

**U.S. House of Representatives
Committee on Science and Technology**

Field Hearing on
***STEM Education Before High School:
Shaping our Future Science, Technology, Engineering and Math Leaders
of Tomorrow by Inspiring our Children Today***

Martha and Josh Morriss Mathematics and Engineering Elementary School
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Testimony of
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1. How was Texas A&M University-Texarkana involved with the creation of the Martha and Josh Morriss Mathematic and Engineering Elementary School?

When the Texarkana ISD superintendent presented the concept of creating a mathematics and engineering elementary school to the board of trustees in 2004, a strong partnership already existed between the district and Texas A&M University-Texarkana. Consequently, The A&M-Texarkana faculty and administration were involved in the project from its inception, primarily in the areas of facility planning, integrated curriculum development, and teacher training.

- Facility planning: A&M-Texarkana engineering faculty worked with Texarkana ISD administrators and their architects in the conceptual design of the building, providing consultation regarding the size, proximity, and utilization of space, as well as the inclusion of engineering and mathematics “value added” elements.
- Integrated curriculum development: Faculty and administration within the College of Arts & Sciences and Education worked collaboratively with representatives from the Texarkana ISD curriculum department to envision and create a framework for the new school’s grade K-5 curriculum. After much research and discussion, the team determined that the Texas curriculum standards (Texas Essential Knowledge and Skills) would serve as the core curriculum, augmented by discrete engineering courses at each grade level, and delivered via an integrated

approach in which engineering and/or mathematics concepts would be threaded through all subjects. Delivery of the curriculum would be student-centered and project-based, with assessment of student learning relying heavily on authentic performance measures.

- **Teacher training:** After the integrated curriculum was outlined, Texarkana ISD curriculum specialists and A&M-Texarkana faculty developed syllabi for two A&M-Texarkana graduate courses that would be taken by all Morriss teachers during the summer prior to the opening of the new school. One course addressed the design (content) of the curriculum; the other addressed the delivery (instructional strategies) of the integrated curriculum. Both courses were taught by Texarkana ISD curriculum specialists who were given adjunct faculty status at the university. Morriss teachers received credit for both courses toward their master of science in curriculum and instruction degrees. All Morriss teachers who did not already have a master's degree at the time of assignment to the school are required to obtain a master's degree as well as the Texas Master Mathematics Teacher (MMT) certification, a 12 semester credit hour program developed by A&M-Texarkana faculty.

What other pre-K through 12 schools does A&M-Texarkana support and how?

Since its inception, A&M-Texarkana has supported Northeast Texas public schools in the preparation of teachers. During the past ten years, partnerships have expanded to include the principal and superintendent preparation programs as well as other types of partnerships. Noteworthy examples include:

- For the past five years, A&M-Texarkana has operated a center on the Northeast Texas Community College (NTCC) in Mt. Pleasant, approximately 60 miles west of Texarkana. The original intent of the center was to provide upper division coursework for NTCC students who wanted to complete their undergraduate degree and teacher certification program in EC-4, EC-4 with special education, 4-8 mathematics, and high school mathematics. The available options have broadened to include additional teaching certificates in biology and a degree in criminal justice. As a community college, NTCC's mission focuses on serving graduates of local high schools as well as citizens who live in the Northeast Texas geographical area.

- The College of Arts and Sciences and Education developed a partnership with Kilgore Community College and public school systems in the Longview-Hallsville area for the purpose of assisting school districts to “grow their own” teachers through an aide-to-teacher program, “Preparing Educators of Tomorrow” (PET). This program has been highly successful in accomplishing the overarching goal of providing quality teachers to area schools. The first cohort that graduated in 2007 achieved a 100 percent passing rate on the state certification examination (TExES), and the second cohort is on schedule to graduate in summer 2008. The Hallsville ISD has been a major partner in this effort as evidenced by the district leadership’s willingness to provide classroom meeting space and equipment for instruction.
- In the fall of 2007, A&M-Texarkana expanded the Hallsville partnership by adding a distance education program in which educators at areas schools can attain a master’s degree in education administration and principal certification via a web-enhanced format involving face-to-face seminar and on-line components. ISD The purpose of this program is to increase the supply of quality principals for area schools. The same program was implemented in the Hughes Springs area, with the Hughes Springs ISD also providing classroom space without cost to the University. During spring 2008, 32 students are enrolled in both programs.
- In 2003, the Texarkana ISD opened the Westlawn Elementary Professional Development School (PDS) where A&M-Texarkana student teachers (teacher interns employed by the ISD) work with master teachers (mentors) during their senior year in a clinical instructional setting. Two interns and a master teacher at each grade level (K-5) are assigned to teach approximately 45 students in a team teaching approach. An A&M-Texarkana faculty member (professor of education) is assigned to the PDS as a university liaison on a full-time basis for demonstration teaching, delivery of integrated instruction of the university pedagogy courses that the teacher interns are taking during their last two semesters, and overall program supervision and management. The Westlawn PDS won the *Magna Award for Teaching Excellence* from the National Association of School Boards and the Innovation in Teacher Education Award from the Southeastern Regional Association of Teacher Educators in 2005.

