



Sustaining the Science, Mathematics and Technology Education Reform

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EXECUTIVE SUMMARY

I. Introduction

Increased national attention to science, mathematics and technology (SMT) education reform, including special focus in the National Education Goals and initiatives of the National Science Foundation (NSF) and U.S. Department of Education has led to:

- Significant increases in mathematics scores for 4th, 8th, and 12th grade students on the 1996 National Assessment of Education Progress (NAEP), as compared to the 1990 NAEP (*The National Education Goals Report*, 1997).
- More high school students of all races/ethnicities enrolling in and completing high school algebra, geometry, biology, and chemistry than in 1982 (*Women, Minorities and Persons With Disabilities in Science and Engineering*: 1996).
- U.S. 4th graders being outperformed by only one country and the United States ranking slightly above the international average in 4th grade mathematics and 8th grade science. (*TIMSS*, 1997).

Much of this improvement is the result of state departments of education, school districts, and schools that reexamined and restructured their policies, curriculum, instructional strategies, assessments, teacher professional development, and parent and community involvement. However, many challenges remain if the positive results of the SMT reform are to be maintained and increased. Particularly troubling indicators are:

- The widening gaps in mathematics and science performance between White and minority students (see Tables 1 and 2).
- U.S. 8th grade students scoring below the international average in mathematics (*TIMSS*, 1997).
- U.S. girls scoring significantly lower than U.S. boys on the TIMSS 4th grade science test (*TIMSS*, 1997).

- The U.S. international standing declining in science and mathematics between Grades 4 and 8 (*TIMSS*, 1997).
- U.S. 12th graders scoring below the international average and among the lowest of the 21 nations in both mathematics and science general knowledge (*TIMSS*, 1998).
- The wide gaps in test scores between urban and non-urban school districts in 8th grade mathematics and science achievement on NAEP (*Education Week, Quality Counts*, 1998).

We have no indicators about the science and mathematics performance of students with disabilities in grades 1-12. However, from *Women, Minorities, and Persons With Disabilities in Science and Engineering: 1996*, we do know the following about the 1992-1993 school year:

- Of the 4.6 million children ages 6-21 with disabilities, over 50% had specific learning disabilities and over 20% had specific language impairments (see Table 32 in A Closer Look at SMT Special Education Programs and Resources on page 85). Students with speech and language impairments were more likely to be in the regular classroom (Table 33).
- In 1993, while little more than 50% of the science or mathematics classes in grades 1-4 reported having children with learning disabilities, only 24% of the mathematics classes and 31% of the science classes in grades 9-12 reported having students with learning disabilities (Table 34).
- In grades 1-12, students with physical disabilities were in 4% to 6% of science classes and 2% to 6% of the mathematics classes (Table 34).
- In grades 1-12, students with mental disabilities were in 1% to 5% of the science classes and 2% to 9% of the mathematics classes (Table 34).

- The 4% of college-bound high school seniors taking the 1994 SAT who reported having a disability scored lower than students who reported having no disabilities (*Women, Minorities, and Persons With Disabilities in Science and Engineering: 1996*, page xix).

Raising the SMT skills of all students, while closing the gaps for minority, female, and disabled students, is a particularly daunting challenge for SMT educational reformers. To gain a better understanding about the manner in which states, school districts, and schools are responding to these challenges, AAAS and CCSSO developed and implemented the Science Education Reform for All (SERA) Project. Over the last four years, this project team undertook planning sessions, reviewed plans and documents, and, conducted surveys and interviews with leaders in three state departments of

education, 10 school districts, and three tribal schools (see Table 3). These three states—Florida, Michigan, and South Dakota—are former recipients of NSF Statewide Systemic Initiative funds.

The results of the first three years of this study were reported in *Science Education Reform for All (SERA): A Look at How State Departments of Education Are Infusing Equity and Excellence into PreK – 12 Systemic Reform (1996)*. Our second report includes updated profiles of the state departments of education as well as first-time profiles of the 10 districts and three tribal schools. As can be noted in the district profiles, they vary in size and type and enroll different mixes of minority, Limited English Proficient (LEP), low-income, or special education students.

