



POLICY REPORT

STEM NETWORK MODELS AND THEIR IMPLICATIONS FOR NEW MEXICO

Report prepared by
New Mexico First

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NEW MEXICO FIRST

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New Mexico First

P. O. Box 56549

Albuquerque, New Mexico 87187

Phone: 505-225-2140

Website: www.nmfirst.org

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CONTENTS

Foreword.....	4
Author.....	4
Sponsor of Research	4
Introduction	5
National Context.....	5
New Mexico Challenges	6
STEM Activities and Models	7
Overview of Current New Mexico STEM Efforts	7
STEM Networks Around the Nation	10
Emerging STEM Trends.....	15
Recommendation for New Mexico	17
Conclusion	18
Appendices.....	19
Appendix A: STEM Action Team Accomplishments, 2012-2013	19
Appendix B: STEM Action Team Policy Achievements, 2014	23
Appendix C: STEM Action Team Presentation to Legislature, 2015.....	24
Bibliography	35

FOREWORD

This report provides a high-level overview of existing science, technology, engineering and math (STEM) activities in New Mexico as well a comparative analysis of STEM networking and coordination models from other states.

Author

New Mexico First, the preparer of this report, engages people in important issues facing their state or community. Established in 1986, the public policy organization offers unique town halls and forums that bring together people from all walks of life to develop their best ideas for policymakers and the public. New Mexico First also produces nonpartisan public policy reports on critical issues facing the state. These reports – on topics like water, education, healthcare, the economy, and energy – are available at nmfirst.org.

Our state's two U.S. Senators – Tom Udall and Martin Heinrich – serve as New Mexico First's honorary co-chairs. The organization was co-founded in 1986 by U.S. Senators Jeff Bingaman and Pete Domenici (retired).

Sponsor of Research

The Los Alamos National Laboratory Foundation funded this report. The foundation's mission is to enhance the vitality of Northern New Mexico by investing in education, learning and community development. The vision for the Foundation is to serve as a catalyst and leader for successful innovation in community and educational endeavors, engaging the region in creating excellence in education. The Foundation primarily works in a seven county area that includes Los Alamos, Mora, Rio Arriba, Sandoval, Santa Fe, Taos and San Miguel Counties.

INTRODUCTION

Education policies that promote Science, Technology, Engineering and Mathematics (STEM) education are a natural fit for New Mexico. The state has numerous government, for-profit and nonprofit resources that give it enormous advantages for maximizing the effectiveness of STEM initiatives. The wide array of existing STEM programs and services have developed over the years because of private sector interest from companies such as Intel, Lockheed Martin and PNM, as well as forward thinking education sector leadership that recognizes the importance of science and math to almost all fields in a rapidly evolving workplace.

Governmental entities in New Mexico also provide major motivation for advancement of STEM skills. New Mexico is home to three air force bases, one army rocket range, two national laboratories and three research universities that boast several higher-education branch campuses, in addition to community colleges with large enrollments. Major healthcare centers, funded heavily by federal and state dollars, include University of New Mexico Hospital, St. Vincent Hospital, Lovelace Medical Center, and Presbyterian Hospital.

Bottom line: STEM is essential for the state's future economic development, educational achievement and healthcare access.

National Context

National statistics show alarming trends. The U.S. economy is estimated to require 123 million advanced technological jobs by 2020, even though only 50 million Americans will be qualified to fill them.¹

Brain drain from the retirement of Baby Boomers, especially at federal government agencies such as the Department of Energy and NASA, will be a threat to future economic growth in the United States. Moreover, the supply of young people graduating from college in computer science fields will not keep up with demand, according to projections by Microsoft.²

These difficulties will negatively affect American competitiveness in the global arena and can threaten traditional innovative advantages enjoyed by industry in this country. Other countries are encroaching on U.S. leadership in the number of qualified employees in STEM fields. The United States continues to fall behind in the number of bachelor degrees awarded. Science and mathematics proficiency overall is eroding as more high school graduates attempt to enter the workforce without STEM preparation.³

¹ (Gordon 2009, 34)

² (Microsoft 2011)

³ (National Research Council 2012)

New Mexico Challenges

New Mexico faces similar difficulties when it comes to answering its needs for a modern workforce. Fields such as healthcare, professional and technical services will be the key drivers of future employment in the state, and these positions require STEM expertise. The aforementioned national laboratories and military installations will need today and in the future a highly skilled workforce. New industries at the thriving southern border region that have capitalized on Mexico's maquiladora industrial model will require sophisticated mathematics and science skills to fill advanced manufacturing and logistics jobs. For example, these workers should be adept in the use of information technology systems that require critical thinking, complex problem solving and data analytics proficiency. They will need to be experts in the operation of hardware and software for warehouse operations and inventory management as well.

However, state education statistics paint a grim picture. While fourth grade math proficiency is improving in New Mexico, these elementary students have not caught up to their peers in other states. In 2013, 31 percent of New Mexican fourth graders were considered proficient, while the national level was 10 percentage points higher.⁴ The same story, disparities in math achievement, repeats itself among eighth graders in New Mexico.⁵ And in either grade, New Mexico also struggles with an achievement gap. Hispanics and Native Americans lag behind Anglo students in math, science and reading.

Overall, New Mexico STEM graduates from community colleges and universities have increased to around 5,500 per year, compared to around 4,500 per year in 2010, according to the U.S. Department of Education.⁶ It is estimated by the NM STEM Action Team that New Mexico will need to increase the number of these graduates by 25 percent in 2020.

The state's business and nonprofit leaders, as well as its policymakers, are aware of the challenges. There are a number of STEM programs and initiatives in the state. However, their effectiveness is sometimes hampered by less than ideal amounts of coordination and teamwork. These programs can sometimes operate in "silos" without proper communication and integration.

These coordination challenges are not uncommon. Other states' solutions will be presented later in this report.

⁴ (U.S. Department of Education 1992-2011)

⁵ (U.S. Department of Education 1992-2011)

⁶ (U.S. Department of Education 1992-2011)

STEM ACTIVITIES AND MODELS

Overview of Current New Mexico STEM Efforts

New Mexico has an advantage when it comes to its existing STEM programs: Numerous stakeholders have a high level of awareness and understanding on the importance of this type of educational attainment and achievement.

According to recent findings by Purdue University researchers, this level of awareness is a necessity for successful STEM efforts. The authors also recommended that a “statewide STEM partnership/network model is a viable option for growing collective impact and sustainability of STEM K-12 education.”⁷ The good news is that New Mexico is already following these recommendations in a number of ways. Many stand-alone programs already exist. The total number is not known, but the following table provides context.

