 institute MSPs from NSF cohort years 2002, 2003, and 2004. Fourteen of the MSPs (Boston Science Partnership, Cleveland MSP, Consortium for Achievement in Mathematics, Focus on Mathematics, Greater Birmingham, Greater Milwaukee, Greater Philadelphia, Preparing Virginia's Mathematics Specialists, Project Pathways, Puerto Rico MSP, Revitalizing Algebra, Rocky Mountain, SCALE, and VIP K-16) are primarily urban projects. Four projects (Appalachian, FOCUS Irvine, MSP-Southwest PA, and North Cascades) focus on rural communities, while the remaining three (El Paso, Penn Science Teacher Institute, and PRISM) serve both urban and rural constituencies. Eighteen of the partnerships involve multiple local school districts. Among the 21 MSPs, 72 colleges and universities and 8 other participating organizations (e.g., research institutes or educational associations) are represented. Eleven of these projects involve three or more IHEs. Six of the partnerships (Appalachian, El Paso, Greater Philadelphia, North Cascades, Project Pathways, and VIP K-16) include community colleges.

To guide this study, the CASHÉ project team developed a set of six overarching questions for analyzing the MSP project data related to curricular change among participating IHEs. Similar to the change model developed by Clark, Froyd, Merton, and Richardson (2004) for engineering education, these questions recognize that curricular change is not merely the development of a new "product" or "deliverable," but a "dynamic entity" whose growth and continuous evolution must be sustained over time. As a result, the analytic framework for this study focuses not only on the content of these curricular changes, but also on the mode, process, participants, audience, and external context. Thus, the guiding questions for this study are as follows:

(1) What type of curricular change is involved (i.e., does the change involve the development of new courses, programs, certifications, or degrees, and/or does it involve the redesign of existing courses, programs, certifications, or degrees)?
(2) Who is/are the primary audience(s) for the change (e.g., pre-service STEM teachers, in-service STEM teachers, IHE undergraduate students, IHE graduate students, IHE faculty, or others)?
(3) Who is responsible for these changes, and are they the result of the efforts of individuals or teams?
(4) Are these changes linked to external educational standards (i.e., local, regional, state, or national)?
(5) Do these changes involve non-curricular or non-credit activities (e.g., workshops or professional development programs)?
(6) What types of evidence support these change claims among IHEs?

Results and Discussion

The information obtained from the analysis of the raw data using the six guiding questions above is presented in Tables 2, 3, and 4. The aggregated data in Table 2 show several important outcomes. All 21 of the selected MSP projects were engaged in the creation or redesign of higher education courses, and in every case these changes were part of new or redesigned programs, curricula, and/or teacher certification pathways. These findings suggest that course development and redesign are not occurring in isolation, but rather as part of broader institutional change efforts. In nine of the MSP projects, these creation and redesign efforts involved more than one IHE partner. At the same time, however, the type and nature of the course change varied across the projects. Eighteen of the projects developed new or redesigned professional development courses for in-service teachers, 16 developed new or redesigned courses for STEM undergraduates (since many of the courses in this second category overlap between STEM majors and STEM teacher candidates, it was difficult to make distinctions), and 10 developed new or redesigned courses specifically for pre-service teachers. Among the MSPs, all of the constituent groups (pre-service teachers, in-service teachers, and STEM undergraduates) appear to be well-served.

Seven of the projects (Appalachian, Cleveland MSP, Greater Milwaukee, North Cascades, Puerto Rico MSP, Revitalizing Algebra, and SCALE) developed new or redesigned courses for all three constituent groups (pre-service teachers, in-service teachers, and STEM undergraduates). Among the remaining projects, nine (Consortium for Achievement in Mathematics, El Paso, FOCUS Irvine, Greater Philadelphia, MSP-Southwest PA, Penn Science Teacher Institute, Preparing Virginia's Mathematics Specialists, PRISM, and Project Pathways) developed new or redesigned courses for two constituent groups, while five (Boston Science Partnership, Focus on Mathematics, Greater Birmingham, Rocky Mountain, and VIP K-16) focused their efforts on a single constituent group. Approximately one-third of the selected MSPs were engaged in STEM course development or redesign at the graduate level.

