EVALUATION REPORT
Math and Science Academy

Year 2 Final Report - November 2002

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Table of Contents

MATH AND SCIENCE ACADEMY

YEAR 2 EVALUATION REPORT

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This evaluation report summarizes Year 2 of the implementation and impact of the Math and Science Academy (MSA), an initiative of the Northern New Mexico Council on Excellence in Education. Below, we present an overview of the project, describe the methodology used to conduct the evaluation, discuss findings from the second year of the program and conclude with recommendations and refinements for future years of MSA.

Background: Project Goals and Objectives

school districts (Chama, Española, and Mora), the Northern Network for Rural Education, the University of California and the Department of Energy's Los Alamos National Laboratory (LANL). MSA's goal is to improve math and science education as part of a larger systematic initiative to improve the education for all students in Northern New Mexico. The project provides middle school teachers and their students the opportunity to work with exemplary instructional mentors–thus gaining content knowledge, experience and expertise. MSA also provides opportunities for participants to work collaboratively with cadres of other committed schools and teachers. MSA addresses multiple purposes, including providing teachers with access to rich professional development sessions to increase content and pedagogical knowledge, stimulating teachers to better prepare students for high school academics, providing tools and conceptual structures for content area instruction to be integrated into classroom teaching and learning practices, and offering students

multiple opportunities to engage in high quality science, math, social studies, and language arts learning experiences. MSA involves middle school students, in an effort to stem the high drop out rate in 9th grade (8.1% in 1997, higher for Latino males), to bolster sagging academic performance (over the past 5 years, standardized test scores decrease statewide an average of 10 points on the Normal Curve Equivalent Scores (NCE) from 6th to 7th grade), and to allow teachers adequate time to help their students develop the knowledge, interest, and enthusiasm to participate in challenging high school classes. Finally, the project aims to improve the overall quality of education in middle schools in Northern New Mexico by providing opportunities for all students to engage in high quality learning experiences taught by qualified, knowledgeable instructors.

Project Overview

As is evident, the goals of the project are ambitious and far reaching– student test scores and teacher competency surveys reveal a continuing need for improving student achievement and teacher preparation in Northern New Mexico. Additionally, the Los Alamos National Laboratory has an on-going need for qualified employees to work in a wide variety of lab positions (scientific, technical, and administrative) and views Northern New Mexico as a valuable and logical source for developing and cultivating a workforce as well as providing employment opportunities for the citizens of the region.

The summer of 2000 marked the beginning of the Math and Science Academy. Teachers and mentors attended a 2-week Summer Institute, discussing and developing curricula and instructional methods, and planning for the 2000-2001 academic year. The project was led by two mentor teachers, selected for the program based on their experience developing curriculum, professional development expertise, knowledge of standards and reform initiative, proficiency in the use of technology in education and experience working with middle school students.

The first year of MSA, referred to as the development year (2000-2001 school year), focused on three middle schools located in Northern New Mexico. These sites were selected for project participation based on a competitive application process. At each site a team of teachers (4 teachers from each site, 12 total teachers) worked with the two mentors during the school year to develop instruction strategies and implement curricula to support and strengthen student

learning and achievement in math, science, social studies and language arts. Throughout the school year, mentors and teachers collaborated with each other, participated in on-going professional development sessions, and worked to develop curricula and teaching methods to support on-going efforts to improve the quality of math, science, language arts and social studies education at MSA schools. Project members also met with school administrators and community members to inform them about the project and its goals.

During Year 2 of MSA (the 2001-2002 school year), the project was expanded to 23 teachers (from the original 12 members), and included 1 team of 8th grade teachers. Additionally, 3 student teachers participated in the MSA Summer Institute; 2 of those teachers participated in the project during the spring of 2002 during their student teaching. Content areas represented in the project included: language arts, math, science, and social studies. Project goals for Year 2 of MSA focused on further refining program objectives, and increasing and strengthening the level and quality of MSA implementation at each of the sites. Specifically, there were 6 over-arching goals for Year 2 of the MSA project: 1) continue to provide high quality, research-based professional development for MSA teachers; 2) further develop teachers' knowledge, understanding and implementation of standards-based curriculum and instruction; 3) refine teachers' use of grouping practices to maximize student learning opportunities; 4) increase project members' understanding and usage of a variety of assessment strategies; 5) increase teacher and student knowledge of and familiarity with technology; 6) strengthen communication between MSA project members, mentors and administrators.

It is important to note that decades of research on professional development and school reform make clear the difficulty of changing, improving and refining teachers' practices, and the fact that such changes occur before increases in student learning and achievement can be expected. This body of research provided the basis for the Year 2 MSA, which placed primary attention and focus on teachers and teacher development as a result of project participation. Subsequent years of the project will devote increasingly more attention and resources to understanding the impact of the project on student learning and achievement.

Year 1 of the UCLA/CRESST evaluation of the MSA project focused on how the program was implemented, assessment of program effects and the development of recommendations for the improvement and enhancement of the program. A primary focus of the research and evaluation efforts was to support and facilitate the refinement of MSA's theory of action, and to provide on-going, continuous feed-back and information to project leaders on the implementation of MSA goals and objectives. Year 2 evaluation of MSA paralleled many of the same research activities as Year 1 of the project, but was expanded to examine issues that emerged during the development (or first) year of MSA. The following research issues were examined during Year 2 of the project:

- How the program was implemented;
- Program effects on mentors, teachers, students and administrators;
- Ways to enhance or improve the program

Additionally, we explored a number of other approaches to assist project leaders in their efforts to refine MSA and to better understand project impact on teachers and students. We included in the evaluation the exploration, development and refinement of tools to better understand classroom assignments as a method of gauging the level and quality of implementation of project goals.