Source	Number of Listed Programs
New Mexico STEM-H Connection	116
New Mexico First 2012 summit report, taken from then-active NM STEM Database	105
SHARE New Mexico, STEM programs	64
NM PED, STEM Resources	8
New Mexico MESA, STEM Resources	7
STEMconnector, New Mexico directory	8

Between each of these listings exist both some duplication and some unique programs. None of the listings offer the same set of initiatives. This reality potentially points to the need for increased coordination. Because of the wide array of programs, this report does not attempt to list or categorize them all. However, the following efforts are focused specifically on coordination.

NM PARTNERSHIP FOR MATH AND SCIENCE EDUCATION

This partnership is a statewide membership network or clearinghouse for STEM institutions and projects. It is comprised primarily of university and K-12 STEM educators as well as private sector and science museum representatives. The organization’s objective is to “promote coherence and quality of STEM education initiatives through dissemination of information, networking, coordination and collaboration.”⁸ It was the fiscal host for the STEM Action Team described above.

⁷ (Sondergeld T. 2016, 104)

⁸ (New Mexico STEM-H Connection n.d.)

NM MATH AND SCIENCE ADVISORY COUNCIL

This state council is an initiative based on state legislation passed in 2007.⁹ It is a 12-member board appointed by the secretary of the New Mexico Public Education Department (PED). The group is staffed by PED's Math and Science Bureau. In order to supply the most up-to-date educational techniques and best practices, the council boasts membership by teachers and administrators in K-12 schools and post-secondary institutions. Because council members are appointed by the PED secretary with approval of the governor, and because each appointment is a four-year term, the membership potentially changes with each administration.

NM EPSCoR

New Mexico's Experimental Program to Stimulate Competitive Research, commonly known as EPSCoR, is funded by the National Science Foundation to build the state's capacity to conduct scientific research. The statewide network of university researchers and community partners is also cultivating a diverse, qualified STEM workforce and supporting a culture of innovation and entrepreneurship.¹⁰

STEM ACTION TEAM

The STEM Action Team, which was not a stand-alone organization but instead a temporary program, was operational from 2013-2015. It functioned with very limited funding from state corporate interests. The statewide coalition of employers, teachers, professors and nonprofit professionals aimed to improve STEM education and awareness in the private and public sectors. This team, which was staffed by New Mexico First, was one early-stage example of Purdue's STEM network model. With modest resources and focus, the project could get underway again.

The STEM Action Team aimed to address a number of statewide shortcomings and challenges in a presentation to the Legislative Education Study Committee in 2015. This presentation set forth three measurable goals that were previously endorsed by the state legislature via a non-binding memorial in 2013. The goals were:

- By 2020, increase by 25 percent the number of students measurably proficient in math and science.
- By 2020, graduate 1,000 new teachers in science and math, including efforts to support and retain existing STEM teachers.
- By 2020, increase by 25 percent the number of college graduates in STEM fields.

The STEM Action Team also communicated numerous challenges for attaining these objectives. The team's report showed how current public education appropriations are focused almost entirely on improving reading achievement instead of math and science. The team also described how elementary education in science is often overlooked in the state, and that

⁹ (NM Public Education Department n.d.)

¹⁰ (NM EPSCoR n.d.)

students in general should attend more after-school programs to assist them in better educational attainment overall.

The team explained how the current shortage of STEM teachers is problematic and they communicated how important it is to maintain and improve the number of college graduates working in STEM fields. They recommended continued support for remedial collegiate programs that prepare high school graduates for university courses in math and science.

Other recommendations from the STEM Action Team included:

- Urging the state’s Higher Education Department to provide merit pay for STEM education majors
- Adding more science in grade school curriculums
- Supporting teacher loan repayment assistance
- Fostering better professional development in STEM education for teachers
- Increase funding for the Math and Science Bureau

OTHER INITIATIVES

Numerous other initiatives over the years have promoted STEM. The New Mexico Public Education Department has funded math and science summer initiatives. New Mexico State University and the University of New Mexico has STEM outreach programs. Los Alamos National Laboratory funded a comprehensive seven-year community plan that began in 2006. The laboratory also was the main driver behind a statewide initiative to provide for improved math and science education called Project 2012.

Regional and local-focused efforts have also contributed to STEM awareness and advocacy. “New Mexico Mission: Graduate” generally seeks to improve high school and college graduation rates.¹¹ Their programs emphasize job-related skills needed in the workplace, of which the STEM disciplines play an important role. Another example would be the Santa Fe Community Foundation and its Dollars4Schools program that supports teacher projects for Santa Fe Public Schools.¹²

One observation of these efforts is that they are not necessarily aligned to a statewide agenda with uniform goals and evaluation metrics for success.

¹¹ (Mission Graduate NM 2016)

¹² (Dollars 4 Schools 2016)

STEM Networks Around the Nation

While the above efforts represent considerable progress in New Mexico, they are each limited by scope, sustainable funding, or capacity for coordination. This report provides a comparative analysis on other states' STEM initiatives. New Mexico First interviewers looked at how STEM initiatives are established and organized, their sponsorship and funding approaches, missions and goals, and staffing models.

States were chosen because they have a similar size and population level comparable to New Mexico. Case studies on the following states are described below:

- Alabama
- Arizona
- Idaho
- Iowa
- Kansas
- Maine
- Massachusetts
- Mississippi
- Nevada
- New Hampshire
- Oregon
- South Dakota
- Utah
- Washington State
- West Virginia

ALABAMA

Alabama has a separate 501(c)(3) nonprofit called Alabama STEM Education. Four full-time employees work on awareness, advocacy and policy formulation and evaluation. Its signature program is "Raise the Bar." This effort targets low-income middle and high school students for entry into a 10-week engineering, robotics and computer science program. The "Science is Fun" program is also a 10-week tutorial for mathematics, physics and mechanics in which students can build individual professional portfolios to be used for applying to college or for internships in industry.

ARIZONA

The Science Foundation Arizona is an independent 501(c) nonprofit that functions as an intermediary between the state's commercial and industrial sectors and its labor force. STEM is an important part of its workforce development strategy. The Science Foundation uses individual grants to promote STEM efforts that have resulted in positive outcomes for 385,000 students and more than 10,000 teachers in Arizona since 2006, according to the nonprofit's web site.

The foundation also uses statistical analysis and predictive research methods to evaluate how effective the STEM grants have been over the years. Its board features members from the private and public sector, in addition to education practitioners and nonprofits.