In terms of the subject matter and academic focus of these newly created or redesigned courses, there was substantial diversity both within and across MSP projects, including content deepening seminars (MSP-Southwest PA), multidisciplinary integrated science courses (Penn Science Teacher Institute), courses that focus on effective teaching strategies and practices (Project Pathways), courses that prepare in-service teachers for "highly qualified" status under *No Child Left Behind* (Cleveland MSP), standard teacher education course sequences across multiple higher education institutions (Appalachian), and courses that provide a forum for the exploration of such factors as gender, race, ethnicity, and class that impact STEM teaching and learning (Revitalizing Algebra).

In nine of the MSP projects, STEM course development or redesign efforts were the product of or resulted in new academic programs. Because new programs generally go through a rigorous review process in higher education institutions, there is high likelihood that these resulting curricular changes will be sustainable. Program reviews generally involve multiple faculty members and formal evaluation and approval by a committee or review panel at the departmental or school/division level (see Barak, 1982, for a detailed discussion of the program review process in higher education). For many colleges and universities, particularly those in the public sector, this review process often involves an external regulatory agency as well (e.g., university system office or state higher education board). Thus, the development and implementation of a new academic program requires substantial buy-in at a variety of levels at an institution, particularly with respect to the allocation of resources to support the program. In light of such investments, the course and curricular changes that are supported by and result from

MSP participation (particularly when linked to new academic programs) are likely to be sustained by IHEs over time.

In seven of the projects, newly developed or redesigned courses were in close alignment with district, state, or national education standards. In at least 13 cases, the newly developed or redesigned courses, curricula, or programs directly involved either K-12 or IHE administrators. In 11 of the projects, the newly developed or redesigned programs included extracurricular, non-credit, or informal activities. For example, through Maryland's VIP K-16 EXPERT Program, high school science teachers spent a summer working in a research laboratory and then continued working together as a learning community during the subsequent academic year. Another major pathway for the delivery of newly developed or redesigned programs was through summer programs or institutes; 18 of the MSP partnerships used this model. While some focused on the recruitment and preparation of future teachers (e.g., PRISM's Summer Bridge Institute, Project Pathways' Summer Certification in Secondary Mathematics Program) or the professional development of in-service teachers (e.g., Greater Birmingham's Summer Content Institutes, Greater Philadelphia's Secondary Education Summer Enrichment Program), others were designed specifically for K-12 students (e.g., Puerto Rico's summer camps for 6^{th} to 12^{th} grade students, Rocky Mountain's Center for Math, Science, and Environmental Education summer camp).

Six of the MSPs explicitly reported the use of a team or consortium approach for the development of new or redesigned courses. Notable examples include the Boston Science Partnership, which involved vertical teams of IHE faculty and K-12 teachers working together to create summer professional development courses for K-12 teachers, and the Appalachian MSP project, which used a team-based approach to develop a variety of courses for pre-service teachers. Appalachian formalized its consortium-building efforts through the creation of the Partnership Enhancement Program (PEP), which partners local school districts with IHEs to work on projects in targeted areas of need, including curricular issues. This program was designed to establish a network of smaller partnerships across all levels of the MSP and was based on the recognition that "micro-investments" were an effective means of initiating new working relationships to address shared challenges, needs, goals, and interests. In an external evaluation of Appalachian's PEPs, K-12 teachers have reported a sense of empowerment resulting from their participation, particularly in having the opportunity to apply their classroom

experiences in addressing larger-scale problems and issues. Participating IHE faculty, in turn, have shared that they now have a better appreciation for and understanding of curriculum and instruction at the K-12 level.

In the vast majority of the 21 MSP projects that were studied, course development or redesign activities predominantly appeared to be the product of individual faculty members. However, from the data provided, it is difficult to know if this is indeed the case. Given the nature of formal and informal collaborations and exchanges among faculty at IHEs, course development and redesign efforts are likely to reflect the input and expertise of multiple faculty members. The nature of collaborative efforts among MSP faculty participants both within and across partner IHEs warrants additional investigation and is a rich area for further inquiry. For example, what structures and incentives have MSPs created in order to encourage and reward formal and informal collaborations of this nature? What factors and conditions either facilitate or hinder such efforts? To what extent do such models as faculty learning communities (e.g., those introduced by VIP K-16) provide opportunities for collaborative course development or redesign activities?