The Year 2 MSA evaluation built upon results and findings from Year 1 of the project, and as such, research time and focus were reallocated during this second year. The first year of the project was spent in gaining understanding of the project and its goals, in developing relationships with mentors, project administrators and project members, and helping to refine the overall program theory of action. The basic evaluation strategies and tools used proved to be very useful in understanding how the project worked and in understanding its impact. The second year evaluation was designed to help project leaders evaluate the program's impact on teachers' knowledge, understanding, and implementation of project goals, and to begin to thinking about the projects impact on student learning, and to further build on the understandings and tools the evaluation developed during the first year of the program.

The evaluation continued to employ a multi-method approach to understand and assess program implementation and effects. Surveys, interviews, focus groups, program documents, observation of program activities, and the collection of classroom assignments were used as information sources on program implementation and impact.

As in Year 1 of MSA, we used a formative approach to the MSA evaluation of Year 2. That is, we systematically conferred with project participants throughout the year, and provided important information to project members regarding successes and challenges. This report synthesizes results and observations from the second year of the project and provides recommendations for strengthening MSA and increasing its impact on teachers and students during subsequent years of the project.

The notion to establish a math and science academy in northern New Mexico emerged as part of a NNMCEE strategic planning session held in February 1999, following a year-long discussion of these issues. Participants represented leadership in northern New Mexico–school district superintendents, two-year college presidents, business leaders, school board members, school principals, teachers, parents, project directors, staff members from Los Alamos National Laboratory, and students all contributed to the initial conceptualization of the long-term project. Program objectives, funding, educational goals and a direction for the academy were developed through a series of consensus building activities that included review of data on schools in northern New Mexico and of the research on similar initiatives throughout the country. Ultimately, NNMCEE established four long-term goals, the fourth of which was the development of a math and science academy.

As a result of extensive research and collaboration between various stakeholders, the MSA model incorporated a number of different features from a number of different reform efforts (including an apprenticeship model, standards-based instruction, technological support and innovation); these program policies and philosophies were combined and refined to create a general "theory of action" for a 5-year project. Work carried out during the development year provided project leaders with more direction, specificity, and

clarity to MSA as a model for teacher professional development for subsequent years of the project.

MSA: Year 1. The project was initiated during the summer of 2000. MSA teachers and project mentors devoted two weeks (10 days) to intense professional development. Teachers participated in a series of sessions to introduce and familiarize them with new instructional approaches, to reinforce the use of standards based instruction, and to discuss current research on learning and instruction. Specifically, at the Summer Institute mentors and teachers worked to: 1) establish the ground work for on-going collaboration between teams of teachers at each site and across sites; 2) develop a thematic, interdisciplinary unit; and 3) study and review recent developments in the area of learning and instruction, specifically assessment and standards-based instruction. These 2000-2001 program goals were then revisited and built upon throughout the academic year as MSA mentors continued their on-going collaboration and coaching of project teachers.

Throughout the school year, mentor teachers visited MSA schools once each week. During these visits, mentors observed MSA teachers in their classrooms, provided demonstration lessons when requested (primarily in math and science classrooms), substituted to allow teachers to visit other classrooms, and worked with students in small groups to answer questions and provide additional assistance and instruction. At the conclusion of these site visits, mentors met with the MSA team for two hours to debrief or discuss the lessons they observed, to discuss specific topics of study or teaching approaches and to provide general support for the teachers and the project. Mentors also gave presentations to school boards and to personnel at district offices to familiarize them with MSA and its objectives.

Over the course of the school year, MSA teachers met during their common planning time or after school to discuss instructional plans, student work and student performance on a weekly basis. Additionally, teachers from all sites met four times during the school year for Saturday sessions to further extend their understandings of new ideas presented in the project and to collaborate with teachers at the other MSA sites. Mentors, teachers and students also gave MSA evening presentations for parents and community members. A final three-day work session for mentors and teachers was the culminating event of the development year of MSA.

Overall, students, teachers, parents, administrators and mentors viewed the development year of the MSA project and its implementation as successful. As the school year progressed, each of the sites experienced successes and challenges as the project was implemented.

. Year 2 of MSA paralleled many of the events and activities of the developmental year of MSA: new MSA teachers met for an intensive three-week Summer Institute with second year MSA teachers joining the Institute for the second two weeks of the training. MSA teachers dedicated time and energy to learning about the project, defining goals and objectives for the year, and in general, developing a sense of what participation in the project would mean at the school and classroom level. The Summer Institute focused on assisting teachers learn to use the tools, language and structures to support implementation of MSA goals. There were 10 returning project members and 13 new MSA members who attended the 2001-2002 Summer Institute. Also new to the project at the 2001 Summer Institute was one of the MSA Mentors.

Throughout the 2001-2002 academic year, MSA teachers engaged in a wide-range of activities to implement MSA goals and objectives. As in Year 1 of the project, MSA mentors continued to visit teachers in their classrooms, and provide important information to teachers on current research on teaching and learning, and generate feedback on teaching and learning effectiveness in classrooms for MSA project members. Year 2 of MSA also incorporated a refined observation protocol; mentors and teachers engaged in a pre-conference prior to the classroom observation, and a one-hour debriefing session at the conclusion of the instructional observation. Mentors continued to provide demonstration lessons when requested, but mentors spent the majority of their time observing teachers.

At the school level, MSA teams met weekly throughout the academic year. A MSA leader at each of the sites facilitated these meetings. The purpose of these weekly meetings was to share information on curriculum and assessment strategies, and to discuss particular student needs. Teachers were responsible for maintaining and sharing a personal growth portfolio throughout the school year. The entire MSA team (all 23 teachers) met twice on Saturdays to continue their on-going investigations and learning. During the school year, three teams made visits to others schools to observe instruction. Similarly, MSA teachers continued to observe each other at their own sites, both within and across MSA teams.