The Science Foundation Arizona also spearheads the Arizona STEM Network. This body focuses on instilling a higher level of business engagement in the workforce. It also aims to strengthen teacher efficacy and to better forge STEM initiatives in schools across the state.

OREGON

The Oregon STEM Education Initiative is a result of business and education stakeholders who recommended that the state improve education standards to better fit requirements of the knowledge economy. The initiative aims to focus on preparing citizens for careers in technology and science along with introducing new education policies and procedures in the classroom. The body is also active in coordinating awareness programs between community leaders and school districts.

In 2012, the Oregon initiative partnered with Oregon State University to create the Center for Research on Lifelong STEM Learning. The center works to take critical Oregon industries such as forestry, agriculture and fisheries to a higher level with a better-educated workforce. The program's competitive advantage is its unique evaluation research into STEM programs in order to optimize policy-making and nonprofit strategy in the field.

The State of Oregon has also developed science and technology hubs based on education initiative. Local governments receive grant funding to allow teachers to execute best practices that are investigated by the center for research. The hubs recruit individuals who have taken coursework and training across the STEM academic disciplines.

IDAHO

The Idaho STEM Pipeline is a nonprofit based on state policy requirements established by the Idaho State Board of Education in 2013. The STEM Pipeline is funded by Idaho EPSCoR and the National Science Foundation, according to the organization's web site. The first function of the STEM Pipeline is to provide a resource and advocacy portal. Second, it encourages stakeholders to apply for programs that meet agency goals.

Programs can be any Idaho STEM-related initiative that targets schools, students, community organizations and industry. The grant application includes the amount of funding for the program. It can be used for a conference or event. Grants can also fund a new organization. Applications should also address underserved communities such as Native American or other minority communities.

IOWA

The Iowa Governor's STEM Advisory Council is based on ongoing input from educators, students, parents and corporate and community partners. Education resources feature teacher "externships" in industry. Iowa's program includes STEM Scale-Up programs that education

entities can use to improve their STEM education offerings. The Iowa council also offers 150 high schools and communities with an “Imagine Academy.” This program is sponsored by Microsoft and it allows individuals to get certified in various technology disciplines in order to increase skills that lead to an IT career.

Iowa’s STEM aims to achieve better parent involvement in STEM education. Parents can receive resources and training to improve home-based activities for educational development. The advisory council allows corporate partners to be included in every step of policy and program development. Corporate volunteers can apply to serve on boards or they can offer their expertise to mentor teachers and students. Community partners can offer their services to supplement education efforts. These offerings include zoos, science centers and museums, Girl Scouts and Boy Scouts, technology challenges, software coding programs and other extra-curricular activities and enrichment.

The Iowa STEM council has 47 members from all STEM stakeholder groups. The total STEM budget appropriated by the governor and the legislature was \$5.2 million for FY 2016.

KANSAS

The State of Kansas focuses and coordinates all statewide STEM activity through its Department of Education. Department personnel believe that their leadership spearheads existing efforts via the State of Kansas’ Career and Technical Education services, according to STEMConnector.org. STEM education includes grants and skill development initiatives. The Career and Technical Education program builds coursework about the STEM disciplines for high school students so they will be better prepared for college majors in appropriate fields determined by the State of Kansas.

MAINE

The Maine Department of Education coordinates the activities of two organizations: The Maine STEM Collaborative and the Maine STEM Council. The STEM Council originated with the state legislature’s initiative supported by Governor Paul LePage in 2011. The council’s job is to set a roadmap of goals and objectives and allow for collaboration to solve issues outlined in various reports and studies commissioned by the council or borrowed from national or regional STEM groups.

The Maine STEM Collaborative then builds and implements these goals through teacher support, STEM curriculum development, economic and workforce development programs, and testing and evaluating educational outcomes. The collaborative is also tasked with finding and implementing funding efforts to support these activities.

MASSACHUSETTS

The Massachusetts STEM Advisory Council began as one of Governor Duval Patrick’s workforce development and education initiatives in 2010. The main objective of the council is to align the needs of the STEM business sector with the state’s workforce supply. The council oversees

regional STEM Networks in order to supplement existing STEM advocacy, education and talent recruitment efforts throughout the commonwealth.

Other objectives of the council include heightening K-12 student interest and achievement; building better teacher credentials and expertise; and increasing the number of STEM-related majors and degrees in universities. These goals are required to have measurable metrics for benchmarks and to determine satisfactory progress.

MISSISSIPPI

Mississippi conducts its STEM initiatives through two universities: The University of Mississippi (Ole Miss) and Jackson State University. Ole Miss has numerous education programs. There is a separate K-12 teacher preparation effort at the School of Education, including a related research clearinghouse called the Center for Mathematics and Science Education. The university also aims to recruit women and minorities into STEM majors and fields. Ole Miss seeks to increase application and enrollment in engineering, medical and computer science.

Jackson State University then focuses its STEM outreach on high school and middle school students in Mississippi. There are summer mathematics camps, a junior meteorology program, a summer institute for transportation technology and STEM college preparatory academy for rising sixth graders.

NEVADA

The Nevada STEM Coalition is a 501(c)(3) nonprofit that promotes advocacy and offers education funding, student mentorship, town hall meetings, statewide coalitions, along with legislative and public policy efforts. In 2011, the coalition raised \$125,000 for a statewide summit and follow-up seminars to outline objectives of the various programs. The coalition worked with the Nevada legislature to pass a bill that would create an advisory council to ensure that STEM goals from the summit will be met.

The coalition and council also aim to provide awards, scholarship and competition for middle school and high school students. Parental involvement is highly encouraged. Educators are provided ample resources to improve their own research in STEM fields. The coalition offers curriculum resources. It also allows teachers to apply for scholarships of their own in addition to classroom resources. Businesses have the ability to partner with schools and teachers to heighten student involvement and STEM scholastic achievement.

The governor of Nevada, through the Office of Science, Innovation and Technology, has an additional program called “STEM Workforce Challenge Grants.” Employers in Nevada determine their workforce needs then partner with a training provider. The grants are for training initiatives focused on post-secondary students and recent college graduates. The objective of the program is for the workforce development of critical in-demand skills across STEM specialties.

NEW HAMPSHIRE

New Hampshire Governor Maggie Hassan issued an executive order in July 2015 that created a STEM Education Task Force. The governor's main priority is to "modernize" existing statewide efforts and coordinate programs through the governor's office. However, all new programs, according to a news release, will be based on a previous task force report that had input from numerous policymakers, educators, community leaders and industry representatives.