As presented in Table 3, these 21 projects have developed or redesigned a total of 169 STEM-related higher education courses through the scope of their MSP work. For the purposes of this study, a redesigned course was operationally defined as a course identified by the MSP project staff as having gone through substantial revision, modification, or restructuring as part of their MSP participation. Interestingly enough, there is no apparent correlation between the type or size of the MSP (as determined by the number of institutional partners) and the number of newly developed or redesigned courses. Sixteen of these projects have developed or redesigned less than 10 courses, while the remaining five (Boston Science Partnership, Cleveland MSP, El Paso, Greater Philadelphia, and PRISM) have developed or redesigned 10 or more. These courses span multiple disciplines within mathematics and the sciences and range from classroom-based content and pedagogy courses to labs, internships, and seminars. Several projects specifically pointed to the incorporation of new inquiry-based techniques or the deepening of content matter as a significant component of new course development or revisions to existing courses, while others mentioned the integration of new theories and research on teaching and learning. For some projects, the impetus for change was to align K-12 and higher education courses and curricula with outside standards. For example, Rocky Mountain reported

that its newly developed IHE courses focused on district needs and the state's performance-based licensing standards for teachers in science and mathematics.

Fifty-four (32%) of the newly developed or redesigned courses targeted pre-service teachers; two-thirds of these courses were math or math education courses. The remaining were spread nearly equally among the various science disciplines (e.g., biology, chemistry, earth/space science, physics, and engineering). Among the 21 projects, there were no reports of the development or redesign of science education courses for pre-service teachers. Ninety (53%) of the newly developed or redesigned courses targeted in-service teachers. In contrast to courses for pre-service teachers, almost half (40) of these courses were in the science disciplines, while 29 were in math education or science education and 21 were in math. This difference likely reflects the rapidly evolving nature of curricular content in the sciences and the need for in-service teachers to continuously learn new subject matter. Only 25 (15%) of the newly developed or redesigned courses were for STEM majors or graduate students. Thus, the vast majority of the changes as measured by newly developed or redesigned courses within participating IHEs focused on pre-service or in-service teachers. Typically, these two groups represent only a small fraction of students enrolled at most IHEs; this is particularly true among research universities and many comprehensive universities. The resulting implication is that MSPs are more likely to have a greater impact on the STEM curriculum within teacher education rather than a broad-based impact on the STEM curriculum for the general undergraduate population among participating IHEs.

A detailed profile of the types of IHE changes reported by each of the MSPs is provided in Table 4. Based on the materials provided to us by the 21 projects, we assigned the primary impact of the reported changes to one of two constituencies: (1) those directly involved in K-12 education (i.e., pre-service or in-service teachers), or (2) undergraduates enrolled in STEM courses (i.e., both majors and non-majors). In some cases, these student populations are intermixed, as many STEM courses that serve pre-service teachers also serve STEM majors, in which case the changes impact both groups. In fact, it was often difficult to discern differences between STEM courses for pre-service teachers and those for other undergraduate students, as there was substantial overlap. Nevertheless, it is clear that the IHE changes summarized in Table 4 primarily affect individuals who are already committed to becoming teachers or who are pursuing teacher certification. In addition, some MSP projects have developed courses and

programs with a specific focus on recruiting more STEM majors into teaching, including FOCUS Irvine's summer program for community college students and Project Pathways' summer certification program for mathematics majors. However, the broader question of curricular change both in K-12 and higher education in order to recruit and retain more STEM students to begin with is an important area that warrants further exploration.