Overall, teachers, students and administrators were positive about Year 2 of the MSA project based on classroom observations, teacher reports and administrator interviews. Mentors and teachers were satisfied with the development in collegiality and collaboration that developed among MSA teams and among the four MSA sites as a result of professional development opportunities. As Year 2 of the project progressed, MSA teachers developed greater understandings of standards-based curriculum and instruction, varied their instructional settings to a greater degree than in previous years, made more and better use of technology to access information and in the context of instruction, and increased their awareness (and in some cases implementation), of a variety of assessment strategies. For veteran teachers in their 1st year of MSA and 2nd year MSA teachers in particular, participation in the project was a valuable experience. More specific details on the why and how this occurred will be presented and discussed in the following paragraphs.

To address our evaluation objectives, multiple sources of information were collected. Table 1 displays the various data sources used to gauge project implementation and impact.

Table 1

MSA Year 2: Data Sources

Surveys	Observations	Interviews	Student Data	Assignments
• Teachers	• Classrooms • Professional development sessions • Summer Institute (2001)	• Teachers • Principals • Administrators • Project mentors	• Standardized achievement scores (CTBS) - language arts - reading - math - science - social studies	• Science units • Math units • Language arts units • Social Studies units

Instruments. The teacher survey was designed to query teachers on the way(s) in which participation in the Math and Science Academy influenced teachers' instructional practices, their knowledge and understanding of

standards-based instruction, use and knowledge of technology, willingness to use a variety of instructional settings, assessment practices, and ratings of program effectiveness. Thus the teacher survey contained a range of questions on topics; it utilized both a 5-point rating scale and open-ended question format. Classroom observation protocols gathered data on a number of project goals, including grouping patterns and practices, assessment strategies and teacher-student interactions. Post-instructional interviews with teachers included specific questions about the lessons observed and general questions about the way(s) in which MSA objectives were evident or implemented in classrooms. Principal interviews included questions about project successes and barriers and general impressions regarding MSA impact on teachers and students.

Survey data are available for 17 of 23 MSA teachers: some MSA teachers left the district before surveys were administered, others did not attend the Summer Institute, and still others failed to complete the survey at the Summer Institute. Specific demographic information is presented in the following section of the report.

Student achievement data represented scores from the 2002 administration of the Terra Nova, a standardized test published by CTB McGraw-Hill. A new edition of the test was administered for the 2001- 2002 school year. Technical issues, specifically those relating to reliability and validity of scores emerged statewide and will be discussed later in the report. Classroom assignments were collected from teachers (and mentors) during the December site visit, and during the April/May site visit when classroom observations were completed. Assignments represented typical work from all content areas. Copies of all instruments developed and used in the evaluation can be found in Appendices A through G.

Project Findings: Year 2

Participants

MSA Teachers.

Variable	Descriptor	n=17
Sex	Male:	5
	Female:	12
Ethnicity	White:	4
	Hispanic/Latino/Spanish American:	12
	Native American:	1
Highest Degree Received	Bachelor's Degree:	2
	Bachelor's + Credential + Units Beyond:	10
	Master's + Units Beyond:	5
Teaching Credential*	General Elementary:	9
	General Secondary:	8
	Special Emergency:	0
	Multiple Subject:	4
	Single Subject:	1
	Bilingual:	5
	Other: (Lang Arts, Special Ed, Early Childhood):	5
Years of Experience	Average Number:	13 years
	Range of Years Teaching:	1 – 30 years
Previous participation in projects like MSA	Yes	3

*Note: teachers may hold multiple credentials.

. During the second year of MSA, approximately 80 6th graders, 450 7th grade students and 200 8th grade students participated in MSA projects. All 7th grade students participated in MSA at three of the project sites. The 8th grade cluster of students who participated in Year 2 MSA was MSA participants in their 7th grade year. Student ethnicity were primarily Hispanic/Latino(a) (80%), with roughly 10 % Native American and 10% white and/or other ethnicities.

One of the original MSA project mentors continued to serve as a mentor to MSA during Year 2 of the project. A second mentor joined the

project in July of 2001. The new mentor was an experienced teacher from Northern New Mexico, and was a well-known teacher trainer and supporter of educational initiatives in the community. Both mentors were acknowledged instructional experts (one in science and the other in language arts) and were experienced in working with teachers in supervisory and/or professional development capacities. Both mentors had extensive experience teaching middle school. The mentors were accomplished leaders as well: each had extensive experience working with district, community college or state level education positions. Both mentors hold Master's degrees in teaching/education. As such, the mentors were well qualified for the position of mentors for MSA.

During Year 2 a LANL employee held the project coordinator position in a 50% time capacity. The coordinator visited MSA sites on several occasions, was familiar with the issues relating to MSA and attended monthly NNMCEE meetings. The project coordinator had additional full-time responsibilities outside MSA as a project director of outreach programs designed to increase teacher's knowledge and understanding in science, math, and technology and ideas on how to integrate this information with classroom instruction. With the New Mexico State Department of Education, the project coordinator was also instrumental in implementing the Regional Educational Technology Assistance Initiative. Additionally, the program coordinator had extensive science teaching experience. Like the mentors, the coordinator was well qualified for the position in MSA.

Information in this section is organized around the 6 project goals, with specific examples of how and in what ways teachers implemented the various elements of the project. As mentioned previously, data sources for project implementation include teacher surveys, teacher and administrator interviews, classroom observations and collection of classroom assignments.

Continue to provide high quality, research-based professional development for MSA teachers.

MSA incorporates concepts and ideas from a wide range of theoretical bases and perspectives. In particular, a practice known as "cognitive coaching", a research-based approach to mentoring and professional development, has been influential in guiding mentors in their work and interactions with teachers and to a lesser degree, with administrators (Costa & Garmston, 1994). Other research-based perspectives that influenced the project include assessment, instructional settings, technology use, and standards-based curriculum and instruction.