The STEM task force will work with colleges and universities and build on existing higher education efforts. The executive order also added new members to the task force to include representatives to promote STEM programs focusing on women and girls. A Pre-K representative will focus on elementary education and a career counselor will work with industry for workforce development needs. The views of business leaders and commercial needs will be emphasized.

The task force will also facilitate local STEM efforts such as the City of Manchester's STEAM Ahead program that emphasizes career advantages of STEM jobs. And the task force will also partner with New Hampshire EPSCoR's STEM New Hampshire program to promote learning opportunities and workforce development.

SOUTH DAKOTA

The South Dakota Department of Education boasts its "Project Lead the Way" program. This effort is a partnership with middle schools and high schools in the state. Education pathways can be in STEM fields such as engineering and biomedical sciences. School districts then offer elective credit from STEM courses. The project offers teachers core course content. Teachers can be certified and endorsed for STEM instruction. Assessment and evaluation of student achievement is done by testing.

Project Lead the Way works with the Institute for STEM Education Enhancement located at South Dakota State University. The institute fosters "sustained advocacy, collaboration, education, recruitment and research," according to the university's web site. Institute goals include increasing advocacy, assist in talent recruitment, foster collaboration from stakeholders and build STEM resources and resources.

UTAH

The Utah STEM Action Center is a result of Utah state law that makes STEM education a priority for existing workforce development programs. The center receives a legislative appropriation each year to create relevant research, coordinate STEM activity, provide students and teachers with appropriate resources and incentives, and aligning university and college training, curriculum and majors with the needs of industry.

The center offers numerous grant opportunities for teachers, school and students. STEM organizations can also apply for grants that result in professional learning to better prepare students for careers in STEM fields. Students can also attend camps and apply for grants and scholarships on their own. Schools can receive special training designations, be endorsed for

STEM learning all the way down to the elementary school level, and specific classrooms can earn grant awards as well. Grant applications are encouraged to have an industry component that shall include mentorship from STEM professionals and commercial input on program development, goals and evaluation.

WASHINGTON STATE

Washington STEM is an independent nonprofit that serves as the main information and advocacy hub for STEM activities in the state of Washington. Washington STEM combines and coordinates philanthropic efforts in business and education through its “network of network” concept. This results in entrepreneurial STEM projects that are incubated in the organization. The idea incubator then enables education partners to make their visions into reality.

Washington STEM has a total of 16 employees who staff various aspects of STEM advocacy and project development. They also have a policy advocacy division to bring about legislative change for all STEM related public policy.

The Washington STEM Education Foundation is a separate effort that serves communities in western Washington in the vicinity of Pullman where Washington State University is located. This foundation was created in 2009 with the goal of making a national blueprint for funding STEM efforts in K-12 education. The organization collects donations so it can make grants available directly to schools. It also recruits volunteers from STEM professions who serve as mentors and role models to students in order for the private sector to better recruit talent in the STEM disciplines.

WEST VIRGINIA

In West Virginia, STEM activities and programs are led by The Education Alliance. This is a partnership among stakeholders in education, community organizations and the private sector. The alliance uses the West Virginia University Center for Excellence in STEM Education as a resource and research portal. It also partners with the Governor’s STEM Initiative. A featured alliance program is the West Virginia STEM Challenge for teachers and students in Pre-K through 12. Awardees can win up to \$2500 for technology purchases related to STEM education. West Virginia University has other STEM initiatives such as robotics team, professional development for K-12 teachers and STEM classes for high school students.

Emerging STEM Trends

After conducting the comparative analysis and performing in-person interviews with New Mexico STEM experts such as Selena Connealy from New Mexico EPSCoR and Gwendolyn Perea Warniment from the Los Alamos National Laboratory Foundation, New Mexico First researchers found that several organizational patterns had emerged from these state initiatives.

Connealy and Warniment also identified several issues that numerous states must address. These topics are paramount and can foster or prohibit success. The issues include subpar K-12 testing performance in STEM fields; lack of student interest in math and science; teachers

without satisfactory STEM expertise; minority performance and achievement gaps in math and science; and lack of awareness from the media along with lack of awareness among public and private-sector stakeholders.

The following is a list of STEM program organizational models:

- 1) The STEM program originates, is housed in, and is led by the state's governor
- 2) The STEM programs originates, is housed in, and is led by the state's public education or higher education department
- 3) The STEM program is a newly-constituted for a special STEM purpose; it is considered "stand-alone;" and it is organized as a separate nonprofit with an IRS designation of 501c3 or something similar
- 4) The STEM program is led by an already-established nonprofit or an already-established or existing nonprofit partner
- 5) The STEM program is led and housed by in a university or college
- 6) The STEM program is comprised of a "hybrid" model that features a combination of the models listed above

New Mexico First researchers also examined the pros and cons or strengths and weaknesses of these classifications or models.

GOVERNOR MODELS

Governor-led STEM programs have the virtue of the governor setting the agenda and making STEM education a high priority. The governor can also make sure STEM permeates other state agencies and that governor-involvement sends a signal to the legislature that these initiatives are a long-term priority. The governor is then able to push for continued funding that is provided from a governor-only appropriation or from funding by a legislative appropriation.

But there are negatives associated with this approach. Governors can change every four years depending on the election cycle. Other elections could stifle continuity. Agenda setting may waiver depending on the amount of political capital a governor may have. Political and legislative priorities also change over time. Priorities may have political foes or ideological and partisan push-back.

EDUCATION DEPARTMENT MODELS

Alternatively, there are pros and cons associated with a STEM program that is housed or led by a state's education department. This model usually has the advantage of guaranteed engagement and policy alignment with existing or future K-12 education initiatives. Bureaucrats often have high levels of technical expertise and are experienced at working with teachers and the organizations that represent them.

However, the effectiveness of bureaucratic efforts could be limited by other priorities and diminished attention over time. Budgets and appropriations could be cut or limited. Departmental leadership is often staffed by political appointees and these personnel could

change depending on election outcomes. Policy initiatives could have partisan opponents that reduce efficacy and funding.

NONPROFITS

There are some advantages when a STEM program is a stand-alone and separate nonprofit solely created to execute STEM policies. A new nonprofit has the opportunity to build initiatives from the “ground up” using best practices and policy formulation along with ideal coordination and optimization. The organization could operate as a nonpartisan organization that is independent from government, a desirable characteristic for would have the public perception of non-partisanship and independence from government. It would also be assumed that the nonprofit would have a strong board of directors that would represent all stakeholders.