This report also includes:

TABLE 1 GAPS IN SCIENCE PERFORMANCE BETWEEN WHITE AND MINORITY STUDENTS

Grade 4 — Science		Disparities (in percentage points) between males and females	
Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in science		1996	
	1996	Females < males	4
American Indian/Alaskan Native	11	Grade 12 — Science	
Black	30	Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in science	
Hispanic	28	1996	
Disparities (in percentage points) between males and females		American Indian/Alaskan Native	17
1996		Black	23
Females < males	4	Hispanic	20
Grade 8 — Science		Disparities (in percentage points) between males and females	
Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in science		1996	
	1996	Females < males	8
American Indian/Alaskan Native	13		
Black	32		
Hispanic	26		

In 1996, the proportions of white and minority students who met the Goals Panel's performance standard in science differed by 11 to 32 percentage points. For example, the difference between the percentages of white and black 4th grade students who met the standard in science was 30 percentage points.

Source: National Educational Goals Panel: *The National Education Goals Report: Building a Nation of Learners 1997*. Washington, DC: US Government Printing Office, p. 46.

- Perspectives from SERA liaisons in each of the three SERA project states which summarize their coordination efforts to create science education reform for all students.
 - Commissioned papers from key education leaders and researchers. These papers focus on:
 - the use of federal education funds to advance fairness,
 - the use of Bureau of Indian Affairs' (BIA) funds for education reform,
 - scoring performance assessments of LEP students,
 - SMT education programs for special education students, and
 - characteristics of highly successful schools in poor communities.
- In addition, we conducted literature searches to identify recent educational equity and SMT reports.

TABLE 2 GAPS IN MATHEMATICS PERFORMANCE BETWEEN WHITE AND MINORITY STUDENTS

Grade 4 — Mathematics

Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in mathematics

	1990	1996	Change
American Indian/Alaskan Native	11	20	+9
Black	15	23	+8
Hispanic	11	20	+9

Disparities (in percentage points) between males and females

	1990	1996	Change
Females < males	1	5	+4 ^{ns}

Grade 8 — Mathematics

Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in mathematics

	1990	1996	Change
American Indian/Alaskan Native	13 ¹	18 ¹	+5 ^{ns}
Black	14	27	+13
Hispanic	14	22	+8

Disparities (in percentage points) between males and females

	1990	1996	Change
Females < males	3	2	-1 ^{ns}

Grade 12 — Mathematics

Disparities (in percentage points) between White and minority students who met the Goals Panel's performance standard in mathematics

	1990	1996	Change
Change			
American Indian/Alaskan Native	— ²	17 ¹	—
Black	12	16	+4 ^{ns}
Hispanic	10	14	+4 ^{ns}

Disparities (in percentage points) between males and females

	1990	1996	Change
Females < males	6	4	-2 ^{ns}

^{ns} Interpret with caution. Change from the baseline was not statistically significant.

¹ Statistical tests involving this value should be interpreted with caution. Standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions.

² Sample size is insufficient to permit a reliable estimate.

This table updates information presented in the 1996 Goals Report.

Between 1990 and 1996, the gaps in mathematics performance widened between Hispanic and White students and between Black and White students in Grades 4 and 8. For example, in 1990, the gap between Black and White 8th graders who met the standard in mathematics was 14 percentage points. The gap had widened to a 27-percentage-point difference by 1996.

Source: National Educational Goals Panel: *The National Education Goals Report: Building a Nation of Learners 1997*. Washington, DC: US Government Printing Office, p. 44.

TABLE 3 PARTICIPANTS IN THE SERA PROJECT

Florida Department of Education	Michigan Department of Education	South Dakota Department of Education and Cultural Affairs
Osceola County Schools	Baldwin Community Schools	Crazy Horse School
Palm Beach County School District	Buena Vista School District	Douglas School District
Pinellas County Schools	City of Saginaw School District	Meade School District
	Covert School District	Pine Ridge School District
	School District of the City of Pontiac	Tiospa Zina Tribal School

II. Lessons Learned

We learned from this SERA study that while the turf wars continue, funds shrink, and leaders depart, state departments of education, school districts, and schools are sticking with SMT reform. In terms of educating a diverse population in SMT, educators are devising strategies that they think fit the needs of their students and their available resources. Many of these strategies are based on educational equity research that has been summarized in print and electronic toolkits. These toolkits have been developed by federal and state education offices and centers as well as other educational organizations and offices.