- A&M-Texarkana engineering faculty teach dual credit introductory engineering courses on the Texas High School campus in the Texarkana ISD each semester.
- During the 2003-04 academic year, an A&M-Texarkana education faculty member served as the Technical Assistance Provider to Dunbar Intermediate School, a low performing Texarkana ISD elementary school (97+ percent minority and economically disadvantaged students) to provide consultant assistance and teacher professional development. After the selection and implementation of a clinical reading program, the campus attained and as continued to maintain “Recognized” status from the Texas Education Agency. This same clinical instruction was expanded to the feeder early literacy campus, Theron Jones, the following year with the same exceptional academic results.
- In 2004, A&M-Texarkana began offering a master of science degree in curriculum and instruction. The 36 semester credit hour degree program includes an 18 hour curriculum core and 18 hours from one to two areas of concentration agreed upon by the student and advisor. By design, the degree is flexible enough to allow local area high school teachers to acquire the 18 hours of content within a master’s degree that are required to teach dual credit courses. Texarkana ISD began immediately to scholarship approximately 20 of their teachers through the program each year. Liberty-Eylau ISD followed quickly with up to five scholarships per year. The two districts also pay for the students’ textbooks.
- Since 1989, the Texarkana Young Writers' Program has offered thousands of area students the opportunity to participate in a two-week, half-day writing activity. Approximately 150 students in grades two through twelve who are recommended by their classroom teachers and selected by a university committee participate each year. Program goals are: (1) to identify students who show potential in writing and encourage them to excel as writers, (2) to create a community of writers and offer students the chance to work with professional authors, (3) to provide students with the opportunity to meet students from other schools who are interested in writing, and (4) to provide students with the opportunity to get their work published. Students have the opportunity to write in various genres, including fiction, nonfiction, and poetry. On the final day of the program, parents and other guests attend a program featuring some

of the works written over the two-week period. Approximately 300 people usually attend. An anthology of the students' work is then prepared, printed, and distributed to students during the following school year.

Please describe any other work or partnerships that Texas A&M University-Texarkana is doing with regards to STEM education for pre-K through 12 schools.

A&M-Texarkana supports professional development for science and mathematics preK-12 teachers through several grant programs, the most successful of which has been the East Texas Regional Collaborative for Excellence in Science Teaching (<http://www.tamut.edu/~allard/etrc/etrcindex.htm>). The program involves A&M-Texarkana, Texarkana College, and prek-12 public school teachers in the Northeast Texas geographical area. The primary focus is on the improvement of science teaching with respect to teacher content knowledge, pedagogy, and technology integration in the classroom. Teachers receive a minimum of 105 hours of intensive professional development per year. Other agencies or institutions that have provided teacher development grants include the Texas Higher Education Coordinating Board (Teacher Quality grant program); the Texas Commission on Environmental Quality, the Institute for Global Environmental Studies ESSEA program, and the NASA NOVA program.

For the past three years, A&M-Texarkana's Student Recruitment Group has received funds from the Texas Workforce Commission to support a Robotics Summer Camp held on the university campus. This Camp is designed to encourage high school and middle school students to consider Computer & Information Sciences (CIS) as a college major. Instructors for the Camp are drawn from A&M-Texarkana's CIS professors and students. Attendees meet from 1pm to 5pm every afternoon for two weeks, where they learn the fundamentals of robotics, robotics programming, robotics construction techniques, and robotics trouble shooting. Camp attendance has grown steadily over the past three years. In summer 2007, 24 students participated in the Camp. There is typically a rich mix of minority students among the attendees. At the end of the Camp, teams of attendees participate in a robotics competition that receives regional news coverage.