2001-2002 Professional Development Implementation.

- **Summer Institute 2001.**

- **MSA Workshops.**

- **MSA Weekly Team Meetings.**

- **Visits to Other MSA Classrooms and Schools.**

Excerpt 1: Teacher Interview

incredible similarities between our students! I saw 7th graders struggling with essay-writing, our math teacher observed 7th grade students struggling to understand the relationship between fractions and decimals . . . the list goes on. This visit really cemented in our minds (the understanding) that there are huge areas of overlap between all of our students. Intellectual challenges, the developmental and discipline stuff kids face in that community are the same at our school (as the other MSA schools). We all saw, firsthand, the importance of this growing collaboration and collegiality between the various MSA schools.

- **Formalized Classroom Observation Protocol.**

guided and considerate assistance.

The process of pre-conference, observation and debriefing experience was extremely beneficial to me and impacted my teaching, learning and planning a great deal. The positive immediate feedback was extremely encouraging and allowed me to focus on teaching strategies and self-evaluation.

For some teachers however, questions arose about the nature and importance of the classroom observations.

I find the "mentoring" stressful and adversarial.

(The observation structure) needs improvement! Seems too formal—intimidating!

Mentors reported varying degrees of success in working with MSA teachers using the observation protocol. At times, mentors reported that teachers found it difficult or impossible to implement the feedback and information generated during their debriefing sessions. This appeared to be particularly true for teachers experiencing significant classroom management issues. As one 1st year teacher noted, "I'm just struggling to keep my head above water here, and keep the students from doing real damage. I can't even begin to think about the stuff the mentor teachers are presenting."

. MSA teacher dedication to teaching and learning was strong during Year 2 of the project. This finding is based on teachers' willingness to try new ideas, extend their thinking and understandings, incorporate suggestions and feedback from mentors and other teachers, and was observed in many classrooms. In particular, for teachers who had participated in two years of MSA, the professional development experience became progressively more important and played a greater role in their teaching and overall MSA experience. Additional outcomes from these rich professional development sessions included a number of different instantiations of project goals. Table 3 below displays teachers' ratings to a number of elements important in the professional development piece of MSA.

Table 3

MSA Goal 1: Teacher Collaboration, Planning, and Articulation

To what extent do you agree with the following statements:	
	4.6 (0.5)
I work with my colleagues within and across disciplines.	3.8 (0.8)

Note. Scale: 1=never, 3= sometimes, 5=always, NA=Not applicable.

Another survey question that asked teachers to evaluate their "overall change in instructional planning, articulation, and collaboration with colleagues as a result of MSA participation" was rated highly by MSA teachers (mean =4.1, sd 0.9), revealing that teachers experienced moderate to strong change in some areas of teacher practice as a result of MSA participation.

MSA's approach to professional development outlined in the previous pages, with multiple and varied opportunities for teachers to build their professional knowledge and expertise, differs significantly in theory and

structure from the vast majority of reform initiatives and/or professional development programs. First, by providing teachers with on-going support and opportunities to observe, reflect and refine their instructional practices, the project does not assume a "spray and pray" or "blow in and blow out" approach to learning and professional development. This feature is critical to project success on a number of different levels. Modeling the level and quality of attention that must be paid to the learning process for growth of any kind to occur is essential to teachers' understandings of the learning process for themselves, and by extension for their students. Second, by empowering teachers and facilitating their development of professional relationships that transcend the boundaries of their rural communities, a sense of ownership, commitment and accountability is emerging for project members. In other words, it means something to teachers be an MSA member, both personally and professionally.

The following passage is excerpted from a teacher interview after a site visit. It highlights the many and interconnected ways that Year 2 of MSA has endeavored to provide high quality, research based professional development opportunities to teachers.

This is one of the most positive professional development experiences I've ever had. I'm a veteran teacher, and I've participated in many, many, many staff development projects. But none of them have done for me what MSA has accomplished: rejuvenated my sense of wonder in teaching and learning. I'm trying new ideas, I'm thinking about things in dramatically different ways. There are so many reasons why this project works . . . One of the primary reasons is that we're treated like professionals, people who are doing important work. Another reason I think MSA is what it is rests on the fact that we've really developed as colleagues. I think of my MSA colleagues as family: some times they make me mad, sometimes I feel irritated, but I treasure and value all the knowledge, ideas, and people in MSA.

The second MSA project goal focused on strengthening teachers' understandings and implementation of standards-based curriculum and instruction. Between August 1996 and August 1997, New Mexico adopted new standards for science, mathematics, social studies and language arts. The New Mexico state standards and benchmarks along with approaches to providing standards-based instruction were presented to MSA teachers at the 2001 Summer Institute and throughout the year at workshops and demonstration lessons during Year 2 of MSA. However, as various researchers have reported on the introduction of standards-based instruction (e.g., Linda Darling-Hammond, *Restructuring Schools for High Performance*

Knowledge and Familiarity with Standards and Benchmarks.

MSA Teacher Knowledge of Alignment of Curriculum, Teaching and Testing

decontextualized scientific information?"

With MSA support to teachers during Year 2 of the project, an increase in curriculum and instruction alignment with standards and benchmarks was evidenced, based on classroom observations, survey results, and interviews. During the Development or Year 1 of MSA, many teachers were provided with the "first step" towards standards-based instruction and curriculum, that is, they were provided with information (including copies of the materials) on the state content standards and benchmarks. During Year 2 of MSA, teachers spent a great deal of time reviewing and discussing specific standards and benchmarks both in the Summer Institute and throughout the school year. This activity had the combined effect of helping teachers develop fluency with the terminology of standards-based instruction and the instructional sequence outlined in the frameworks, and making clear the goals and expectations for each of the content areas. Teachers made the following comments about their use and understandings of standards and benchmarks:

> My main focus due to MSA was on standards and benchmarks. I think that my staying on track helped my students in many ways. Students would ask why we were working on certain problems and the questions were easy to answer once I explained standards and benchmarks.