Unfortunately, this model has its weaknesses. A startup organization would have funding challenges. Many private foundations and philanthropists often prefer to fund established organizations. A lack of funding from the start would mean that its leadership would spend too much time on acquiring an appropriate budget rather than executing the group’s STEM vision. Startups need time to be effective and gain trust from the public and media.

Many of the same pros and cons affect STEM efforts that use existing nonprofit partners. One big advantage of this model would be the built-in trust of an established organization and its current budget and funding sources. But the existing nonprofit could fall into the “mission creep trap” when it loses focus on its other missions or projects. Also, this nonprofit could have existing doubts from political opponents that would cramp or constrain its new STEM mission.

UNIVERSITIES

When a STEM program is housed in a university or college, the following strengths and weaknesses can occur. Higher education institutions have obvious strengths because of their existing technical expertise in the STEM disciplines. Universities and colleges can mobilize and jumpstart existing programs and embolden administrators. Higher education institutions can harness massive research and development programs that would favor STEM. Universities and colleges can also grow and expand resources to succeed at executing their vision.

However, colleges and universities can fall victim to budgetary constraints and mission creep as well. The administration and faculty may have misaligned goals and priorities. The university may also have differing communication and lobbying strategies that could hurt funding from year to year. K-12 teachers may have difficulty in coordinating policy priorities and execution with college professors.

Recommendation for New Mexico

After weighing these pros and cons from each model, New Mexico First sees at least two structures that appear viable for our state:

- 1) Create a permanent STEM network program, housed within an existing nonprofit, with the goals of integrating efforts, tracking legislation, advocating for reforms, advancing best

practices, and benefitting from the wide array of existing science and math activities that are underway. This network would not provide direct STEM programming, and thus would not “put out of business” longstanding successful programs. This network program could also serve as a “backbone organization” for any future collective impact initiatives regarding STEM education. The New Mexico Partnership for Math and Science Education or New Mexico First are two logical candidates, though not the only ones. It appears important that the nonprofit be statewide in focus, as oppose to local or regional.

- 2) Establish a new nonprofit organization with the same functions as above. This approach brings the benefit of a fresh identity; funders and stakeholders are often more excited about funding some new, rather than extending or rebranding existing work. A new nonprofit would face the natural challenges of getting off the ground: establishing a board, hiring staff, locating office/storage space, creating internal infrastructure or back-office systems, building a website, etc.

In either model, the new network would absolutely need to partner with New Mexico universities and colleges, private sector leaders, K-12 leaders, foundations, policymakers, the Math & Science Advisory Council and others.

EVALUATION OF THIS RECOMMENDATION

New Mexico First does not claim that this recommendation is the only answer. Readers of the different state models may see potential in very different structures. If so, another way to evaluate the various models is to review them using a “Red Team” review group comprised of outside evaluators. Red Teams are used by the federal government to evaluate proposals in an objective and independent manner.

According to Onvia, a publicly traded government contracting advisory firm, Red Teams can supply the critical “5 C’s of Review,” which include coherence, completeness, compliance, consistency and correctness.¹³

Conclusion

Fundamentally, New Mexico is blessed to have many good activities underway. Our main shortfall is in coordination of STEM efforts and identifying a home for long-term STEM policy/advocacy. New Mexico First hopes that the state case studies spark enthusiasm for, and useful context around, a permanent home for STEM coordination in our state.

¹³ (Onvia 2016). Additional information on “red teaming” is available at: See <http://redteamjournal.com/about/red-teaming-and-alternative-analysis>.

APPENDICES

These appendices illustrate the capacity of statewide collaboration and provide a potential starting point for a future STEM network in New Mexico. Each appendix presents a different set of outcomes from the STEM Action Team, convened by the New Mexico Partnership for Math and Science Education and managed by New Mexico First. This team was created to advance the recommendations from the 2012 STEM Action Planning Summit.



STEM
Action Planning Summit
Science, Technology, Engineering & Math

These implementation efforts were minimally funded, lacking any full-time staff. Despite those limitations, significant accomplishments took place. Regardless where a STEM network is housed, one can easily imagine how the following efforts could be expanded and maintained given a permanent organizational home and reliable funding.

Appendix A: STEM Action Team Accomplishments, 2012-2013

A wide range of New Mexico professionals interested in science, technology, engineering, and math came together in late 2012 to develop action plans for strengthening STEM education.

Participants at the two-day summit addressed three main goals:

- Cultivate top-notch, inspiring K-12 math and science teachers.
- Make STEM more relevant, exciting, and rigorous in the K-12 classroom.
- Recruit and retain more STEM college students.

These issues overlap a great deal, and the detailed actions plans reflect that reality. A few cross-cutting ideas came up repeatedly in the discussions:

1. Cultivate student interest in STEM subjects at K-12 and college levels, by using proven **active-learning strategies** and **hands-on research**. Help future teachers, current teachers, and professors develop the ability to use these techniques instead of relying on lecturing.
2. Implement the **Common Core State Standards** in math effectively, with significant involvement from educators, adequate professional support, and effective classroom tools.
3. Adopt the **Next Generation Science Standards**, and similarly support their implementation.
4. **Involve industry** in STEM education at every opportunity, including K-12 classrooms, colleges of education that are preparing future math and science teachers, recruitment of university STEM majors, and development of industry-relevant curricula.
5. Get teachers the **quality materials** they need to teach science and math effectively.
6. Provide **ongoing professional development** to K-12 and college teachers, so they remain current in the rapidly evolving STEM fields.

7. **Break out of silos** and create collaborations between government agencies, school districts, colleges and universities, departments, industry, unions, and other groups who may tend to work in isolation.
8. **Fund STEM efforts** in a sustainable way, drawing on public and private sources.

In order to advance these recommendations, a STEM Collective Impact Team consisting six working groups was formed. The team's accomplishments follow.