The following lessons learned from the SERA study may offer some guidance for other educators who are trying to figure out how to infuse equity into systemic reform initiatives.

- **Take the time to ensure that new assessments are aligned with content standards and are sensitive and appropriate for diverse student populations.**

Many state departments of education and school districts are in the process of developing or identifying assessments that align with their content standards. Given concerns about using only fair, non-biased tests, districts need to take the time to ensure that new assessments and the administration of these assessments are appropriate for diverse student populations. Particularly with performance-based assessment, test developers need to be concerned about:

- the use of stereotypes,
- language that may be offensive to a particular group,

- language and literacy development of LEP students,
- accommodations for special education students.

As outlined in a paper written by Kopriva and Lara (see page 105), it is not clear if scorers of performance-based activities are assessing subtleties in English language acquisition or knowledge of mathematics and science content. States that should be particularly careful about their assessments of LEP students are, in general, those that have the largest percentage of students who are English language learners. These states include California (15%), Texas (11.3%), New Mexico (10.5%), Arizona (8.9%), New York (8.2%), New Jersey (6.0%), Hawaii (5.7%), Rhode Island (5.6%), Florida (5.6%), and Massachusetts (5.4%), (*The Condition of Education, 1996*).

According to the Center for Applied Linguistics, *The Benchmark Study*, December 1996, the 154 schools that receive Title VII Bilingual funds represent 19 different states. The top 10 language groups in these schools are Spanish (119), Vietnamese (32), Cantonese (21), Tagalog (18), Cambodian (13), Haitian-Creole (11), Mandarin (9), Samoan (8), Russian (8), and Korean (7). Of the 20 schools that serve Native American students, Lakota (in 5 schools) is the top language and culture.

As reported by Sandra Fox, Chief, Monitoring and Evaluation for the Bureau of Indian Affairs (BIA), Office of Indian Education Programs (OIEP) in a paper in this report (see page 82), the BIA has adopted national standards and has developed a corresponding set of Indian content standards that infuse Indian cultural content into the standards. For assessment purposes, a BIA school will utilize the new assessment system of the state in which it is located or an

adaptation of the California Learning Record, which is endorsed by the National Center for Fair and Open Testing (FairTest).

One of the tribal schools profiled in this report, Tiopsa Zina Tribal School in South Dakota, is already aligning content standards, assessment, values, technology, and Dakota Nation culture. The mission statement for Tiospa Zina follows: *“Learners will retain their own unique culture and be prepared for a technological/multicultural society.”*

- **Integrate strategies related to teaching a diverse student population into teacher professional development for SMT subject matter content.**

As teachers gain content knowledge and skills, they need to develop teaching strategies and behaviors that are effective with diverse learners. They also need to understand the background and cultures of the students they teach. Through the use of toolkits, checklists, and workshops, states and districts are recommending teaching strategies and behaviors for working with a diverse student population, particularly LEP, special education, and American Indian students. Tables 4 and 5 provide some specific instructional ideas for helping LEP and special education students to succeed in science and mathematics.

As pointed out by Susan Bailey in the *Research Report* (1997), it is important to recognize that gender equity is not just for “girls only” and, is not a threat to boys. It is important for boys to learn about the contribution of women in SMT and to recognize that women can succeed in science and mathematics.

- **Link teacher professional development to the school’s improvement plan.**

While many teachers self-select professional development opportunities, school districts in Palm Beach and Pinellas County, Florida, and in Covert and Buena Vista, Michigan, are linking their teachers’ professional development to their schools’ improvement plans. Leaders in the City of Saginaw School District in Michigan have recognized that many of its teachers may not be choosing professional development activities that help them grow professionally.

As indicated by Cynthia G. Brown, Director, Resource Center on Educational Equity for CCSSO, in a paper in this report (see page 79):

“Despite growing knowledge about what kinds of professional development lead to improved student achievement, too many school boards, superintendents and school principals fail to evaluate the effectiveness of their expenditures in this area, reallocate funds, and/or seek adequate funds to support high-quality professional development. There are vast sums spent on professional development with little relation to improved student results. The best example is the increase in teachers’ pay for taking courses unrelated to classroom practice and their school’s curriculum, instructional strategy, and improvement needs.”