Conclusions

Based on this analysis of 21 selected MSP projects, there is strong evidence that participating IHEs have engaged in significant curricular development initiatives in support of STEM teacher preparation programs. The data presented in this report support the following general observations:

- Every MSP, and most of the IHEs involved in these projects, have developed or redesigned courses through their MSP funding.
- Every partnership has developed new programs, degrees, or teacher certification pathways through their MSP funding**.**
- Most of the MSPs have focused their efforts on the K-12 side of the partnerships, including pre-service and in-service courses, with fewer resources explicitly devoted to changing STEM courses for general education requirements, undergraduate majors, or graduate programs.
- Course design efforts have taken multiple forms but predominantly reflect the work of individuals or small teams within an MSP project.
- In addition to new courses, newly developed extracurricular, non-credit, or informal activities were reported by a number of the projects.
- Although the majority of new or redesigned professional development courses and activities involved faculty and teachers, many MSP project administrators were also directly involved in this work.
- The degree and nature of curricular change activities did not appear to be dependent on the initial year of the MSP grant, size of partnership, or type of partnership.

Limitations of the Analysis

One of the major limitations of this study was that it relied on the secondary analysis of written, self-reported materials that were submitted by individual MSP projects (e.g., annual reports, internal and external evaluation reports, etc.). In some instances, this information was supplemented by Web-based materials gathered by the CASHÉ project team. As a result, the quantity and quality of available data varied widely across the 21 projects. In the next phase of this study (see "Next Steps" below), it will be important for us to triangulate these findings with other project-related evidence, including data collected from interviews and site visits, data from the MSP Management Information System (MIS), data from annual surveys of projects and partners (e.g., WESTAT), and data from MSP-related workshops (e.g., National Research Council).

Another challenge related to this study was that the curricular changes varied so widely across the MSP projects that they were often difficult to classify. In some cases, it was difficult to determine from the materials provided whether the change was a new course, the alteration of an existing course, or the development of a nontraditional course such as a professional development workshop during a summer institute. In addition, while several projects did mention the alignment of new courses and programs with external standards, particularly the alignment of pre-service and in-service IHE courses with local school district standards, the extent to which these alignment processes were mutual was unclear (i.e., whether K-12 and IHE partners equally influenced each other's change processes and/or if such changes flowed in both directions in the partnership). From the materials provided, it was also difficult to uncover the original impetus or motivation for many of the curricular changes and the extent to which STEM faculty versus teacher education faculty (or both groups working together) were primarily responsible for these change initiatives. This is an important topic that warrants further investigation during the upcoming site visits with select MSP projects. Also, the specific manner in which MSP funds were spent in order to support these curricular changes was not apparent from the data we collected from participating projects (i.e., purchasing new instructional materials and equipment, funding faculty course releases, hiring external consultants, offering more sections to reduce class size). In order to examine these issues in depth, the CASHÉ project team plans to complete a comprehensive analysis of MSP project budgets and spending

patterns to see how participating IHEs have leveraged NSF funding for project activities related to curriculum development, faculty engagement, and sustainable change.

In addition to these limitations, there were other noticeable gaps in the study's findings. From our review of the project materials, we found only two mentions (Greater Philadelphia and PRISM) of plans for involvement with professional development schools (PDS), despite the fact that PDS is a well-established form of partnership in numerous districts and states across the nation. In addition, only one partnership (Rocky Mountain) made any direct mention of collaboration with other federally-funded K-12/higher education reform efforts, such as the Title II Teacher Quality Enhancement grants or U.S. Department of Education MSP grants. As we consider questions related to the sustainability of the changes that result from these MSP projects, it will be important to continue to examine the extent to which IHEs have successfully linked and integrated their MSP initiatives with other ongoing developments.

Next Steps

This report examined MSP curriculum development initiatives among participating IHEs as measured by changes to courses, programs, degrees, and teacher certification pathways. By beginning with relatively concrete, easily documented changes, the CASHÉ project team was able to discover a number of "wedge" issues that require further study using different approaches and methodologies. As highlighted in this report, these issues include the nature of faculty collaboration in the course development and revision process, motivating factors behind curricular change, the leveraging of institutional and grant resources for curricular change, and the broader long-term impact of MSP projects on STEM teaching and learning outside of pre-service and in-service teacher education.