POLICY WORKING GROUP

- Created an online bill tracker for STEM, drawing hundreds of visitors during the 2013 legislative session.
- Informed and/or actively supported a number of policies during the 2013 legislative session:
 - \$500k appropriation for professional development grants for K-12 STEM teachers (based on HB 258)
 - Passage of HM 19 and SM 38, creating NM STEM Week and setting voluntary targets for STEM education (See targets below.)
 - \$1.5 million appropriation to create a stipend program to recruit and retain math teachers and hire an additional math and specialist at PED (passed and direct result of STEM Summit)
 - Funding for NM MESA, Café Scientifique New Mexico, and the Museum of Natural History and Science for their STEM initiatives (passed)
 - Support for ENMU to prepare student teams in grades three through twelve to design, build, program, and test robots, as well as compete in an international robot competition (passed)
 - Through capital outlay appropriations, robotics materials for after-school programs (passed)
 - Additional bills on Next Generational Science Standards, Minority Math, Engineering & Science Program, Northern NM Youth Science & Math Program, Bernalillo Math & Science Skills Program (did not pass, but advanced policymaker knowledge of the importance of STEM)
- Reviewed, provided amended language, and endorsed U.S. Senator Tom Udall's pending STEM bill in the U.S. Congress.
- Advocated the successful renewal and repopulation of the NM Math and Science Advisory Council.
- Developed a policy statement on the Next Generation Science Standards, voicing clear support for adoption. The statement has been shared with the PED and will be used in the upcoming session as appropriate.
- Delivered multiple presentations, educating policymaker and community leaders about the importance of strengthened STEM policies and programs (LESC, Senator Udall's health and science briefings, NM Math & Science Advisory Committee).

- Drafted new STEM legislation (bill and memorial) to be considered in January 2014 by the Legislative Education Study Committee for potential endorsement in the upcoming session (passed)

STEM WEBSITE WORKING GROUP

- Established a statewide collaborative effort among institutions of higher education, nonprofit organizations, media organizations, and student organizations to develop a NM STEM Connection website.
- Secured funding and launched phase one of a new website with a searchable database of NM STEM programs and people, national and state STEM resources, and a forum feature.
- Established a plan for seeking funding and implementing phase two of the site to add information on STEM careers, NM STEM professionals, on-line curriculum packages, student recruitment/retention programs and practices, and social networking and file sharing features.

PARTNER-INVESTMENT WORKING GROUP

- Secured industry support for a STEM Education in New Mexico Proclamation which will establish a foundation for collective action to put New Mexico on the forefront of STEM education and workforce development and education.
- Collected data, which can be used to measure progress of collective action and increase knowledge of best practices in STEM education.

PRE-SERVICE TEACHER WORKING GROUP

- Established a working group consisting of math and science professionals from New Mexico institutions of higher education to create common goals/structures for math/science teacher courses and programs.
- Secured endorsement for using the math/science Common Core Standards and Next Generation Science Standards to guide the group's work.
- Created an online repository to share instructional materials.
- Drafted common student learning outcomes for math which can guide pre-service courses for elementary teachers, and plan to do the same for secondary math and science.

PROFESSIONAL DEVELOPMENT WORKING GROUP

- Developed and submitted a plan to the NM Public Education Department Cabinet Secretary recommending the adoption of the 2011 Learning Forward's Professional Learning Standards, including implementation steps for establishing the standards.
- Drafted a report detailing the historical and current status of teacher professional development in New Mexico, which can be used to increase knowledge of best practices.

RECRUIT & RETAIN WORKING GROUP

- Collected information about recruitment and retention programs and practices that work best for NM STEM students.

- Coordinated with STEM Website working group to ensure the program and practices information is available through the NM STEM Connection website.

STEM TARGETS FROM SM38/HM19

- New Mexico will certify 1,000 new science and mathematics teachers by 2020.
- New Mexico will demonstrate a 25% increase in the number of high school students measurably proficient in mathematics by 2020.
- Public post-secondary educational institutions will coordinate with one another and present to the legislature by December 2014 information on combined efforts to reform the pre-service teacher programs that will prepare the next generation of science and mathematics educators.
- New Mexico will increase the college graduation rate in science, technology, engineering and mathematics fields by 25% by 2020.
- Departments, public post-secondary educational institutions and private sector partners will present progress on these goals to the legislative education study committee annually for the next three years.

Appendix B: STEM Action Team Policy Achievements, 2014

STEM Action Team efforts associated with the 2014 New Mexico legislative session follow.

- Passage of New Mexico private-sector partnerships HM 21, SM30, recognized New Mexico's major science and technology employers for working together to improve math and science achievement across the state. Partners include Los Alamos National Laboratory, Sandia National Laboratories, Intel, Air Force Research Lab, PNM Resources, and Northrup Grumman.
- Passage of school licensure reciprocity requirements, SB329, the bill revised minimum requirements for licensure or reciprocity for teachers, initially calling for the reduction of college math credits for elementary teacher from nine credits to three. Thanks to attention by the STEM Action Team and other education experts, an amendment brought the number up to six. See senate memorial below, calling for the study of math teacher competencies, introduced to complement the bill.
- Passage of study math teacher competency update, SM130, the memorial was introduced in response to the school licensure bill. The memorial requests that the Public Education Department update the required math teacher competencies in the NM Administrative Code. These competencies guide universities in developing their curricula, but have not been revised in almost 20 years. Updating these competencies may help ensure that, despite the reduction in the number of college math courses that pre-service elementary teachers must take under SB329, they receive adequate content. This memorial was authored by the STEM Action Team.
- Passage of high school math education task force, HM83, the memorial passed the house and requests that the Public Education Department convene a high school mathematics education task force to review policies and practices around Algebra II requirements and waivers. It also calls for regular publication of the Education Accountability Report System (EARS) report. Lastly, the memorial stresses the importance of revising the Higher Education Department's funding formula in order to incentivize colleges of education to graduate teachers certified in STEM fields. This memorial was authored by the STEM Action Team.

The STEM Action Team also followed, and in some cases directly endorsed, appropriations. The following special appropriations in 2014 were made for the Public Education Department and directly or indirectly support STEM education in New Mexico:

- \$2.4 million for the science, technology, engineering and math initiative
- \$7.25 million for teacher and school leader programs and supports for training, preparation, recruitment and retention
- \$2.901 million for college preparation, career readiness and dropout prevention
- \$4.145 million for teacher and school leader preparation
- \$1.5 million for stipends for teachers in hard-to-staff areas

Appendix C: STEM Action Team Presentation to Legislature, 2015

This presentation to the Legislative Education Study Committee compiled critical information on STEM education including concrete policy recommendations for the future. It informed the 2016 legislative session.



STEM Action Team

PRESENTATION TO THE LESC, OCTOBER 2015

CONTEXT

What is the STEM Action Team?



- Statewide coalition
- Employers, teachers, professors, nonprofit professionals
- Seeks to improve STEM education and raise awareness among policymakers and public

- Convened by:
NM Partnership for Math & Science Education
- Managed by:
New Mexico First

CONTEXT

Why STEM, Why Now?



