

NORTHERN NM MATH & SCIENCE ACADEMY –OVERVIEW

Background and Need

*The Northern New Mexico Math and Science Academy is a program conducted by Los Alamos National Laboratory (LANL) in cooperation with its regional academic, government and business sector partners. Started in 2000, the **Academy** was developed by LANL in partnership with the Northern New Mexico Council for Excellence in Education and other concerned New Mexico organizations as a direct response to the unchanging top priority concern of the area's business, academic and governmental leaders – **the critical need to improve K-16 education in northern New Mexico.** The LANL Foundation and Northern NM College serve as the fiscal agents for managing external funds received from the private sector and the NM Legislature, respectively. The mission of the **Academy** is to provide math and science professional development to teachers in five economically depressed and rural school districts in northern New Mexico (Chama, Española, Pojoaque, Mora and Taos).*

The school districts targeted by the **Academy** are located in communities in northern New Mexico where many Los Alamos National Security, LLC (LANS) employees live. These communities have populations that include significant numbers of Hispanics and Native Americans and a high percentage of individuals who are low-income. Area school districts have student populations ranging from 72% to 94% Hispanic students and from .2% to 19% Native American students. Additionally, the percentage of students receiving free and reduced lunch in these districts ranges from 57% to a high of 85%. *Educational performance in these school districts has been historically low. These districts also are home to 25% of the employees working at Los Alamos National Laboratory and their children participate extensively in the Laboratory's high school and student internship programs, many eventually becoming employees themselves.* These northern New Mexico communities share very similar demographics to those in El Centro, CA and Washington state where the adoption of the inquiry-based reform science model developed by the National Science Resources Center (NSRC) has shown very positive improvements in K-12 teacher math and science expertise, teaching skills and student proficiency scores in science over recent years. The **Academy** has developed a close working partnership with NSRC over the last four years and will be customizing their model for reform science as an extension to its already established and proven model for reform math instruction in the participating northern New Mexico school districts.

The **Academy's** aim is to significantly improve math and science education as part of a larger systemic change initiative in northern New Mexico. Without the **Academy**, hundreds of teachers would not realistically be able – logistically or economically – to acquire the enhanced math and science teaching skills needed for them to progress to New Mexico's highest Tier III licensure level and for their 5,000 plus students to compete effectively in today's technological world.

The Core Reform Math Program

The **Northern New Mexico Math and Science Academy** is a virtual academy that operates in school districts as a school-approved professional development program. *To date, the Academy has primarily focused upon the reform mathematics component of the program, which includes:*

Summer Institute: The three-year **Academy** program starts with an intense three-week Summer Institute, which is divided into two weeks of Standards-Based Education training and one week of “MathCitement” reform math content and pedagogy training. Separate and mandatory summer institute sessions are provided for first, second and third year cohorts. Participating teachers must attend the MSA Summer Institute for each of their three years in the program to graduate. Additionally, a two week Principals Summer Institute is conducted each summer.

School Year Reform Math Program: After the MSA Summer Institute and during the school year, teachers meet after school for collaboration and planning in mathematics content and pedagogy. The meetings focus on defining concepts and learning goals, developing common assessments, and reviewing student work. **Academy** staff and coaches are in the classrooms regularly and conduct quarterly follow-up professional development sessions that foster standards-based teaching and learning as well as mathematics content and pedagogy; **Academy** staff and coaches regularly follow-up with observations using a common protocol. Teachers are also required to develop a growth portfolio of lessons using research-based strategies with reflections on the student work generated. **Academy** teacher teams at each site additionally hold *Celebrations of Learning* once a semester where students showcase their mathematics work and articulate to their parents and community members what they have learned. **Academy** teachers from all sites collaborate online bi-weekly using Yahoo Groups, a free online virtual community, and use Internet technology as a way to enhance learning, collaboration and communication. Teachers also meet twice during the school year on a Saturday for “MSA Days” to strengthen inter-district bonds and share their portfolios. Districts requesting professional development are required to send principals with the school unit team of teachers to the MSA Summer Institutes. This strategy provides the kinds of support required for changes in teacher thinking and practice and for systemic reform. Additionally, principals learn how to be capable leaders for their schools and effectively support the mathematics program.

