

**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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Texas A&M University-Texarkana has had a long tradition of partnering with area public schools. One of the components of our institutional mission is service to the Northeast Texas region. The preparation of teachers for area public schools was one of the first manifestations of this commitment and continues to be a major emphasis. During the past ten to fifteen years, partnerships have grown to include new programs and initiatives, as well as the expansion of existing programs at new sites. Noteworthy examples include:

- *The A&M-Texarkana Center on the Northeast Texas Community College (NTCC) in Mt. Pleasant that provides upper division coursework for NTCC students who want to complete their undergraduate degree and teacher certification program in selected areas.* The NTCC Center, in its fifth year, offers students to opportunity to pursue a teaching certificate 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.
- *"Preparing Educators of Tomorrow" (PET), an aide-to-teacher program at Hallsville:* 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. 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.

- *Expansion of the master of education degree in education leadership and principal certification program to teachers in the Hallsville and Hughes Springs areas, via a Web-enhanced format:* In the fall of 2007, A&M-Texarkana expanded the existing Hallsville partnership by adding a distance education program in which educators at area 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. The purpose of this program is to increase the supply of quality principals for area schools. The Hughes Springs and Hallsville ISDs provide classroom space without cost to the University. During spring 2008, 32 students are enrolled in both programs.
- *Westlawn Elementary Professional Development School (PDS), a Texarkana Independent School District (ISD) elementary school where A&M-Texarkana student teachers (teacher interns employed by the district) work with master teachers (mentors) in a clinical instructional setting during the fall and spring semesters of the students' senior year.* 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 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.
- *Dual credit introductory engineering courses on the Texas High School campus:* A&M-Texarkana engineering faculty have taught dual credit introductory engineering courses on the Texas High School campus in the Texarkana ISD each semester for the past two school years.
- *Instructional improvement consultant service to select Texarkana ISD schools:* During the 2003-04 academic year, an A&M-Texarkana faculty member served as the Technical Assistance Provider (TAP) to Dunbar Intermediate School, a low performing Texarkana ISD elementary school 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.

The same clinical instruction was expanded to the feeder early literacy campus, Theron Jones, the following year with the same exceptional academic results.

- *The master of science degree in curriculum and instruction that provides sufficient flexibility for surrounding school districts to tailor the graduate study of teachers to meet district needs:* 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.
- *The Young Writers' Program, a program that has offered thousands of area students the opportunity to participate in a two-week, half-day writing activity each summer:* 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.
- *Region VIII Education Service Center partnership in which A&M-Texarkana faculty work collaboratively with ESC personnel to train and certify elementary bilingual teachers for area schools:* In the past five to six years, the percentage of limited English proficient (LEP) students in the Mt. Pleasant area has grown significantly, and the need for bilingual teachers has grown accordingly. To address this need, A&M-Texarkana faculty developed and implemented a EC-4 Generalist with Bilingual Education certification program. Faculty offer coursework to students via face-to-face and distance education formats. Participants spend from two to four weeks at a partner institution in Mexico each May refining their Spanish language skills.

For the past ten years, the Texarkana ISD has been A&M Texarkana's major public school partner. Consequently, when the Texarkana ISD Board of Trustees approved the Martha and Josh Morriss Elementary School for Mathematics and Engineering in 2004, the university faculty and administration made an immediate commitment to assist the district with this formidable project. The three main categories of collaboration were 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 upon 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 degrees in curriculum and instruction. All Morriss teachers who do not already have a master's degree at the time of assignment to the school are required to obtain the degree, as well as the Texas Master Mathematics Teacher (MMT) certification, a 12 semester credit hour program developed by A&M-Texarkana faculty.

In addition to being a partner in the Martha and Josh Morriss Elementary School for Mathematics and Engineering, A&M-Texarkana is involved in other STEM activities:

- *East Texas Regional Collaborative for Excellence in Science Teaching* (<http://www.tamut.edu/~allard/etrc/etrcindex.htm>): This 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.
- *Robotics Summer Camp for students held on the A&M-Texarkana campus each summer*: For the past three years, A&M-Texarkana's Student Recruitment Group has received funds from the Texas Workforce Commission to support the Robotics Camp, 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 to 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.
- *Teachers' Robotics Workshop for preK-12 teachers*: A&M-Texarkana's computer & information sciences (CIS) program has sponsored three workshops 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.
- *A Saturday Programming Clinic to teach and refine to teach and refine computer programming language skills of the participants*. A&M-Texarkana computer & information sciences faculty initiated and operate the 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.

- *A “think tank” collaborative to develop replicable models that can aggressively improve the success of public school children in all aspect of STEM:* For the past two years, select members of the A&M-Texarkana faculty, the Texarkana ISD leadership and curriculum staff, and City of Texarkana leadership 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.
- *National Science Foundation (NSF) Robert Noyce Scholarship Program:* Almost four years ago, A&M-Texarkana was one of 17 universities 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.

All of the initiatives described above, as well as those underway in other collaboratives across the nation, are certainly worthy efforts in attempting to address the important mission so eloquently stated in the title of this hearing-- *Shaping Our Future Science, Technology, Engineering, and Mathematics Leaders of Tomorrow by Inspiring Our Children of Today*. However, much more is needed. . . Although the United States may be a world economic and political power in many aspects, data support a widely held concern that our students are not leading the way in science,

technology, mathematics and engineering. I propose that this lack of achievement is primarily a function of what happens in schools, 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.

In the areas of 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., student-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 that forms the foundation for 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 their best, considering 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 of the greater teacher 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 high school and university level that has a proven high probability of producing teachers prepared to teach the advanced academic courses necessary for students to compete in a world economy. Random delivery of a non-aligned curriculum at 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 youth;

The Federal government can certainly help to actualize these efforts by establishing expectations and continuing to offer competitive funding opportunities to increase the effectiveness (knowledge and skills) of new and existing teachers.

If we are to 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, we must take decisive steps toward that end. In addition to those already cited, the following initiatives should be considered:

- 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 information, 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:

- a. Provide a federal tax credit to encourage employers to make continuing education available to practicing scientists and engineers;
- b. Improve the visa processing for international students and scholars (Complying with the 18 month limit regarding labor certification is difficult in higher education); and
- c. 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.

The need for a working understanding of mathematics, science, and technology goes well beyond applying it in a career and shoring-up the workforce. 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 quickly to changes that can significantly affect their short-term and long-range quality of life.

Providing sufficient opportunities that allow students, researchers, educators, and employees to become and then remain current and competitive in science, mathematics, and technology is critical to living, working, and prospering in a rapidly evolving world. The first step to achieving this goal 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) as well as opportunities for career advancement; and providing access to free and reasonably priced quality training and professional development.

In closing, I believe that what we have seen here today at the Martha and Josh Morriss Elementary School for Mathematics and Engineering is the result of open, collaborative efforts between and among a community willing to seek excellence, a university whose leadership embraced the wishes of the community, and a public school that was willing to take a risk to do what was needed as opposed to what has always been done. There is nothing profound or complex in this replicable model. It is the result of an integration of vision, tenacity, and the courage to do what is required to offer our children the chance to compete and lead in tomorrow's world.