> I learned how to use standards and began developing units. I need more time with teachers to develop interdisciplinary units and assessment strategies.

Table 4 below displays teachers' ratings of the impact of MSA on their knowledge and understanding of content standards and benchmarks. There were statistically significant differences between 1st and 2nd year MSA participants' ratings of some of these items ($p < .05$), suggesting that a period of time is required for teachers' ideas and understandings to incubate before they

can be fully comprehended and implemented. Caution should be used however, when interpreting these data, due to the small sample size.

Table 4

MSA Goal 2: Standards and Benchmarks.

Please rate yourself along the following dimensions as a result of your participation in MSA:	Overall 2001 - 2002 Mean (SD) N = 17	Year 1 MSA Teachers Mean (SD) N = 7	Year 2 MSA Teachers Mean (SD) N = 9
Knowledge/understanding of your content area (math, science, language arts, social studies)	4.2* (1.0)	3.7* (1.5)	4.6* (0.5)
Knowledge/understanding of your content standards (math, science, language arts, social studies)	3.9* (1.0)	3.4* (1.3)	4.2* (0.7)
Confidence in teaching content area	4.6 (0.8)	4.3 (1.1)	4.8 (0.4)
Familiarity with state standards and benchmarks for your content area	4.0* (1.0)	3.6* (1.3)	4.3* (0.7)

Note. Scale: 1=weak, 3= moderately strong, 5=very strong, NA=Not applicable.

*statistically significant at the ($p < .05$) level

At the conclusion of their second year, veteran MSA teachers viewed their understandings of standards and benchmarks as "vastly increased" and "dramatically different," based on teacher interviews and surveys. Teachers commented that the first year of working with standards and benchmarks represented a somewhat basic level of understanding of the information, while Year 2 meant deeper understandings, more actively expressed in teachers instructional practices, thinking, and interactions with students. A number of Year 1 MSA teachers were already familiar with content standards. For new teachers, however, the emphasis on standards and benchmarks was somewhat overwhelming. Mentors and teachers alike acknowledged this challenge and worked together to strengthen teachers' knowledge whenever possible and appropriate.

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The third area of focus during Year 2 of MSA was the realm of technology. Project leaders were convinced that easy access to reliable technologies could serve as another vehicle through which to strengthen teaching and learning in project schools. Additionally, technology was viewed as important resource for teachers, as a means through which to communicate with other project members, and as way to access current teaching and learning resources. Teachers and mentors were guided by a research perspective on technology where technology is viewed as a tool to support instruction, rather than as a "skill" in and of itself.

There were 2 areas of focus for MSA implementation of technology during Year 2: 1) access to resources and communication; and 2) instructional uses in the classroom. At the onset of MSA, a number of MSA teachers (14 of the 23 project members) were novice technology users, with limited or no experience using technology. There were other teachers (approximately nine members) who were more technologically savvy, many having learned to use computers as a function of their undergraduate or graduate education experiences. Virtually none of the MSA teachers had computers in their classrooms that were used for instructional purposes at the beginning of Year 2, and many had limited access to computers for individual use. Access to the Internet, for communication purposes (with MSA mentors and other MSA teachers) was difficult during Year 1 of the project. Year 2 of MSA brought more and better technology to all of the sites. Additionally, one site, by using funds from another reform initiative at their site, purchased a mobile, remote lab. 30 laptop computers were available to MSA teachers, with a wireless connection to the Internet at this site. While seemingly relatively insignificant to schools and other institutions accustomed to easy access to technology, the mobile lab represented a major step forward in connectivity to the outside world for this school, given that phone and fax service were frequently inoperable during the course of the school year at this site.

- . Teachers learned to use a variety of technology applications at the 2001 Summer Institute (e.g., e-mail, MarcoPolo, Inspiration, Timeliner, Office 2000), courtesy of the Regional Educational

Technology Assistance (RETA) from the New Mexico State University (NMSU). For some teachers, these applications became regular features of their instruction, planning and/or interaction with other teachers. During the school year, many teachers used technology to communicate with other MSA personnel, access information, and find resources to support classroom instruction. One application that teachers found particularly useful for instructional planning was Timeliner, a program that organizes information graphically, and allows for long-range planning. A second application teachers used during Year 2 of MSA was PowerPoint. Teachers and students alike learned to use this program. At one school, the graduating 8th grade class created and showed a PowerPoint presentation at their culmination ceremony, incorporating video clips, photos and music into what was described by MSA teachers as a "moving and emotional production.".

MSA teachers made the following comments about their knowledge of technology:

> I have personally gotten a lot of use out of the "Inspiration" program disk I received at the 2001 Summer Institute.
>
> My knowledge of technology and how to use different kinds of programs has really increased. Even though there are just a few computers for kids, the laptop and Internet connection help me with teaching and communicating.
>
> Given where I was at the inception of this program, I have made great/significant gains in areas of technology.

- . During the school year, many teachers used technology to communicate with other MSA personnel, access information, and find resources to support their classroom instruction. Teachers reported that communication with each other with regard to scheduling mentor visits, access to web-based samples of standards-based curriculum and assessments, and other instructional tools were facilitated and improved because of easy access to technology. The following excerpt is an example of one way that technology use was implemented in MSA classrooms.

Excerpt 3

Observation: 4/23/02

8th Grade Science

2001 – 2002 Technology Implementation.

Goal IV: Instructional Settings

Refine use of grouping practices to maximize student learning opportunities

2001-2002 Implementation of Instructional Settings

> I've begun to use cooperative groups in the 7th grade!
>
> Changes are evident as you observe my classroom. Cooperative learning activities certainly made learning fun and more challenging.
>
> I have used learning groups more often in my classroom. I have set up groups differently in a more organized way using guidelines from MSA training.