Master of Arts in Teaching Math and Science Degree Program:

Participating teachers have the option of entering a concurrent Master of Arts in Teaching Math and Science degree program through an **Academy** partnership with New Mexico State University in Las Cruces. To date 48 teachers have graduated and 13 **Academy** teachers remain enrolled in this unique Masters program, which is a blended face-to-face/online program. An optional professional doctorate in education program for MSA teachers is planned for introduction in the Fall of 2010 in cooperation with NM State University.

Other MSA Professional Development Initiatives:

The **Academy**, in partnership with Española Public Schools and Northern New Mexico College, Española, recently began the first ever reform math curriculum of instruction for

all district educational assistants. During 2008, 27 educational assistants enrolled in the Associate of Arts degree-granting program at Northern New Mexico College. During 2009, 11 educational assistants are enrolled in the mathematics content course of the A.A. program. **Academy** staff provided the instruction as adjunct instructors to ensure fidelity to the **Academy** core curriculum. This year, in order to build the capacity of the district personnel, the district's MSA math specialist is the course instructor, again, to ensure the consistency of the mathematics program. In addition, the neighboring K-12 district of Pojoaque Valley Schools, recently requested professional development in reform mathematics for its special education staff and K-6 staff beginning in June 2009. As a solution, MSA formed a team of MSA trained Española Schools math coaches and Española MSA teachers to deliver the K-6 training. In effect, Española Public Schools, is now exporting its reform math capacity in the form of human capital developed through MSA's professional development program.

Math Program Outcomes

Using standards-based education and research-based concepts and instructional practices, three **Academy** Master Teachers have worked with over 300 elementary and middle school teachers and principals at 22 school sites over the last eight years in the core areas of math, science, social studies, language arts, learning and technologies, and data analysis and decision-making. This has resulted in improvements in mathematics and science curriculum, assessment and instruction impacting more than 5,000 students to date.

The **Academy** has had *impressive positive impact* on student learning and achievement in mathematics in one of the most economically depressed school districts in northern New Mexico, the Española School District. After a critical number of teachers were trained in the new reform math curriculum and standards-based education through the 2007-8 school year, student performance in math began to show significant gains as follows:

- Between Spring 2005 and Spring 2008, the average proficient and above levels for 3rd, 4th and 5th grades in math increased from 22% to 32%.
- A 10.5% increase in math proficiency from 5% to 15.5% was also realized in grades 6th-8th from 2005-8.
- A dramatic 2005-8 increase in math proficiency from 19% to 38% was realized by Native American students in grades 3rd-5th; at 38% proficient, these Native American students are significantly ahead of the NM State average of 26%.

In 2008, Velarde Elementary School in the Española School District, where 75% of students qualify for free or reduced lunch and 40% of students are from disadvantaged backgrounds, received the designation as a *Blue Ribbon School* from the U.S. Department of Education. This award recognized the dramatic achievement by students, where *approximately 50% of Velarde's students scored proficient or better in math and approximately 60% of students scored proficient or better in reading.*

The **Academy** program has evolved over the last nine years to become the *primary and only reform math initiative and teacher professional development program available and utilized by the participating five northern New Mexico school districts.* Without the **Academy**, it is likely that these districts would have remained users of the less effective traditional rote memory oriented curricula and related teaching pedagogy for mathematics instruction.

The **Academy**'s unique nature and positive impact on enhancing rural K-12 school district capacity in math and science has been recognized as a regional and national "best practice". The **Academy** was honored with U.S. Secretary of Energy Samuel Bodman's Best Practices Award for Equal Employment Opportunity and Diversity in July 2008. The Secretary earlier praised the first graduates of this Masters degree program in his memo of November 27, 2007 where he said "*I was pleased to learn from New Mexico Senator Pete Domenici about the continuing success of the **Northern New Mexico Math and Science Academy** program and would like to extend my sincere best wishes to the first thirty teachers who are completing this program*". NM Senator Bingaman in 2007 stated "*MSA serves as a model in New Mexico and throughout the country*". He commented further in 2008 "*The MSA Masters Program is a great example of what's needed throughout the country. I am delighted to see the lasting positive impact that the MSA program is having on the enhancement of our Northern NM K-12 math and science learning environment and the related academic achievement levels of the over 3500 New Mexico students who have been taught by MSA-trained teachers, as evidenced by the 2005-2008 statistics supplied by LANL, showing increasing proficiency each year in math*".