It is important to acknowledge that curricular changes are not the only types of developments that have resulted from IHE participation in MSP projects. Changes in institutional culture, priorities, policies, recognition and reward structures, and incentives for faculty engagement in such initiatives are equally important to examine. The metrics for measuring changes in these areas are more complex, however, since they evolve over time and are not always readily documented. Also, it is often difficult to establish a cause-effect relationship when evaluating outcomes of this nature (i.e., differentiating which outcomes can be directly attributed to MSP participation and which outcomes would have likely occurred

anyway). Unlike curricular change, which can be demonstrated with such evidence as the creation of a new academic program, course, syllabus, portfolio of instructional activities, or set of learning outcomes, the evidence for institutional change is more subtle and requires deeper study for understanding.

In preparation for these challenges, the CASHÉ project team is drawing upon the expertise of its national Advisory Board to develop a conceptual framework and evidence-based protocol for conducting research in these areas, which will involve site visits to several MSP projects in Fall 2006 and Spring 2007. There are several overarching questions that will frame the next phase of this study: To what extent have institutional priorities and practices changed relative to MSP goals and objectives among participating IHEs? What conclusions can be drawn regarding the depth and breadth of IHE changes fostered through their involvement in MSPs, particularly in the areas of curriculum transformation and faculty engagement? Is there evidence of an emerging sea change within the STEM disciplines, or are we still looking at "a thousand points of light?" The answers to these questions and others will provide evidence regarding the extent to which MSPs have permeated the culture of higher education in ways that will leave permanent, sustainable, and embedded transformations leading to more robust teaching and learning across the entire educational spectrum.

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List of Tables

Table 1: Profiles of Selected MSPs

Partnership	Type	Initial Grant Year	States	Urban/ Rural	# Public School Systems	IHE Types			
	Targeted/ Comprehensive/ Institute					Comprehensive Institutions	Predominantly Undergraduate Institutions	Community Colleges	Other
Appalachian	C	2004	KY	R	53	5	3	2	1
Boston Science Partnership	T	2004	MA	U	49	3			
Cleveland MSP	T	2002	OH	U	1	2	1		1
Consortium for Achievement in Mathematics	T	2003	NJ	U	4	1			2
El Paso	C	2002	TX	Both	12	1		1	
FOCUS Irvine	C	2002	CA	R	3	1			
Focus on Mathematics (Boston University)	T	2003	MA	U	5	1			
Greater Birmingham	T	2004	AL	U	8	1	1		1
Greater Milwaukee	C	2003	WI	U	1	1	1		
Greater Philadelphia	T	2003	PA and NJ	U	46	5	6	2	
MSP-Southwest PA	C	2003	PA	R	40	1	3		
North Cascades	T	2003	WA	R	26	1	2	2	
Penn Science Teacher Institute	I	2004	PA	Both	20	1			

Table 1 (cont.): Profiles of Selected MSPs

Partnership	Type	Initial Grant Year	States	Urban/ Rural	# Public School Systems	IHE Types			
	Targeted/ Comprehensive/ Institute					Comprehensive Institutions	Predominantly Undergraduate Institutions	Community Colleges	Other
Preparing Virginia's Mathematics Specialists	I	2004	VA	U	5	3			
PRISM	C	2003	GA	Both	13	3	1		1
Project Pathways	T	2004	AZ	U	4	1		1	
Puerto Rico MSP	C	2003	PR	U	84	4			
Revitalizing Algebra	T	2003	CA	U	3	1			
Rocky Mountain	T	2004	CO	U	3	3	1		
SCALE	C	2003	WI	U	4		2		
VIP K-16	T	2002	MD	U	1	3		1	2

Table 2: Types of IHE Curricular Changes in Selected MSPs

Course or Program Change	**Appalachian**	**Boston Science Partnership**	**Cleveland MSP**	**Consortium for Achievement in Mathematics**	**El Paso**	**FOCUS Irvine**	**Focus on Mathematics (Boston University)**	**Greater Birmingham**	**Greater Milwaukee**	**Greater Philadelphia**	**MSP-Southwest PA**	**North Cascades**	**Penn Science Teacher Institute**	**Preparing Virginia's Mathematics Specialists**	**PRISM**	**Project Pathways**	**Puerto Rico MSP**	**Revitalizing Algebra**	**Rocky Mountain**	**SCALE**	**VIP K-16**
Project Type: Comprehensive [C], Targeted [T], or Institute [I]	C	T	T	T	C	C	T	T	C	T	C	T	I	I	C	T	C	T	T	C	T
Creation or redesign of courses	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Creation or redesign of pre-service STEM courses	X		X	X		X			X	X		X					X	X		X	
Creation or redesign for in-service STEM teachers (professional development)	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Creation or redesign for STEM undergraduates	X		X	X	X	X			X		X	X	X	X	X	X	X	X		X	X
Creation or redesign involves STEM graduate program	X				X		X			X						X		X		X	
Creation or redesign involves summer professional development program	X	X	X	X	X	X	X	X		X	X	X		X		X	X	X	X	X	X