In some MSA classrooms, teachers reported an increase in quality and quantity of work generated by levels of students due to group work. There was some initial reluctance by MSA teachers to introduce cooperative learning settings into classrooms due partially to the accountability issue. How, wondered teachers, could all students be held accountable for work completed in group settings? Would the "high-performers" simply complete all the work and then allow the "lower-performers" to attach their names to the assignments? Teachers also expressed concern about classroom management issues involved with cooperative groups, specifically because they suspected that students would have more opportunities to be off-task, and the potential for disruptions would be greater. One teacher made the following observation about the introduction of cooperative learning groups.

> Collaborative assignments and cooperative learning progressed as the year passed. Increased student progress from all achievement levels.

As the Year 2 of MSA progressed, there was an increase in teacher familiarity and flexibility of how to best use cooperative learning groups (dyads, small groups, jigsaw, etc). Through careful planning, and a certain degree of trial and error, teachers were able to find which types of instructional settings best fit certain types of learning goals. One teacher commented during an interview:

> At the beginning of the year, I tried to use dyads or pairs when I was introducing new concepts in the class. That didn't work too well. Everyone was busy reinforcing the other students mistakes or errors. Instead, what I found was that small groups

> worked better after we'd had a whole group discussion, or after I'd introduced the lesson and concepts, and students had the idea about what they were doing.

Additional comments from teachers as they experimented with different approaches to structuring the instructional settings in their rooms included:

> I have learned to be a facilitator and use small groups 2-3 times weekly. I need to focus on the collaborative process.

> Collaborative assignments and cooperative learning progressed as the year passed. Increased student progress.

. Effective cooperative learning strategies were developing in many MSA classrooms, as evidenced by classroom observations, teacher interviews and survey comments. For 2nd year MSA teachers in particular, greater benefits were reported and demonstrated in the nature, quality and in some cases quantity of work generated by all performance level of students as a result of cooperative group work. Greater variation in instructional settings was also observed – there were fewer instances of lecture only classrooms, and more observations of classes that varied the instructional setting during the class time (whole group discussions, followed by individual work, and small group discussions). Teacher survey comments on their uses of cooperative learning strategies and different approaches to guiding and facilitating learning include the following:

> I have used more group work—cooperative learning groups—used different forms of assessment (group/individual projects).

> I have used learning groups more often in my classroom. I have set up groups differently in a more organized way using guidelines from MSA training.

An excerpt from a class where a variety of instructional settings were embedded in a single class session is found below. Note the use of whole group discussion, teacher directed activity, and the skillful manner in which student ideas, procedural information and small group settings are varied and combined with whole group instruction.

Science, 7th Grade

T: Ok class, today you're going to look at human skin cells and onion skin cells. Hopefully the dye will show the nucleus a bit more clearly than before. One person from your group will give cheek cells. For both of these you're going to be using a blue dye. This is methylene blue. It will stain anything it touches. If it touches your shirt it will turn it blue.

T: Let's think a little bit what you already know about cells.

Students raise their hands and contribute information about what they've learned about cells from their textbook and homework assignments over the past week.

T: Now let's get started. I prefer that you pair up. One person will get a toothpick, use the wide end to get some cells. Take the slide and with the edge make a small circle. You have hundreds of cells on here now. Now you're going to put the dye on there. What you're looking for is clumps of blue. Look at the blue clumps. Start on low power, then go to medium and then on high-power, draw the cells.

T: What are you looking for?

S1: Look for the nucleus.

S2: Look for the cell membrane.

S3: Look for the cytoplasm

Toothpicks, slides and slide covers are distributed. Students create a cheek cell slide, dye it and then examine it under the microscope, under low, medium and high power. Students begin calling out: "I can see it! I see the nucleus. I can see the cell walls!"

Some students have trouble seeing anything, others quickly and easily identify the various cell parts (nucleus, cytoplasm and cell wall). In general, students are on-task and focused. They are using scientific language (power, magnification, nuclei, etc.). They are involved and focused, intermingled into their conversations are social commentaries.

S1: That cover slip is way too small for that . . .

S2: And how was I supposed to know that?

S3: Telepathy. Know what that is?

S: Yeah, like you know, when I can communicate with my grandmother without calling her on the phone.

S4: Oh, my god! That is soooo nasty. It looks scary. This is like really frightening. Where is the nucleus? How come we can't see it?

S1: Well, move the slide a little bit. Then it's more clearly focused.

The investigation continues. At one point, the teacher interrupts the investigation to comment:

T: "Ok, I want you to all come up here and take a look at Maria and Tami's sample. The nuclei are really dark and really clear. They did a great job to create slide.

T: Ok, tell us how you created it.

S: We pulled the skin from the outside curve of the onion, not the inside. You said "onion skin", so I think that means on the outside.

(This particular slide shows cell walls and cell membranes, the nuclei, and the cytoplasm. All are clearly defined. The teacher asks that individual students have the opportunity to look at the slides. She requests that they "line up" to view the slide. The creators of the slide appear to take pride in their creation, but lament the fact that everyone gets to see the slide before they do!).

After approximately 20 minutes of investigation, the teacher brings the whole group together again, focusing their attention on the conclusion of the investigation.

T: Ok, now let's look at the back of the paper (worksheet that accompanies the microscope work). Remember when we did Venn Diagrams earlier in the year?

S1: What?

T: Venn Diagrams?

S4: Yeah, to show similarities and differences between the cells.

T: Right. So let's use the Venn Diagram to show similarities and differences in the plant and animal cell slides. Give me one example of a difference.

S5: Shape

T: Excellent. What is the shape of the animal cell?

