State of New Mexico
LEGISLATIVE EDUCATION STUDY COMMITTEE

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MEMORANDUM

TO: Legislative Education Study Committee

FR: David Harrell

RE: STAFF BRIEF: MATH AND SCIENCE EDUCATION INITIATIVE: PROFESSIONAL DEVELOPMENT AND NM STANDARDS IN MATH AND SCIENCE

As the third part of the hearing on math and science education, the workplan for the Legislative Education Study Committee (LESC) for the 2006 interim includes a presentation on professional development and state standards in math and science.

Issues:

State Standards

According to a state-by-state review, New Mexico has strong standards in both science and math.

- In December 2005, the Public Education Department (PED) received notification that, in its nationwide review of states' academic standards for primary and secondary school science, the Thomas B. Fordham Foundation had awarded New Mexico a grade of "A." Only six other states earned this grade, and nearly half received either a "D" or an "F." Among other points, the review states:

  - that "the science content [in the standards] is 'rich, varied, ambitious, and builds from grade to grade'";

- that the way the standards build toward "teaching and effective learning of evolutionary science reveals original thought on content and presentation, not just copying from national models"; and

- that, regarding the nature of science, "New Mexico provides an unusual amount of well-articulated good sense."

The state standards in math have also received favorable notice: a grade of "B" in the Fordham Foundation rankings published in January 2005. In this case, the report says:

- New Mexico deserves accolades for strong improvements in its statewide math standards since our last evaluation, when the state received an "F." Though not perfect, the new standards are well organized, coherent, and feature solid . . . coverage of important content; and

- the standards for grades 9-12 in particular "outline a credible course of study for secondary students."

As the Fordham report on science standards explains, strong standards are the starting point for strong student achievement: "Some states – notably A-rated California, Indiana, Massachusetts, New York, New Mexico, South Carolina, and Virginia – produced exceptional academic standards documents that, if followed in the classroom, would result in excellent science programs." As the report further explains, however, "We all know that great standards don't guarantee a good education for a state's students . . . ."

Indeed, while New Mexico is a good example of high standards it is also a good example of the fact that high standards do not guarantee student success because student achievement in math and science has not approached the level of the state standards.

The fundamental issue, then, is this discrepancy between state standards and student performance – a sort of achievement gap between what is or should be taught and what should be learned.

This achievement gap raises a number of questions, among them:

- whether teachers are sufficiently familiar with the standards;

- whether teachers' instruction is properly connected to the standards; and

- whether their instruction is effective in helping students achieve mastery of the standards.

Student Proficiency in Math and Science

According to the results of the math portion of the 2005 National Assessment of Educational Progress (NAEP), in New Mexico:

- overall math scores for grade 8 are higher than only three of the 52 jurisdictions tested (the 50 states, the District of Columbia, and the Department of Defense Education Activity schools) and lower than 47 jurisdictions;

- on average, Hispanic eighth-graders scored 24 points lower and Native American eighth-graders scored 26 points lower than white eighth-graders; and

- students eligible for a free/reduced-fee lunch program had an average grade 8 math score that was 24 points lower than students who were not eligible.

In science, New Mexico students in grades 4 and 8 demonstrated little or no improvement between 2000 and 2005 on the NAEP science test and posted proficiency scores that were among the lowest in the nation:

- in grade 4, approximately 18 percent of the state's students performed at or above proficiency, not significantly different from the 17 percent in 2000 and lower than the 27 percent proficiency rate of fourth-graders in the nation as a whole in 2005;

- for students in grade 8, some 18 percent tested proficient or better in 2005, lower than the 20 percent in 2000 and the 27 percent proficiency rate of the nation's eighth graders in 2005;

- overall, New Mexico performed lower than 37 jurisdictions, and – along with Alabama, Arizona, California, Hawaii, Louisiana, Nevada, and Mississippi – the state had the lowest percentages of children performing at a proficient level; and

- according to PED, the average scores in science of all ethnic groups in New Mexico showed no significant difference between 2000 and 2005; however, Anglo students performed better than black, Hispanic, or Native American students.

The picture is no brighter when framed by state-level assessments:

- For example, students' achievement in science on the 2005 New Mexico Standards-based Assessment declined steadily from elementary through middle school, with approximately 77 percent at or above proficiency in grade 3 to approximately 25 percent in grade 8. Grade 9, the highest grade currently tested in science, was slightly higher than the middle school grades, with 36 percent at or above proficiency.

- These state assessments also showed that the lowest proficiency rates for both science and math are in grades 6, 7, and 8. (Perhaps not coincidentally, during the 2005 interim, the LESC heard testimony indicating that middle school has the lowest percentage of core classes taught by highly qualified teachers.)

Other Factors

While these test scores are far from encouraging, the broader issue is not student achievement in science and math *per se* or for its own sake but student achievement in those subjects as part of the range of 21st Century skills.

- As a number of organizations and concerned individuals have observed, those skills require not only an understanding of science and math but also an understanding of the other core academic subjects – English, reading or language arts, foreign languages, civics, government, economics, arts, history, and geography – as well as skills in communication, critical thinking, and problem-solving and mastery of the tools and devices of the digital age.

- An observation by Representative Vernon Ehlers (R-MI) highlights the importance of the teacher in this context:

> We know that a single teacher can have a tremendous impact on a student, and we need to support teachers for their entire careers, providing them with the necessary tools to empower students with the skills needed for 21st Century jobs. STEM (science, technology, engineering and mathematics) education is the best way that we can equip our nation to remain competitive and innovative in the global economy.