New Inquiry-based Science Program Pilot

In 2009, the **Academy** will begin the addition of a reform science professional development program, which will be phased in over the next four years. The science program will involve a new MSA Summer Institute component as well as a core school year component to model the structure of the current math program. The initiative will further introduce a complementary school-year pilot program in August of 2009 working with ten 4th grade teachers. To prepare for the pilot, the ten teachers will participate in a new two-week Science Institute where they will learn reform or "kit-based" science concepts, pedagogy and assessment for two science modules. Modules will consist of research-based inquiry science curricula endorsed by the National Science Foundation and developed over the last twenty years by the National Science Resources Center, (NSRC) a unit of the Smithsonian Institute and the National Academies in Washington, and others.

These curricula: are aligned with the National Science Education Standards; were developed by the NSRC and others using a rigorous research and development process (see http://www.nsrconline.org/about_the_nsrc/index.html); were field-tested with diverse student populations representing urban, rural, and suburban districts; were assessed by an external evaluator and reviewed by master teachers, scientists, and engineers to ensure scientific integrity and educational effectiveness; provide age-appropriate opportunities for children to expand their conceptual understanding of important science concepts, acquire problem-solving and critical-thinking skills, and develop positive habits of mind toward science; incorporate opportunities for reading and reflection, discussion and analysis, and writing and independent study; offer students opportunities to apply newly learned concepts and skills to their everyday lives; and incorporate assessment tools and the critical implementation needs of both teachers and districts.

Additionally, during the school year, the science program plans to draw on the extensive

science expertise of New Mexico's very large community of engineers, mathematicians, and scientists in providing specialized science content knowledge, teacher and student mentoring, and assistance in conducting the professional development activities for the teachers. During the second year of the science initiative, 20 more teachers will join the program. These will include an additional ten 4th grade teachers and ten 5th grade teachers. The first group of 4th grade teachers will be trained on two additional science modules. Each year the number of teachers trained will increase with 160 K-6 teachers using an inquiry science curriculum in their classroom by 2012. It is anticipated that all five of the targeted school districts will adopt the reform science curriculum, associated costs, and required science support staff to continue a successful program. The **Academy**, the LANL Foundation, the New Mexico Public Education Department (PED) and all other partners anticipate increases in teacher skills and student proficiency in science similar to those being achieved in math as a result of the **Academy's** programs.

The **Academy's** Master Teachers and Program Manager have developed a very close working relationship with the NSRC over the last four years. These activities have included a keynote address by NSRC's Executive Director at a K-16 science education reform conference held in Santa Fe, NM in 2005 that was co-sponsored by LANL, the LANL Foundation and NM Senator Bingaman, followed by a second K-16 science education reform conference held in Santa Fe in 2007 that was co-sponsored by LANL and the NSRC. The **Academy's** Program Manager assisted NSRC with its 2008 annual conference held in San Diego as an invited speaker and later co-sponsored with the LANL Foundation a ten person team of teachers and principals from northern NM who participated in the July 2008 NSRC Strategic Planning Institute in Alexandria VA. During this Institute, preliminary plans were drafted for introduction of inquiry-based science into selective school districts under the umbrella guidance of a new "Northern New Mexico STEM Education Consortium" framework co-sponsored by MSA and the LANL Foundation STEM Working Group. We are also planning to conduct a customized NSRC Leadership Institute in New Mexico in the Fall of 2009 to educate and engage additional New Mexico educators and community members in the five essential components of the NSRC Science Education Systemic Reform Model.

This introduction of inquiry-based science curricula into the participating **Academy** school districts is also strongly endorsed regionally by the NM PED Math and Science Bureau and its evolving *NM Project 2012*, referenced above, as a pilot program that may form the basis for future expansion in other regions of the state.

Evaluation

The **Academy's** well-established math program has been formally evaluated by the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) at the University of California Los Angeles. The **Academy's** evaluation plan for its expanded science program includes identification of specific, measurable goals and metrics that will be used to measure progress towards goals. Evaluation will include qualitative (teacher surveys, focus groups, observations) and quantitative (analysis of New Mexico Standards-Based Assessment results, and locally developed tests).