S6: Blob.

T: Right, it's irregular, roundish shape. And what shape is the onion cell?

S1: It's rectangular, squarish.

T: Correct.

T: What's a similarity between the cells? Between the onion and the cheek cell. David?

S7: They both have a membrane

T: Excellent. Ok, so go ahead. Use your partner to come up with good ideas. Check with each other, check your understandings.

This lesson exemplifies the instructional setting variation MSA supports and encourages as means to maximize student learning. Procedural information is delivered in the context of a whole group setting, students work in pairs to conduct the investigation, the teacher uses a student-created slide as an exemplary model of "good work" and requests that students identify the process/processes involved with the procedure. At the conclusion of the lesson, all students are invited to participate in the Venn Diagram activity as a formal setting in which to formalize observations, that is, to understand the similarities and differences between plant and animal cells. By varying the instructional settings, and carefully matching the setting with the learning goal or objective, this teacher was able to involve all students in the learning process.

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A fifth project goal was to strengthen teachers' knowledge and understanding of assessment. Specifically, the project was geared towards helping teachers better understand how assessment practices can and should support standards-based learning.

During Year 2 of MSA, each teacher maintained and developed a professional portfolio of his/her work during the course of the academic year. Some teachers chose to include reflections on their practice in their portfolios, while others used the personal portfolio as a "cook book" of successful ideas and practices used throughout Year 2 of MSA. In general, teachers found the portfolio experience beneficial, although many commented that the time and space necessary to maintain a similar type of portfolio in the classroom would be daunting.

Rubrics and other performance-assessment use increased in classrooms during Year 2 of MSA. In particular, teachers reported that rubric development and use functioned to strengthen teachers thinking on learning outcomes and objectives. One teacher commented about the contribution of rubrics to his/her understanding of assessment of student work.

> I think that learning about rubrics helped me to clarify my intentions and methods of assessment. MSA certainly made me more aware of how I communicate, or don't communicate, my grading practices to the students.

Another area of impact of assessment was in increased opportunities for students to "show what they know" in a variety of contexts (e.g., presentations, Internet-based research projects, graphic organizers). Teachers reported moving beyond homework, class participation, and end of unit tests as the only indicators of student learning. MSA teachers included group projects, performance assessments and written extensions of thinking and reasoning (in social studies, science and math), as evidence of student learning, and began to consider these tasks and tools as providing important information about what students knew and understood.

> I have used more group/individual projects as forms of assessment. Become aware that many types of assessment are good instruments to evaluate learning.

> I use a wider variety of types of assessments like portfolios, projects and typical tests/quizzes.

One example of this extension of assessment practices emerged in a 7th grade math class. Students had recently completed a unit of study on scale and the conversion of fractions to decimals (and decimals to fractions). The "culminating project" was to design a dream house, and draw it to scale.

Students worked in groups of 4 to 6 to develop these "model homes." Large-scale drawing and posters were created, and each group of students presented its project in front of the class. A presentation rubric was used by the teacher and students in the audience to evaluate the final product. The rubric is displayed in Table 5.

Table 5

7th Grade Mathematics Class: Model Home Rubric

Activity	Number of Points Possible
Group rating of individual member participation	1 – 10 points
Neatness, color and beauty	40 points
Accuracy in scale	10 points
Results	20 points
3 Drawings: floor plan, front elevation, side view of house	30 points
On-Time: Due April 24th, 2002	20 points
Total	130 points

In a post-instructional interview (Excerpt 6), the teacher made the following observations about the use of rubrics and various kinds of projects as a means to assess student understandings.

5

2001-2002 Assessment Impact

Please respond to the following statements based on your participation in MSA:

Excerpt 6

Goal VI: Project Logistics

2001-2002 Implementation

2001-2002 Impact

MSA Impact on Students

Standardized test scores.

MSA Impact on Administrators

Principle 1

Principle 2

Principal 1

Principal 2

school? At the beginning, you wouldn't notice that much difference. Then it starts taking effect–you see stuff happening in technology, then in projects, then in the kinds of learning that happens. Another way you see it is in teachers' comfort and familiarity with the language of standards.

As an indication of the importance of supporting administrators in the project's quest to increase teaching effectiveness and student learning at MSA schools, a 3-day Summer Leadership Institute was held for administrators in 2002. Administrators engaged in learning experiences to promote and support their understandings of MSA and the project objectives. Specifically, the Leadership Institute focused on helping principals to better understand standards-based instruction, the use of varied and multiple assessments, technology use in instruction, and overall leadership strategies as principals.

Program Effectiveness

In general, teachers, students, administrators and mentors were positive about Year 2 of MSA. Classroom observations, interviews, and survey results provide data to support these conclusions. Teachers were asked to rate MSA's overall effectiveness in a number of areas. These survey results are displayed in Table 11 below. Notice that while the overall ratings were moderately positive, Year 2 MSA teachers rated all survey items more positively than did Year 1 MSA teachers. Statistically significant differences are noted on a number of the subscales.

Table 11

MSA Effectiveness

How effective was MSA in the following areas?

1=Not effective; 3=Somewhat Effective; 5=Highly Effective.

*statistically significant at the (p< .05) level

** statistically significant at the (p< .01) level

: As has been noted and documented throughout this evaluation report, MSA is a rigorous project for professional development that requires time, dedication, and interest on the part of the teachers involved with the program. A stipend is awarded to teachers, but many project participants went beyond the required work and challenged themselves in ways to extend their thinking and learning. Two MSA teachers encountered significant challenges as they worked within the program parameters, and were sufficiently weak instructionally that their contracts were not renewed for the 2002-03 year. This situation has implications for MSA on

three levels: first, it demonstrates the rigor of the program and the importance of hiring and training strong, qualified teachers. Second, during Year 2 of the project, MSA mentors dedicated a significant amount of time and energy to support these teachers, representing time that could have conceivably been spent working with other teachers. Finally, MSA mentors will need to work closely with the two new teachers hired to fill the vacant positions, and bring them "up to speed" for Year 3 of MSA.