A&M-Texarkana's Computer & Information Sciences (CIS) Program has sponsored three Teachers Robotics Workshops for preK-12 teachers. The

purpose of these Workshops is to demonstrate how robots can be used as a teaching tool in preK-12 classrooms. Robotics instruction and demonstrations are provided by professional robotics instructors. Participating teachers are given access to robotics kits throughout the year to enhance their knowledge about the techniques presented in the Workshop. Previous Workshops have been one day in duration and each has attracted approximately 12 teachers. In summer 2008, the Teachers Robotics Workshop will be expanded to two days.

During the 2007-08 academic year, two A&M-Texarkana Computer & Information Sciences faculty initiated a Saturday Programming Clinic. The purpose of this Clinic is to teach and refine computer programming language skills of the participants. The Programming Clinic meets on A&M-Texarkana's campus each Saturday from 10am to 2pm. To date, the Clinic has served community college students and members of the general public totaling approximately 25 participants. Next year, the Clinic plans to actively recruit high school students as well.

During 2006 and continuing to the present, select members of the A&M-Texarkana faculty, the TEXARKANA ISD leadership and curriculum staff, and leadership from the City of Texarkana have collaborated with faculty from UT-Dallas, Baylor University, Princeton University, and Texas State Technical Institute in the analysis and selection of next step initiatives to further the STEM agenda utilizing the Texarkana collaboration as a laboratory model. The goal of this select think-tank group is to develop replicable models that can aggressively improve the success of public school children in all aspect of STEM.

2. What are the major problems that limit the performance of students and teachers, and what do you feel is the single, most important step that the federal government should take to improve pre-K through 12 grade mathematics and science education?

The lack of desired performance of students and teachers in mathematics and science education is primarily driven by what the teacher does, not limitations inherent within the students. Research supports the proposition that students from all demographic groups learn at higher rates when the curriculum objectives are clear and measurable, effective teaching methods are utilized, and formative and summative assessment data are routinely translated into feedback for instructional improvement. A final requirement is that all major

stakeholders have and communicate high expectations that all students can learn the objectives at a high degree of mastery.

For mathematics and science, achieving this lofty goal involves the delivery of a rigorous curriculum in the primary grades via pedagogy that initiates and sustains the engagement, curiosity, and excitement of children—i.e., learner-centered activities; meaningful, real-world applications; discovery learning; and challenging projects. It is critical that students develop a strong sense of confidence in their ability to “do” mathematics and science at an early age. This self-confidence promotes the further pursuit of rigorous coursework in the middle and high school years and develops into a strong internal locus of control regarding their ability to choose and experience success in challenging careers in mathematics or science. Reversing a student’s negative attitude toward and failure to thrive in science or mathematics that has developed in elementary school is extremely difficult to accomplish during the middle years and almost impossible by the time a student arrives on the high school campus.

Elementary teachers charged with this incredibly challenging but important task of hooking children to mathematics and science in the elementary years are, for the most part, doing the best they can with their limited formal training. Many teachers lack the content knowledge themselves and the pedagogy skills to make mathematics and science come alive for students and, therefore, to promote high levels of student curriculum mastery. A review of elementary teachers’ college transcripts as well as university teacher certification plans typically reveals few mathematics/mathematic education and science/science education courses. Further, many elementary teachers self report a lack of interest, preparation, or confidence in their ability to teach mathematics or science.

The first step to improved student achievement in mathematics and science is building the capacity of teachers by increasing their content knowledge and broadening their skill sets in delivering a rigorous, but compelling and engaging curriculum. Although important at all grade levels, an urgency must be placed at the elementary level because the greater need, exacerbated by the criticality of making the student mathematics and science “connection” in the early, impressionable years. The solution to accomplishing this goal involves several approaches, ideally implemented simultaneously:

- a. Redefine teacher education to require additional science and mathematics content and pedagogy coursework,
- b. Strengthen the knowledge and skills of existing teachers through professional development via summer institutes, specific topic seminars, graduate degree and certificate programs (such as the MMT), and professional learning communities.
- c. Refine and expand the knowledge base of “what works” in mathematics and science education through applied and action research. Disseminate the results far and wide.
- d. Increase the number of mathematics and science teachers by awarding four-year comprehensive scholarships to highly ranked teacher education institutions.
- e. Require an aligned delivery system at the college and university level that has a proven high probability of producing teachers prepared to teach the early advanced academics necessary for US students to compete in a world economy. Random delivery of a non-aligned curriculum at the college and university level will continue to produce teachers that are often ill prepared to deliver the richness of advanced mathematics, science, and engineering curriculum to our children.