The TIMSS researchers also suggest that we can raise science and mathematics achievement by having tougher standards; aligning standards, curricula, instruction, textbooks, assessments, and school policies; strengthening teachers’ subject matter content and teaching skills; and aligning states’ teacher policies with instructional goals that are embedded in standards (*The National Education Goals Report, 1997*).

- **Monitor tracking of students to ensure that they are getting the full benefits of the SMT reform, particularly tracking of LEP students, special education students, and students in alternative programs for prospective drop-outs or teen parents.**

While schools are exploring ways of reducing tracking, a significant number still use pull-out programs, particularly for LEP students, severely disabled special education students, teen parents, and prospective drop-outs. Some districts in this study appear to be trying to provide special services with a mix of remedial and more challenging mathematics and science classes.

- In Michigan, special education and general education students in the Buena Vista School District will share some classes together. The Covert Public School District has set a policy that no student is to be in special education class more than 50% of the time.

- In Florida, the Palm Beach County School District has classes composed of only LEP students.

These students are taught by certified mathematics and science teachers who are trained in the use of effective instructional strategies for LEP students. This district has also designed mathematics and science classes for special education students and provides these students with diplomas that indicate their participation in these more challenging courses.

- In Florida, the Pinellas County School District identifies prospective drop-out students in grades 4 to 7 and places them in discovery or challenge schools.

In *Beyond the Technicalities of School Reform: Policy Lessons for Detracking Schools* (1996), Jeanie Oakes and others studied 10 racially and socio-economically mixed secondary schools involved in a detracking process. This study identified organizational and pedagogical changes for detracking schools, including:

- Eliminating the bottom track and reducing the number of tracks in the academic program.
- Balancing class enrollment with high- and low-achieving students.

TABLE 4 TEACHING STRATEGIES AND BEHAVIORS FOR WORKING WITH LIMITED ENGLISH PROFICIENT STUDENTS

Teaching Behaviors	Teaching Strategies	Other LEP Information
Draw connections between content and real life.	Demonstrate, dramatize, and use body language.	Students cannot wait to speak English fluently before being deemed ready for science instruction.
Speak slowly and clearly in a normal tone of voice.	Use visuals (photos, illustrations, maps, and charts).	Determine if students understand the science but not the language or the language but not the science by answering the following questions:
Repeat key phrases.	Use graphic organizers (trees, webs, Venn diagrams, etc).	Do they know the word in their language?
Stress the main words in a sentence.	Use cooperative learning.	Do they know the word in their second language?
Ask students yes/no questions to determine if they understand the concept.	Use peer tutoring.	Do they know the science concept in either language?
Check frequently for comprehension.	Use multiple assessment strategies.	Learning a new language is not only a linguistic phenomenon, but a psychological one as well... silent period, taking in the environment, not speaking until later.
Break information into reasonable chunks.		
Limit new vocabulary per lesson or unit.		
Allow a variety of student response modes (oral, visual, and translations by other students).		
Ask factual questions first, then higher order thinking questions.		

Source: National Center for Science Teaching and Learning, 1995.

- Enrolling students in summer classes that allowed them to switch to more challenging mathematics and science classes during the school year.
- Concurrently enrolling students in both standards-based classes and back-up classes.

This study also looked at the cultural and political dimensions of the detracking process. These dimensions included social justice as a motivation for detracking, rethinking what it means to be “smart,” confronting racial stereotypes within and outside the school, and dealing with parents who believe their children deserve more resources because they are gifted and talented.