Recent studies have confirmed what many in education have always suspected: outside of home and family factors, teacher qualification and expertise account for approximately 40 percent of measurable variance in student test scores in math and reading across grades 1 through 11 (National Commission on Teaching and America's Future, 1996; Darling-Hammond, 1997a). Other studies point to teacher education as the single most productive use of additional education dollars if the goal is to improve student learning (Greenwald, Hedges, and Laine, 1996).

Based on research cited in the previous paragraphs, the conclusion is clear: knowledgeable, skilled teachers make the difference in student achievement. For reforms such as MSA to be successful, they must include standards-based learning, challenging curriculum and rigorous assessments. Further, teachers must be skilled to ensure successful reform implementation. Settings that foster and support teacher learning provide multiple opportunities for research and inquiry, trying out new ideas and approaches, and discussing and critiquing the results of this teaching and learning.

The refinements and revisions in the MSA model or theory of action during Year 2 of the project have strengthened MSA into a model for on-going professional development, with coaching or mentoring from expert teachers a key dimension. The Math and Science Academy model embodies many of the professional development strategies proven to improve teaching and learning (Darling-Hammond and McLaughlin, 1995). Specifically, the MSA model is:

- experiential in nature;
- theoretical, research driven;

- collaborative;
- oriented towards coaching, mentoring, and problem solving;
- sustained, intensive, and on-going.

Year 2 of the Math and Science Academy was a year of challenges and successes, of rethinking, revising and revamping ideas, understandings and conceptualizations. A powerful model for professional development is emerging, one that encompasses the most important and essential elements of providing quality instruction for middle school students. MSA provides what researchers deem essential to improving the quality of teaching and learning in schools in Northern New Mexico: the context, the expectation and the opportunities for teaches to learn what they need to know and practice those skills in a reflective, continually improving manner.

The recommendations that follow are organized around the six project goals of Year 2.

Continued project involvement is important to teachers as they develop and refine their instructional strategies and incorporate new approaches into their classrooms. To the greatest extent possible, administrators should continue to support MSA teachers and the project ideas. Teachers look to administrators to generate positive communication about the project, its goals and accomplishments, and to support teachers in their commitment to the project.

As teachers work to become more technologically proficient themselves, projects that lend themselves to technology use will emerge. MSA mentors can provide guidance to teachers to support and encourage technology use for particular projects and work. Teachers and mentors should continue to examine the appropriateness of particular assignments to technology use and various applications.

Administrators can support and facilitate technology usage by communicating with teachers electronically, spotlighting or highlighting student work that incorporates technology in meaningful ways, and by becoming technologically proficient themselves.

It is important for MSA teachers to continue to refine their use of varied classroom settings, particularly cooperative groupings, to support and maximize student learning. Careful examination of the task and group settings will assist teachers in providing optimal learning situations for students.

Administrator presence in classrooms, as observers, rather than evaluators, is critical to establishing and supporting a culture of teaching and learning that is based on understanding and mutual respect. Student response to administrative classroom presence is more likely to be positive when students perceive interest and enthusiasm for teaching and learning from administrators and other "visitors."

Teachers and administrators can support the use of assessments by presenting student progress and achievement in alternative ways to students themselves, parents, and other members of the community. A "report card" on school progress, for example, that includes a number of dimensions (e.g., levels of student participation in special programs, awards, scale ratings of classroom culture, citizenship), to demonstrate how assessments are developed and used to demonstrate growth, is one possible approach for teachers and administrators to employ in support of MSA's goal to use high quality, meaningful assessments to document student learning and achievement.

Continued work and discussion is essential to teachers' understandings of standards-based instruction. MSA can support teacher's development in those areas. Further, it is evident that administrators need to be familiar with content standards and benchmarks, and develop a clear understanding of what standards-based instruction should (and should not) look like. Workshop

attendance, classroom visitation, and participation in after-school working sessions are all important and viable ways for administrators to deepen their knowledge and understanding of a standards-based curriculum and simultaneously show support for teachers and their implementation of a standards-based curriculum and instruction.

Teacher knowledge and understanding of project goals and objectives is critical to the on-going success of MSA. Development and articulation of policies, procedures and project expectations prior to the onset of the school year will help to maximize teacher buy-in for the project. These policies and procedures were developed and refined during the 2002 Summer Institute. For example, teachers were responsible for turning in daily reflection pieces, work samples as evidence of their thinking and planning for the 2002-2003 academic year. Completion of these tasks was tied to the Summer Institute stipend. This practice, while time-consuming and detailed, ensured that teachers were on-task and focused during the work sessions, and for mentors, served as a check on teachers' understandings of the work and tasks at hand. Appendix H contains the Year 3, 2002-2003 work requirements for MSA teachers.

To the greatest extent possible, teachers, administrators and school should work together to develop policies early in the school year regarding specific "house-keeping" issues (e.g., tardiness, restroom privileges, intercom interruptions, parent-teacher conference attendance), and implementing them consistently can provide schools, teachers, students, and parents with the type of leadership and support necessary to create a positive learning environment.

Year 2 of MSA has brought about substantial change in many teachers' practices throughout the project. As the data have shown, the results of this year's evaluation were very positive: MSA teachers are taking important steps towards refining their teaching practices and implementing the kinds of instructional strategies, methods and tools that will ultimately lead to increases in student learning and achievement. And while student performance was not a focus of this study, improvements in the quality and quantity of student work and performance do show promising results. The specter of student learning

and achievement, and how MSA influences and impacts these areas, will be the focus of evaluation efforts in the future years of the project.