Table 2 (cont.): Types of IHE Curricular Changes in Selected MSPs

Course or Program Change	Appalachian	Boston Science Partnership	Cleveland MSP	Consortium for Achievement in Mathematics	El Paso	FOCUS Irvine	Focus on Mathematics (Boston University)	Greater Birmingham	Greater Milwaukee	Greater Philadelphia	MSP-Southwest PA	North Cascades	Penn Science Teacher Institute	Preparing Virginia's Mathematics Specialists	PRISM	Project Pathways	Puerto Rico MSP	Revitalizing Algebra	Rocky Mountain	SCALE	VIP K-16
Creation or redesign involves team or consortium approach	X	X									X	X								X	X
Creation or redesign involves more than one IHE	X				X				X		X	X		X	X	X				X	
Creation or redesign involves new programs, curricula, or certification pathways	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Creation or redesign generates new degree program(s)	X		X	X	X		X			X			X	X		X					
Creation or redesign involves external STEM standards	X	X	X			X									X			X	X		
Creation or redesign involves K-12 or IHE administrators		X		X	X		X	X	X	X	X	X	X			X	X			X	
Creation or redesign involves extra-curricular or informal activities			X			X	X		X	X	X				X		X	X		X	X

Table 3: Number of IHE Course Changes in Selected MSPs

Type of Course Created or Redesigned	**Appalachian**	**Boston Science Partnership**	**Cleveland MSP**	**Consortium for Achievement in Mathematics**	**El Paso**	**FOCUS Irvine**	**Focus on Mathematics (Boston University)**	**Greater Birmingham**	**Greater Milwaukee**	**Greater Philadelphia**	**MSP-Southwest PA**	**North Cascades**	**Penn Science Teacher Institute**	**Preparing Virginia's Mathematics Specialists**	**PRISM**	**Project Pathways**	**Puerto Rico MSP**	**Revitalizing Algebra**	**Rocky Mountain**	**SCALE**	**VIP K-16**	**Total Courses**
Project Type: Comprehensive [C], Targeted [T], or Institute [I]	C	T	T	T	C	C	T	T	C	T	C	T	I	I	C	T	C	T	T	C	T	
Pre-service math courses	2					2		6	4	5					8			1				**28**
Pre-service science courses	2			8											8							**18**
Pre-service math-ed courses				1		5														2		**8**
Pre-service science-ed courses																						
In-service professional development math courses	1		3		7					1	3			2			1		3			**21**
In-service professional development science courses			12		4					1		3	11			4	1		4			**40**
In-service professional development math-ed or science-ed courses		10	2		5		2		1	2	1		3	1		1		1				**29**
STEM undergraduate courses	2									7							2			4	6	**21**
STEM or education graduate courses	1															2		1				**4**
Total Courses	**8**	**10**	**17**	**9**	**16**	**7**	**2**	**6**	**5**	**16**	**4**	**3**	**14**	**3**	**16**	**7**	**4**	**3**	**7**	**6**	**6**	**169**

Table 4: Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Appalachian	Pre-Serv	x	Math (3), Science (3)	Redesign		2+2 teacher prep program, summer institute		x
	In-Serv	x	Math (2), Science (2)	New				
	IHE	x	2 graduate level online courses	New	Revised teacher prep program	1 course with community college, summer institute		
Boston Science Partnership	Pre-Serv						x	
	In-Serv	x	PD courses (3), Biology (1), Chemistry (2), ESS (2), Physics (1), Engineering (1)	New		K-12 summer program, "Vertical Teaming" (VT)		
	IHE	x				Faculty participate in VT		
Cleveland MSP	Pre-Serv	x				Faculty in Residence	x	
	In-Serv	x	Content-rich classes: Biology, Chemistry, ESS, Math, Physics	New		Math and science program, certification master's program (new), laboratory-based PD program, "Middle Grades Mentoring Initiative"		
	IHE	x				Faculty in residence, graduate certificate program in middle childhood science and math		