- **Strengthen the SMT education components of preschool and early childhood education programs.**

State departments of education and school districts are beginning to restructure preschool and early childhood education programs and align them with their standards. For example, the Florida Department of Education and the Florida Department of Children and Families introduced the *Florida Sunrise Standards for Publicly Funded Early Education and Care Programs*. These standards serve as a guide and framework for public child-care agencies. The four specific performance measures that programs should achieve

TABLE 5 TEACHING STRATEGIES AND BEHAVIORS FOR WORKING WITH LEARNING DISABLED STUDENTS

Visual Impairments	Hearing Impairments	Physical Impairments	Behavior Disturbances
Encourage the student to use other senses. (Touch objects, smell and taste when safe, and listen for sound.)	Use visual aids, especially when explaining safety procedures.	Touch-sensitive students are often wary of handling new or highly sensory materials. Describe the texture. Offer gradual exposure by encouraging the student to touch the object quickly or gently, working up to prolonged exposure.	Students with aggressive behavior find it difficult to work in small groups and therefore need plenty of materials to choose from and plenty of space to work in.
Draw the students attentions to shapes, weights, sizes, temperature, and textures.	Talk at a normal speed and volume at a distance that is best for the student to hear.	Help the child find a position that allows for the greatest movement, such as on the floor or on a cushion, sitting in a wheelchair, or secured to a chair.	Children who act withdrawn need to observe activity before trying it on their own. Look for comfortable ways for them to interact with others, such as filling containers with water for a group experiment.
Describe colors or patterns he or she cannot understand.	Talk with the student and ask questions to check for understanding.	As needed, rearrange materials or equipment.	Students who are hyperactive do best with short activities so they can feel a sense of closure before trying something new.
Be sure area is well lit. White butcher paper on tables and solid colored materials and containers are easier to see.	Be careful of using the terms “sound” and “pitch” with hearing impaired students. For deaf students this is a concept which is memorized, not experienced.	Take into consideration mobility impairment when asking students to draw something.	Watch for signs of restlessness and take steps before the child loses control.

Source: Adapted from *Learning through Play: A Practical Guide for Teaching Young Children*, Scholastic, Inc., 1991.

include school readiness; coordinated staff development; improved access for families to services and resources to achieve self-sufficiency; and a simplified point of entry. Subject matter content standards are located in the *Florida Sunshine Standards* in the preK-2 sections. Child-care agencies using the *Sunrise Standards* include teen parent programs, pre-kindergarten early intervention programs, subsidized child-care, Title I, First Start, and Even Start.

- **Expand parent programs to focus on helping parents understand standards, multiple assessments, and indicators of reform.**

For the most part, school districts in this study are offering family mathematics and science nights and providing information for parents online or in hard copy. It appears that little attention is being given to educating parents about SMT content standards, instruction, and multiple assessment strategies. However, some districts are attempting to adopt new strategies with parents and guardians.

- In Florida, Pinellas County is implementing a mathematics and science education support program for parents of minorities and female students. The program offers educational research presentations; opportunities to meet scientists; and on-site, hands-on and take-home activities.

- In South Dakota, Tiospa Zina parents and guardians participate in field trips and competitions such as *Odyssey of the Mind* and the *Science Olympiad*. Family nights provide opportunities for adults and students to work on computers, make traditional outfits, or practice reading.

- In Michigan, Saginaw parents have three opportunities to participate in a program called *Parents Lending Us Support (PLUS)*, which assists parents in developing skills to work with their children at home as well as in the school classroom.

The U.S. Department of Education publication, *Reaching All Families: Creating Family Friendly Schools* (1996), suggests ways that schools can support parents of disabled children, including:

- establishing parent resource centers to help parents and teachers develop productive relationships, such as conducting workshops to help parents understand cooperative planning;

- providing parents with information about support groups and special services in the school and community, such as pairing families who will complement each other when they participate in school activities; and
- involving parents in hobby classes or as role models in classes.

- **Include informal SMT activities in before- and after-school programs for school-age children.**

In the 1996 *Science Linkages in the Community (SLIC)* annual report, Shirley Malcom pointed out that, in general, SMT systemic education reform activities are tied to the regular school day. Support for curriculum standards and assessment and teacher professional development has overwhelmed any modest resources directed toward parent and community engagement or after-school educational activities.

Research summarized in *Years of Promise (1997)*, a Carnegie Corporation of New York Report, indicates that a home atmosphere conducive to learning, preschool and school-age child care programs offered by both schools and community groups, and the media, all have a profound impact on children's learning. In response to this and other reports, the U.S. Department of Education established the 21st Century Community Learning Centers Program. The program enables rural and inner-city public schools to stay open before and after school hours and provide extended learning activities in safe and constructive environments, under adult supervision.