One situation that is likely to exacerbate the issue is the finding from a recent Government Accountability Office (GAO) study of students earning degrees in science, math, and related fields. According to this study, the proportion of students earning degrees in science, technology, engineering, and math has fallen from 32 percent to 27 percent over the past decade.

On a more promising note, neither the low test scores nor the GAO findings have escaped notice or response. The two other LESC staff briefs on this topic – *Math and Science Education Initiative: New Mexico Partnership for Math and Science/Implementation of the Math and Science Bureau* and *Federal Math and Science Legislation* – have noted, respectively, some of the state-level and federal-level efforts to reverse the trend.

Nor is the student achievement landscape without bright spots altogether.

- At the state level, there are such examples as the three students from San Jon High School who represented New Mexico at the Intel International Science and Engineering Fair in Indianapolis, Indiana in May 2006; and the two New Mexico delegates to the National Youth Science Camp in Charleston, West Virginia in June and July 2006.

- At the national level, the performance of elementary students in science has improved, if only in a modest increment: the average scores of fourth-graders rose from 147 in 2000 to 151 in 2005.

To see more of these bright spots, most experts agree, the states and the nation must enhance teacher professional development in math and science.

Professional Development

According to some sources, the goal of professional development should not be to make students better test-takers but to help them think like mathematicians and scientists, sharpening their critical thinking skills and applying what they have learned. Improved test scores are likely to follow these sorts of gains.

In addition, a group of math educators met recently in Ruidoso, New Mexico to prepare a draft model for quality mathematics education in the state. According to this document, professional development must be "ongoing and multi-faceted," not a "one-time event." It must also foster learning communities for teachers; contain meaningful, useful content; align with the state standards; and be subject to evaluation in terms of its impact on student learning.

Professional development comes in a variety of forms. One approach is collaboration with an entity outside the school, like the Math and Science Academy (MSA), an initiative of the Northern New Mexico Council for Excellence in Education in partnership with Northern New Mexico College and the Los Alamos National Laboratory.

- During the 2004 interim, the LESC heard testimony about the professional development that MSA provides to teachers to facilitate student achievement, especially in math, science, and technology. Among the goals of the MSA are (1) graduating students who meet the expectations of the 21st Century by being well grounded in core academic subjects (with an emphasis on technical literacy, mathematics, science, and technology) and (2) increasing the pool of highly qualified teachers.

- According to a March 2005 evaluation report from the University of California, teachers participating in MSA indicate an improved understanding of content areas and standards, an increased knowledge of instructional techniques, and greater confidence in teaching the content areas.

Another example of a formal collaboration is the Outdoor Classroom Initiative, developed by PED and the State Parks Division of the Energy, Minerals & Natural Resources Department in response to Senate Joint Memorial 24 (2005) to build upon existing partnerships between public schools and some state parks.

- Benefits of this collaboration include providing students with opportunities for hands-on experiences in science, augmenting training for teachers and state parks staff, augmenting outdoor supplies and teaching materials, and cultivating outdoor education partnerships with other state agencies.

- During the 2006 session, the LESC recommended an appropriation of $250,000 to pilot an outdoor classroom initiative in New Mexico's 33 state parks, but the appropriation did not pass. The Outdoor Classroom Initiative was also a feature of unsuccessful legislation to create a mathematics and science bureau in PED.

Other approaches may be less formal or institutional:

- partnering with a local museum, for example, pairing teachers with scientists to help teachers obtain the content and pedagogical knowledge that they need and to assist in applications for grants for professional development; or

- relying on veteran teachers to assist novice teachers, a relationship both encouraged and required by New Mexico's three-tiered teacher licensure, evaluation, and salary system.

Still more approaches will come from the presenters on this issue.

Background:

New Mexico's content standards, benchmarks, and performance standards for nine academic areas were an initiative of the former State Board of Education (SBE). For each of the disciplines, the standards and benchmarks were a product of collaboration among teachers, students, parents, education department personnel, and experts in the respective fields, who based their final product on research and experience.

- The SBE adopted the standards and benchmarks for math in June 2002. These standards are organized into five strands: numbers and operations, algebra, geometry, measurement, and data analysis and probability.

- The SBE adopted the standards and benchmarks for science in August 2003. These standards are organized into three strands: scientific thinking and practice, content of science, and science and society.

A tenth set of standards and benchmarks, 21st Century Skills, is under development at PED.

Presenters:

For this presentation, several presenters will offer their perspectives on the relationship between teacher professional development and student achievement in math and science:

- representing teachers are Mr. Steve Goodgame, science teacher at San Jon High School, San Jon Municipal Schools; and Mr. Jason DeWitte, science teacher and National Board certified teacher, La Cueva High School, Albuquerque Public Schools;

- representing providers of professional development are Dr. Lorenzo Gonzales, with the Math and Science Academy; and Ms. Wanda Guzman, Project Director for Mathematically Connected Communities, New Mexico State University;

- representing business is Mr. Larry Langley, President and CEO, New Mexico Business Roundtable for Educational Excellence; and

- representing the Public Education Department is Dr. Catherine Cross Maple, Deputy Secretary for Learning & Accountability, PED.

Questions the committee may wish to consider:

1. What are the major impediments to effective teacher professional development in math and science?

2. What are PED's recommendations for bridging the gap between the standards and student achievement?

3. To what extent is teacher preparation a factor in student achievement in math and science? What changes or enhancements should occur there?

4. What is the extent of state-level coordination between teacher preparation in math and science and teacher professional development in those fields?

5. At which grade level is there the greatest need for professional development in math and science?

6. To what extent do professional development programs in math and science address multiple grade levels or correspondences among grade levels?

7. What roles might parents and the community play in increasing student achievement in math and science?