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Consortium for Achievement in Mathematics	Pre-Serv	x	PRAXIS review sessions in content areas	New	Developed consortium-wide curriculum frameworks	Summer institute, improvements to existing certification programs (focus on recruitment)	x	
	In-Serv	x			Revised special education math, general changes in math instructional materials	LC, lenses on learning, administrators' institute, math and science coaches, peer study groups		
	IHE	x				Summer institute, improvements to existing certification programs		
El Paso	Pre-Serv		History of Mathematics, Introduction to Research in Mathematics Education, Technology in the Mathematics Classroom, Number Theory and Algebra, Probability, Number Theory, Statistics in Research, Logic and Proof, Calculus and Analysis, Thermodynamics, Contemporary Topics in Biochemistry, Advances in Ecology Theory, Fundamentals of Earth Science				x	
	In-Serv	x		Both		Master of Arts in Teaching (MAT) with a major in science		
	IHE	x		Both				

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
FOCUS Irvine	Pre-Serv	x	Pre-MAT Calculus I and II			Teacher Education Academy (CC) scholars, classroom placements for undergraduates		x
	In-Serv	x	Secondary Math-ed (7)	New	Developed curriculum/pacing guidelines	Developed peer classroom observations protocols instructional programs		
	IHE	x				Undergraduate summer institute		
Focus on Mathematics (Boston University)	Pre-Serv						x	
	In-Serv	x	Mathematical Problem Solving, Fibonacci Minicourse	New		Master of Mathematics for Teaching (MMT) the Certificate of Advanced Graduate Study (CAGS)		
	IHE							
Greater Birmingham	Pre-Serv	x	Math and engineering summer courses	New		Funding and recruitment of under-represented math and science teachers	x	
	In-Serv	x	Math and engineering summer courses	New	Assessment of needed curricular change	Summer certification program for math and science, peer mentoring, training on pedagogy and instructional practices		
	IHE	x	Math (4)	Redesign	Changes to math curriculum	Workshops on mathematics, summer engineering projects for high school students		

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Greater Milwaukee	Pre-Serv	x	Math for future teachers	New		2+2 program, Cooperative Urban Teacher Education Program	x	
	In-Serv	x	Math courses for teachers in grades 1-8	New	Alignment, implementation of contemporary mathematics "core plus" curriculum	Math tutor program		
	IHE	x	Elementary Grades (1-6) Math	New				
Greater Philadelphia	Pre-Serv	x	Biology, Math (2), Education Chemistry Science	New		Science education, math and science certification, "Secondary Education Summer Enrichment Program"	x	
	In-Serv	x	Summer content institutes in Biology, Chemistry, ESS, and Math	New		Professional development program, teacher mentoring program		
	IHE	x	Biology, Chemistry, Math-ed, ESS-ed	New	Curriculum enhancement for core math and science courses at community college, STEM courses, internet based courseware for physics	America Counts math tutoring, intern certificate (teacher/student mentor), certification in environmental education, master's with certification program		

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
MSP-Southwest PA	Pre-Serv						x	
	In-Serv	x	Math (Algebra I/II, Geometry), Lenses on Learning Seminar, Content Deepening Seminars	Redesign	Development of Regional Science Curriculum Framework, curriculum alignment and pedagogical and course refinement	Academies and seminars, Teacher Leadership Action Academies, Teacher Fellow (TF) program, online chemistry tutoring program		
	IHE	x				Academies and seminars		
North Cascades	Pre-Serv	x			Changes and outcomes for pre-service content courses planned	Future teachers, scholarship program to attract more teachers, LASER Strategic Planning Institute for curriculum development, Curriculum Showcase, recruitment committee for increasing diverse pre-service teachers	x	
	In-Serv	x	SCED 201 Matter and Energy in Physical Systems, SCED 201 Matter and Energy in Earth Systems, SCED 201 Matter and Energy in Life Systems		Elementary schools already have adopted NSF-funded curriculum	Summer academies to develop teacher leaders, undergraduates as tutors for neighboring school districts, mentoring to support new teachers, specialized symposium for administrators, focus on curriculum assessment and implementation, LASER		
	IHE	x	Higher education science faculty develop year-long science course sequence for future elementary teachers	New	Elementary education major curriculum revisions	Professional development for faculty provided to build capacity in science education research methods and applications		