In his 1998 State of the Union speech, President Bill Clinton indicated that only about 1.7 million K-8th grade students enrolled in 49,500 formal before- and after-school programs. He further indicated that 70% of all public elementary and combined schools do not offer such programs. These before-and after-school programs can benefit from informal SMT activities developed by youth-serving organizations and their affiliates.

Organizations with existing programs include the Association for Science Technology Centers (ASTC); Boys and Girls Clubs of America; Girls Inc.; Girl Scouts; the National Urban League; the Easter Seal Society; Recording for the Blind; ASPIRA; and the Center for Children and Technology at the Educational

Development Center (*Science Linkages in the Community, Profiles in Intervention, 1997*).

- **Involve high school students in the SMT reform.**

In Michigan, the Pontiac School District uses student advocates at the secondary level to counsel at-risk students and provide academic and social support. The Covert School District matches LEP students with student interpreters. One caution: make sure that the student interpreters know the science and mathematics content before matching them with LEP students.

At the post-secondary level, research shows that underprepared SMT students benefit socially and academically from well-designed peer group mentoring in which mutually supported learning take place. Examples of such programs include the Emerging Scholars Program (also known as the Treisman model) which began as the Professional Development Program at the University of California, Berkeley (Conference Board of the Mathematical Sciences, 1990) and Problem-Based Learning (PBL) which started over 20 years ago in medical education (Schmidt, 1993). AAAS, as well as others, have used both high school and college students as leaders of SMT workshops in out-of-school settings. Given that many high schools and colleges are instituting community service policies, it may be an opportune time to involve high school students in the preK-12 SMT reform in a more strategic way.

- **Link the school-to-work experience or career exploration to the standards-based curricula.**

While most school districts are providing some type of school-to-work and career exploration programs, these experiences need to be linked to standards-based curriculum. Some school districts are already doing so.

- In Florida, the Palm Beach County School District has incorporated applied mathematics and principles of technology into the high school curriculum. Many school districts in Florida are also helping students to succeed in Tech Prep and school-to-work programs. Students take a planned sequence of study that begins in high school and continues into at least two years of post-secondary education.

- In Michigan, the City of Saginaw School District has linked careers and course work in the curriculum of its elementary schools.

- In South Dakota, the Douglas School District aligned career clusters with its mathematics programs. The Meade School District has developed an award-winning school-to-work program, including an activity book that helps students link class work and careers. Tiospa Zina Tribal School sponsors an annual Native American Career Day. Tiospa Zina Tribal School also operates programs with the community college that allow qualified juniors and seniors in high school to take courses at Sisseton Wahpeton Community College.

In addition, telecommunications and CD-ROM technology are providing online, interactive career opportunities. For example, AAAS has developed *Science's Next Wave*, an electronic network for the next generation of scientists. *Next Wave* includes open forums for discussion of key science career topics; a series of features on alternative science careers; a semimonthly column of science career advice; and links to Science's Professional Network, an online jobs referral network.

The Alfred P. Sloan Foundation, one of the funders of the *Next Wave*, provided grants to other professional societies for online SMT advice to young scientists.

These professional societies include:

- The American Chemical Society
- The American Geological Institute
- The American Institute of Chemical Engineering
- The American Society of Civil Engineering
- The American Society of Mechanical Engineering
- The Institute of Electrical and Electronics Engineering
- The Minerals, Metals, and Materials Society

- **Involve the community in SMT education reform.**

Although most of the school districts in this study have community volunteer programs and classes for adults, they are not using these opportunities to educate the community about SMT education reform. Some districts in this study are moving beyond the traditional school volunteer and adult education classes.

- In Michigan, the Covert School District describes itself as a "community center that is a school district." Several community clubs and a coalition of senior citizens function jointly with the school.

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- In South Dakota, Tiospa Zina Tribal School uses public forums, with a committee of Elders and the school board, to solicit community ideas. The Meade School District has a number of committees that advise on school reform, substance abuse issues, and violence. The Douglas School District has School Community Improvement Councils.