Although it is difficult to conclude the single most important step (from those listed above) that the federal government could take to improve preK-12 mathematics and science education, continued competitive funding opportunities to increase the effectiveness (knowledge and skills) of new and existing teachers (a combination of a., b., and c.) should produce a significant positive impact.

What involvement have you had with mathematics and science education programs at the National Science Foundation or other federal agencies as well as those in the state of Texas? What are the most important and effective components of these programs?

In September 2004, A&M-Texarkana was one of 17 Universities that was awarded a first time Robert Noyce Scholarship Program funded by the National Science Foundation in the amount of \$389,850 for four years. The purpose of the Noyce Program is to provide scholarship assistance to talented junior and senior mathematics and science undergraduate majors who demonstrate financial need and who desire to earn their teacher certification through the bachelor’s degree. STEM professionals, who have a mathematics or science degree and have been working in their field, may choose to enter A&M-

Texarkana's Alternative Certification Program (ACP) to earn their teaching credentials and receive stipends through the Noyce Program. Recruitment is specifically aimed at underrepresented racial minority and female students.

The Noyce Program has awarded 28 scholarships to date. Twenty-nine (29) percent of the recipients are science majors and 71 percent are mathematics majors. Seventeen (17) undergraduate students have graduated and are fully certified mathematics or science teachers while four STEM professionals have received their teaching credentials for mathematics or science. Two additional students will complete resident teaching in May and will graduate in spring 2008, bringing the total number of graduates to 23. The most effective component of this program is the scholarship awards.

3. *How can we attract, educate, and retain the critical mass of talent necessary to keep the state of Texas and the country as a whole at the forefront of research, development and groundbreaking advances in science and technology?*

In addition to those cited above, the following initiatives should have a positive effect on achieving this goal:

- a. Increase the number of doctoral/post-doctoral fellowships to promote increased numbers of terminal degree prepared university faculty to support larger and/or additional university undergraduate and master's level programs, increasing the probability that all students who meet entrance requirements and have the desire to pursue a degree in science, mathematics, technology, and/or engineering can do so;
- b. Increase the number and dollar amount of funded research grants and undergraduate, as well as graduate university scholarships in critical mathematics, engineering, and science fields;
- c. Develop and implement strong informational, advising, and marketing programs for science, mathematics, technology, and engineering careers in middle and high schools, targeting females and racial minority students; and
- d. Enlarge the pipeline of students who are prepared to enter college and graduate with a degree in science, mathematics by increasing the number of students who pass Advanced Placement (AP) and International Baccalaureate (IB) science and mathematics courses.

From the National Academies of Science and Engineering:

- e. Provide a federal tax credit to encourage employers to make continuing education available to practicing scientists and engineers;
- f. Improve the visa processing for international students and scholars (Complying with the 18 month limit regarding labor certification is difficult in higher education); and
- g. Provide a one-year automatic visa extension to international students who receive doctorates in science, engineering, technology, and mathematics to remain in the United States to seek employment.

In addition to providing a technically literate workforce, why is it important to improve public support and understanding of mathematics and science?

The need for a working understanding of mathematics, science, and technology goes well beyond applying it in a career. Such knowledge and skills actually serve as tools for increasing productivity and enjoyment in everyday life, including but not limited to managing/operating a residence, participating in leisure activities and hobbies, traveling, volunteering, and maximizing entertainment options. Further, as the environment in which we live becomes increasingly complex as a result of a variety of human-induced conditions and natural phenomena, increased knowledge in, and application of, science, mathematics, and/or technology will be necessary for citizens to understand and respond to changes that can significantly affect their short term and long range quality of life.

4. How can we ensure that we provide sufficient opportunities to allow students and researchers, educators and employees to become and then remain current and competitive in our rapidly evolving world?

First and foremost, this outcome is much more likely to occur by design (via a plan) rather than default. The first step is to heighten stakeholder awareness of the importance and benefits of becoming and remaining current and competitive, followed closely by establishing reasonable but high expectations and measures of accountability; offering incentives (i.e., recognition; financial rewards and/or other benefits; career advancement; and providing access to free or reasonably priced quality training and professional development opportunities.

In closing, I believe that what you have seen here today at the Martha and Josh Morriss Elementary School for Mathematics and Engineering is the result of open, collaborative efforts between a community willing to seek excellence, a university whose leadership was willing to embrace the wishes of the community, and a public school that was willing to take a risk to do what was

needed versus what has always been done. There is nothing profound in what you see. It is an integration of vision, tenacity, and the courage to do what is needed to offer our children the chance to lead in tomorrow's world.