- **EVERY** child deserves:
 - a bright future
 - tools with which to forge a path
 - a meaningful career
- How many future jobs will require STEM skills?
 - **80%**
- Industry Retirees

CONTEXT

Three Measurable Goals, by 2020



1. Increase by 25% the **number of students measurably proficient** in math and science.
2. Graduate 1,000 **new teachers** in science and math. Also, support and retain existing STEM teachers.
3. Increase by 25% the **number of college graduates** in STEM fields (including health).

Voluntary targets established in SM38-Sapient/HM19-Stewart, 2014.

GOAL 1

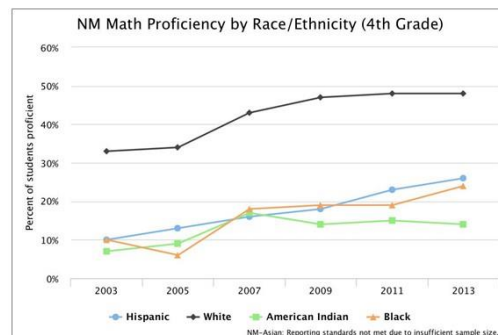
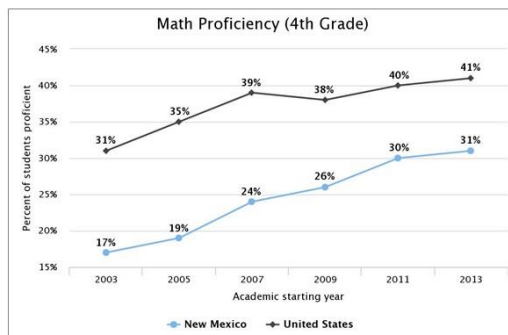
Student Proficiency

Based on SM38-2014, Sapien
and HM 19-2014, Stewart

By 2020, increase by 25%
the number of students
measurably proficient in
math and science.

CHALLENGE

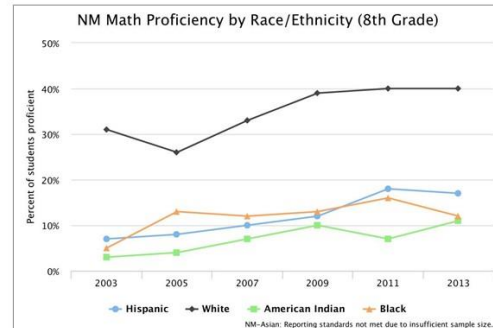
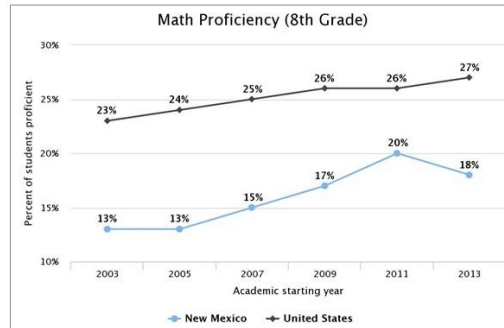
Disparities in Achievement



Data source: U.S. Department of Education

CHALLENGE

Disparities in Achievement



Data source: U.S. Department of Education

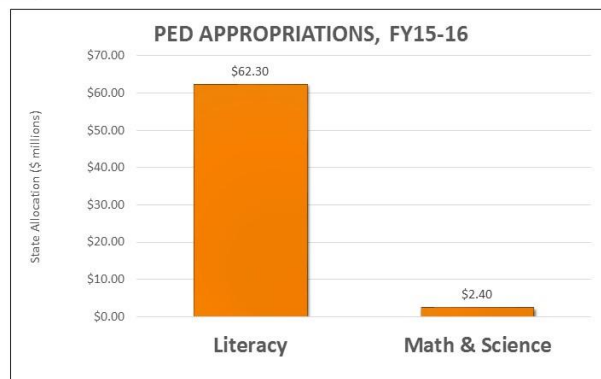
CHALLENGE

K-12 STEM Underfunded

- Lawmakers place a heavy emphasis on early literacy.
- But... It's more complex than it looks.

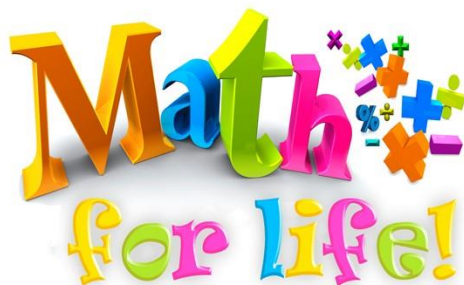


RECOMMENDATION: Increase funding for the Math & Science Bureau, and watch for opportunities to better leverage literacy dollars that can also support math or science.



CONTEXT

Elementary Math is Critical



- What is the single strongest predictor of long-term academic success?
 - MATH.
- School-entry math also predicts later literacy skills.

Source: Duncan et al., 2007; Hooper et al., 2010

CHALLENGE

Elementary Science Overlooked

- Early science = key to long-term critical thinking and love of learning.
- Science often overlooked until 4th grade (tied to testing).
- K-3 Plus = a great opportunity to bring in science.



RECOMMENDATION: Build more science into K-3 Plus through curricula like *Seeds of Science/Roots of Reading*.



RECOMMENDATION: Investigate how to increase time/capacity for science in elementary classrooms.



CHALLENGE

Students in School only 20% of Waking Hours

- Summer and after-school programs boost student achievement
- After-school programs in NM offer less STEM than other states:
 - 69% of US after-school programs offer STEM
 - 37% of NM after-school programs offer STEM
- 80% of NM parents want STEM in after-school programs
- 70,000 NM students in after-school programs today.
- 90,000 more students would enroll if they could.



RECOMMENDATION: Increase funding for after-school and summer programs that include STEM – or prioritize existing funding toward STEM.



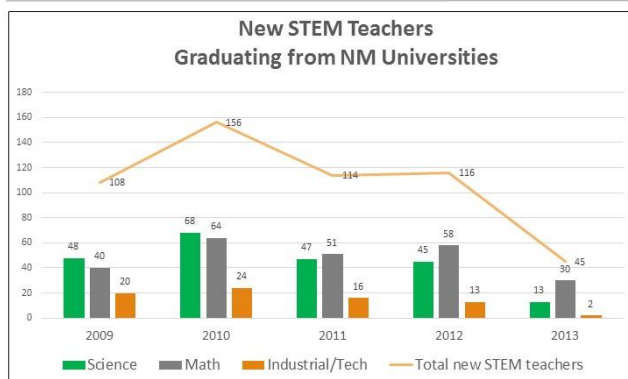
GOAL 2 Teachers

By 2020, graduate 1,000 new science and math teachers. Also, support and retain existing STEM teachers.