- In Florida, Pinellas County Schools have established a mentoring program aimed at African American males.

In addition, the NSF and the U.S. Department of Education have joined forces to implement a large-scale public initiative to inform and engage the public in activities directed toward preparing middle school students for success in high school SMT courses. These courses are gateways to college, employment opportunities, and effective citizenship.

- **Use technology to enhance science and mathematics learning.**

In response to the nation's mission to ensure technology literacy for all students in the 21st century, state departments of education are revisiting their technology plans.

- The Florida Department of Education has developed a print and electronic guide, *Improving Schools With Technology: Reaching Florida's Goals for Education (1998)*. This guide, organized around the state's education goals, provides examples of how technology is being used to improve both student learning and management of the education reform. Examples include how technology complements the curricula, reinforces instruction, keeps electronic student portfolios, and links reform partners. One award-winning technology tool is *STEPS to English Language Development*, produced by Jostens Learning with funds from the Florida Department of Education.

- In terms of technology, the state of South Dakota is providing planning and implementation grants to support long-range plans for utilization, configuration, and acquisition of technology and telecommunications resources; improvement in curriculum that is aligned with the state standards; and professional development and capacity building. The state's Governor funded a university-based

technology academy for teachers that includes a 20-day intensive summer session and follow-up activities. Teachers are provided with opportunities to investigate, experiment, collaborate, and engage in authentic tasks, which helps them develop curriculum products they can use in their own classroom.

- The Michigan State Superintendent's Educational Technology Advisory Group (ETAG) developed a technology plan approved by the Michigan Board of Education in January 1998. Many of the 21 recommendations in this plan hinge on the creation of statewide policies that address access to technology-delivered learning resources for all students. To illustrate how the use of technology is transforming education, ETAG developed the Use of Technology in Transforming Education Table (see Table 6).

- **Learn how to converge resources to maximize the funds available for reform.**

The *Improving America's School Act* permits states to consolidate federal funds to meet their educational goals and effectively meet the needs of the intended beneficiaries that a particular fund is designed to serve. The U.S. Department of Education, *Cross-Cutting Guidance* (1996) booklet indicates that the following programs can be consolidated:

- Title I, Part A (Improving Basic Programs Operated by LEAs).
- Title I, Part B (Even Start)
- Title I, Part C (Migrant Education)
- Title I, Part D (Neglected, Delinquent or At-Risk Youth)
- Title II (Dwight D. Eisenhower Professional Development)
- Title IV (Safe and Drug-Free Schools and Communities)
- Title VI (Innovative Education Program Strategies)
- Subtitle B of Title VII (McKinney Homeless Assistance Act)
- Title XI (Coordinated Services)

In addition to the Dwight D. Eisenhower Professional Development program, other federal programs can support professional development, including:

- Title I, Helping Disadvantaged Students Meet High Standards (LEA Grants; Even Start; Migrant Education; Neglected and Delinquent)

- Title III, (Technology for Education)
- Title IV, (Safe and Drug-Free Schools and Communities)
- Title VI, (Innovative Education Program Strategies)
- Title VII, (Bilingual Education; Capacity and Demonstration Grants; Research, Evaluation, and Dissemination; Training for All Teachers Programs; Foreign Language Assistance Program)
- Title IX, (Indian Education Formula Grants to LEAs; Special Programs for Indian Children; Native Hawaiian Curriculum Development, Teacher Training, and Recruitment Program)
- Title X, (Funds for the Improvement of Education; Gifted and Talented; Arts in Education; Civic Education; Charter Schools)
- Title XI, (Coordinated Services)
- Title XIII, (Comprehensive Regional Assistance Centers; Eisenhower Regional Consortia).

To facilitate the convergence of funds at the district and school level: the Michigan State Department of Education issued a memorandum to superintendents and school administrators that outlined what federal and state funds can be used for potential interagency collaborations and the restrictions placed on those funds. The South Dakota State Department of Education and Cultural Affairs is conducting a series of workshops on consolidating funds.