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Penn Science Teacher Institute	Pre-Serv						x	
	In-Serv	x	Developed 14 courses in integrated science (math, physics, environment, chemistry)	New		Master of Integrated Science Education program designed for current middle level science teachers, Master of Chemistry Education program designed for current high school science teachers		
	IHE							
Preparing Virginia's Mathematics Specialists	Pre-Serv						x	
	In-Serv	x	Numbers and Operations, Geometry and Measurement, Education Leadership I	New		Master's degree and certification as a math Specialist		
	IHE							
PRISM	Pre-Serv					Bridge Institute	x	
	In-Serv	x	Math endorsement courses, math and science courses	Both	Revised 6th grade math curriculum	PD-K-12, LC, endorsement on teaching certificate		
	IHE	x				Faculty rewards		

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Project Pathways	Pre-Serv						x	
	In-Serv	x	Developed 4 courses to meet 12 hours of the course requirements for a master's degree for secondary mathematics, physics, chemistry, biology, and geology teachers	New		Alternative certification program SCISM (Summer Certification in Secondary Mathematics) to recruit current mathematics majors to become certified to teach secondary mathematics		
	IHE	x	PHY 590: focus more on effective teaching strategies and practices and de-emphasize the study of physics education research; PHY 598: establish a graduate-level physics education seminar for in-service high school math and science teachers, STEM faculty, and STEM graduate students	New				x

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Puerto Rico MSP	Pre-Serv	x	Teaching with technology workshop	New		Future Teachers Induction and Certification Component (FTIC), Assistant Capacitators Program, Mentors' Academy, summer research projects	x	
	In-Serv	x	Certification courses, math and science advanced courses, online courses in physics, math, and chemistry	New	Publication of training materials and curriculum implementation	Certify in-service teachers, Corporation for the Support and Education of the Community, "Authentic Professional Development Program" (APDP), summer professional development, summer camps for 6th-12th grade students. residential academy professional development program, learning communities		
	IHE	x	Developed 2 environmental science courses	New	Revised General Chemistry Laboratory			
Revitalizing Algebra	Pre-Serv	x	Field study course, Math 375, Math 700, capstone course, three-week all day summer institute, forum for issues of race, class, and ethnicity that can inhibit the learning of mathematics				x	
	In-Serv	x		New				
	IHE	x		New				

Table 4 (cont.): Detailed Profile of Changes in Selected MSPs

MSP	Audience		Types of Changes				Primary Focus	
	(Pre-Serv, In-Serv, IHE)		Courses		Curriculum	Programs (professional development, certificates, workshops)	K-12	IHE
			Subject	New/Redesign				
Rocky Mountain	Pre-Serv						x	
	In-Serv	x	Biology, Chemistry, ESS, Math (4)	New		Summer program, certificate program		
	IHE	x				Center for math and science and environmental ed, summer science camp (high school and STEM students)		
SCALE	Pre-Serv	x	General psychology course for all elementary education majors, content specific course in the secondary education program (both embed the "Principles of Learning")	New		SCALE Middle School Science Conference Disciplinary Literacy (DL) Mathematics and Science Institutes IFL Institute for Learning/SCALE In-District Work Urban Mathematics Leadership Network (UMLN) Content-Pedagogy Modular Learning Units CSUDH Summer Institute	x	
	In-Serv							
	IHE	x	Biology, Physics, Math, Chemistry (courses designed to attract STEM majors into K-12 teaching careers)	New				
VIP K-16	Pre-Serv							x
	In-Serv							
	IHE	x	Biology (gen ed), Chemistry (gen ed), Introductory Geology	Redesign	Lab course/activities	Physics faculty learning community, ExPert high school teachers summer visiting researcher program		