Based on SM38-2014, Sapien
and HM 19-2014, Stewart

CONTEXT

New STEM Teachers

**Existing Teacher Incentives:**

- Teacher Loan for Service (LFS)
- Teacher Loan Repayment Program (TLRP)
- STEM and Hard-to-Staff Teacher Initiative



RECOMMENDATION: Continue to fund all these initiatives, and consider increases to the TLRP.



RECOMMENDATION: Consider expanding eligibility for TLRP to include rural areas in addition to just high-risk schools.

QUESTION

Would Universities Benefit From Incentives?

Higher Ed Funding Formula Incentives

- Currently the formula pays universities extra for STEM grads, but not for math & science education grads.
- The amount is not huge, but it creates dialogue about the value of STEM.
- HM 83 (Jimmie Hall) asked for research on this issue.



RECOMMENDATION: Urge HED to do a cost study on the potential impacts of adding math-certified and science-certified education majors to the list of degrees for which the NM higher education funding formula provides performance pay.



CHALLENGE

NM Administrative Code Outdated

- Quality of teaching is key to raising student proficiency and creating love of learning.
- Teachers are made, not born.
- SB329 (2015) reduced the number of math credits elementary education majors are required to take, from 9 to 6.
- SM130 (2015) called on PED to update the state's required teacher competencies, which guide the faculty syllabi for education courses
- Effort by the AMTE is doing that work on a national scale right now, led by UNM's Kristin Umland, Ph.D.



RECOMMENDATION: Monitor the national effort and, when complete, urge PED to fulfill SM130 and update the NM elementary teacher competencies.

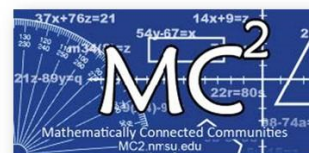
CHALLENGE

Retain and Support Existing Teachers

- Ongoing, quality professional development for math & science teachers is essential.
 - Remain current in a changing world.
 - Hands-on learning is more effective, but takes more prep and training.
- Evidence-based programs already exist. Examples:
 - Making Sense of Science
 - Mathematically Connected Communities (MC²)



RECOMMENDATION: Strengthen *existing* teachers by continuing to invest in quality professional development, but don't reinvent the wheel. Focus on evidence-based programs in NM.



Making Sense of
SCIENCE

"It's creating a culture shift within the schools as these teachers bring back the lessons they're learning, about how to become better facilitators in learning."

PD coordinator, Oakland school district

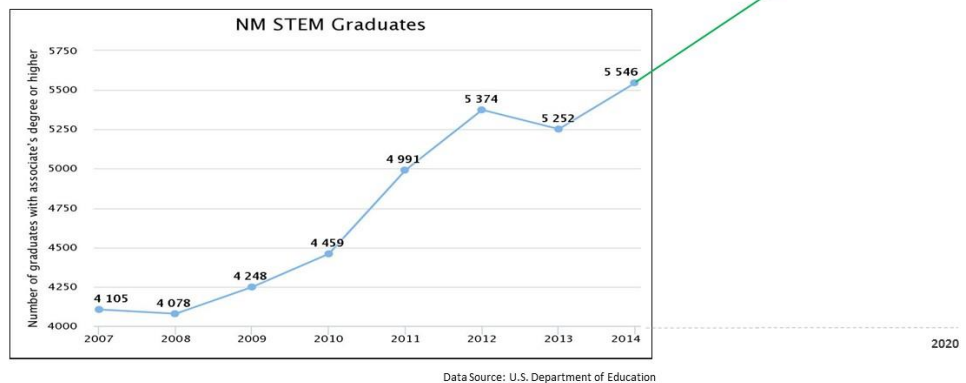
GOAL 3

College STEM Grads

Based on SM38-2014, Sapien
and HM 19-2014, Stewart

By 2020, increase by 25%
the number of college
graduates in STEM fields
(including health).

How Many STEM Grads?



CHALLENGE

Keep College Grads in STEM

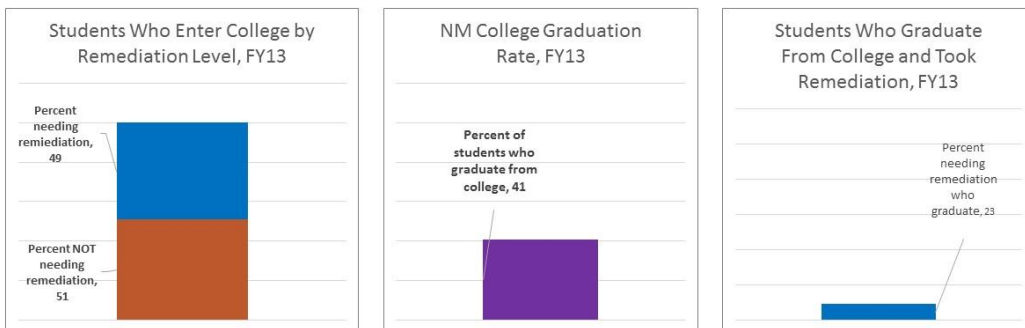
- Support for college students in STEM fields exists, such as the NM Alliance for Minority Participation (AMP), STEM Gateway, ARMAS, and more.
- Hands-on internships and research keep students engaged in STEM.

**RECOMMENDATION:**

Continued/increase support for programs that support STEM students in college, including internships and student research.

CHALLENGE

Remedial Math Tar Pit

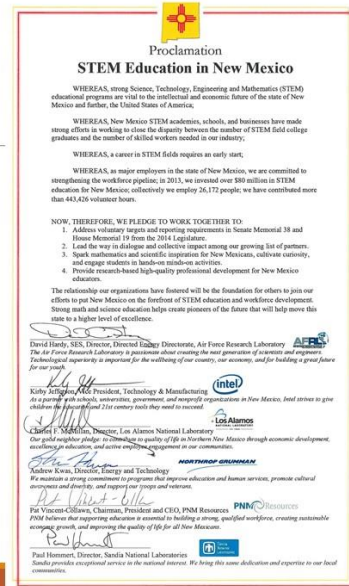


RECOMMENDATION: Study best practices regarding implementation of alternate, or multiple mathematics pathways at NM institutions of higher education.

PROGRESS

Industry Is Your Partner

- 2014 Proclamation
- HM 21/SM 30 (Garcia-Richards/Stewart): Private Sector STEM Education Partnerships
- Private industries investing ~ \$80 million each year in STEM education



STEM Action Team

PRESENTATION TO THE LESC, OCTOBER 2015

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