- **Develop an accountability system that includes indicators for student progress and school improvement.**

The Florida Department of Education is one of 13 states that have an accountability system that includes public reporting, rewards, and sanctions. Using 16 indicators aligned to state education goals (see Table 7), Florida reports both school and student performance to parents and the community (see Table 8 in the Florida Profiles section). In addition, Florida provides a School Advisory Council Report by gender and race/ethnicity. Assistance is provided for schools that perform below expected achievement levels.

Michigan has public reporting and sanctions. South Dakota only conducts public reporting. Also, the OIEP has established goals and benchmarks for BIA schools and prepares annual reports for Congress (please refer to Table 31 in the South Dakota Profiles section).

- **Encourage and provide funds for careful experimentation with appropriate evaluation at the school level.**

Johnson, Lein, and Ragland, in a paper contained in this report (see page 109), discuss the concept of careful experimentation at the school level. As teachers try out new strategies in their schools and classrooms, they need to have an internal and external plan for collecting, analyzing and sharing the results of curricula and instructional experimentation. These small-scale

TABLE 6 THE USE OF TECHNOLOGY IN TRANSFORMING EDUCATION

Traditional Approach to Education:	Technology Allows:
<ul style="list-style-type: none"> • Teacher-Centered Learning • Mass Instruction (One Size Fits All) • One Pace Applies to All Students • Learning in Classrooms and School Buildings • Learning During School Hours • Facts and Recitation • Individual Student Performance • Textbooks • Parent-Teacher Meeting Each Semester 	<ul style="list-style-type: none"> • Student-Centered Learning • Mass Customization With Instruction to Fit Individual Student Needs • Flexible Pacing Based on Students' Abilities • Distributed Learning Possible From Any Location • Learning at Any Time • Critical Thinking in Realworld Contexts • Collaboration With Dialogue Among Students and Teachers • Up-to-Date Primary Information Sources • Parent-Teacher Communication Available Daily

Source: Michigan State Superintendent's Educational Technology Advisory Group.

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research efforts should be a part of the accountability system and when appropriate should be included in reports to the school improvement council and the general public.

III. Conclusions

If the SMT educational reform is to reach its full potential, systemic reformers need to be more deliberate and strategic about:

- Infusing equity into systemic reform. To assist leaders of systemic initiatives in pursuing the goal of equity and excellence in SMT education, the NSF, with the assistance of Westat*McKenzie and a team of educational equity educators and researchers, is developing an implementation schema for infusing equity into systemic reform.
- Identifying and planning for the political and cultural difficulties, tensions, and changes associated with SMT reform. From our experience with this reform, we know that changes will occur in leadership, and tensions will mount within and outside our offices, schools, and classes. These inevitable transitions will be smoother if we plan for them.
- Helping teachers and administrators who are resistant to the SMT reform, particularly those schools that have predominantly minority and poor students. One of the myths that is stalling the reform at many schoolhouse doors is the belief that poor and minority children cannot succeed in challenging mathematics and science classes. Teachers and administrators need to understand that with the proper instructional strategies, poor and minority students can meet high standards.
Another myth about the SMT reform is that this is another initiative that will come and go like all the others. Resistant teachers and administrators need to understand that this reform is built on past research and reform efforts. They can benefit both professionally and personally from all the education reforms that will occur throughout the course of their careers.
- Linking formal SMT education with informal SMT activities that take place after school, in the home,

and in the community. Many opportunities are being missed to strengthen SMT learning that takes place in the classroom, including the use of technology, youth-serving organizations, and community service and volunteer programs.

- Developing an accountability system that not only includes sanctions and rewards, but one that also includes funds for thoughtful research and evaluation at both the district and school levels. Current accountability systems use a series of indicators to report both student and school performance. As indicated in the Florida Department of Education's description of "Vital Signs for School Improvement" these accountability reports gauge progress toward attainment of state education goals, provide information to school improvement councils for planning and evaluation, link low achieving schools for technical assistance, and identify successful schools.

Many of these state accountability systems already include funds for technical assistance to low achieving schools; and, some include funds for monetary incentives for successful schools. Funds should also be included for careful research and evaluation at the school level to identify characteristics of successful programs and practices. It is important to specify funds for research and evaluation because oftentimes if such funds are attached to implementation grants, educators focus more on the intervention than on research and evaluation.