Views from the Field

SECTION II

Using Federal Education Programs to Advance Fairness in Science, Mathematics, and Technology Education

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Most of the major federal education programs have been reauthorized in the past five years, and a wonderful thing has happened to those that have been. They now have a coherence unparalleled in their history.

The anchor is Goals 2000. Goals 2000 has set forth a state planning structure for standards-based reform to achieve improved student performance. It has clearly articulated a national policy belief that virtually all students can learn to high levels if they are taught to high levels. All of the titles of the Improving America's School Act (IASA), but most especially the $7 billion-plus Title I, are fully aligned with the beliefs and processes of Goals 2000. Also included under IASA are programs for migrant and homeless children, bilingual education, safe and drug-free schools, and the Eisenhower professional development program, among others. Another important program, the School-to-Work Opportunities Act, is also coordinated with Goals 2000.

Two other major federal education programs are now being considered by Congress for reauthorization or change—the Perkins Act, which helps fund vocational education programs, and the Individuals with Disabilities Education Act (IDEA), which supports special education efforts for disabled students. These programs will also be aligned with the vision, support and accountability provisions of Goals 2000.

The standards-based school improvement movement, which is going on in literally every state, is the most important equity breakthrough since the civil rights and federal aid legislation of the 1960s and early 1970s. Even some of that ground-breaking legislation of 20 or more years ago, particularly Title I and the Education of the Handicapped Act, was misguided in assuming that watered down, remedial, pull-out programs could lead to high-level learning and achievement for disadvantaged kids or the closing of the performance gap between minority and nonminority students. (Title IX and other gender equity legislation hold up better over time.) This equity breakthrough of the 1990s could be major, but only if we move beyond the rhetoric of a goal of success for all to the hard work of making it happen.

There are several important changes in the 1994 version of Title I:

- a new purpose of providing opportunities for children in high poverty schools to meet the challenging state content and student performance standards.
- a focus on high standards rather than on perpetuating a separate remedial track focused on low-level skills.
- elimination of the disincentive for success by allocating funds strictly on the basis of poverty and by mildly increasing targeting to higher poverty schools.
- decision-making moved much more to the school level, which offers much greater flexibility, especially with the expansion of schoolwide projects.
- removal of barriers to serving second-language learners and disabled children.
- a requirement for intensive and sustained professional development for teachers and other school staff – not just Title I funded personnel.
- a greater emphasis on parental support and involvement, including "parent-school compacts."
- a system of state and district support for schoolwide programs and for schools farthest from meeting state student performance standards.
- accountability of schools and districts for student achievement results, based on new state assessment systems and procedures for measuring improvement progress.

This new coherence in federal legislation and its emphasis on fairness and equity is the good news.

The bad news is that this vision is not penetrating deeply enough to the teaching and learning activities at the classroom level, particularly in high-poverty schools and those with large enrollments of minority students and second-language learners. Students in these schools are gaining only marginally in their math, literacy, and science skills.

Why is this and what should and could be done?

Before examining these issues, it is important to put one more piece of context on the table. Federal funds provide, at most, 7 percent of the cost of educating the nation's children. They alone can not finance the costs of providing equitable education. They can only serve as leverage and make available partial financial support. Even if the U.S. Department of Education enforced the provisions of the laws that they administer and implemented them wisely, it would still take strong state and local leadership and commitment to realize fair and equitable education in this country.

Another thing to keep in mind is that with the exception of vocational education and school-to-work money, most federal education funds are directed to the elementary school level.

Why are the components of standards-based reforms or the elements of the new, improved Title I not reaching the classroom? Or stated another way, why are most schools with high proportions of disadvantaged kids doing the "same ole thing?" There are several reasons:

- turf—Whole bureaucracies and job titles have grown up around federal categorical programs. Too often, the people in these programs resist more functional or team approaches to program delivery and teaching.
- one-shot—time-limited or too narrow—activities, such as a workshop on science standards or a new math textbook instead of a variety of well-integrated, systemic initiatives in and out of school that improve teaching and learning over time.
- no system of deep, sustained help for low performing schools despite the Title I requirements that states and districts establish them. Some states should be exempted from this criticism; Kentucky and Texas are well along in implementing such systems of suppor, and other states are also moving to establish them.
- delays in developing accountability systems and the new assessments that supply the basic information upon which action is based. Again, some states are exceptions: Kentucky, Texas, and Maryland.
- weak professional development. 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 relationship 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.
- expenditures on things that don't work instead of what does work as demonstrated by research. The best example of this failure is spending Title I dollars on undereducated instructional aides in classrooms rather than on certified teacher tutors.

What can be done, especially with regard to math, science, and technology?

- Use Title I to invest in building up school capacity. In other words, invest in curriculum materials, high-quality and mostly school-based professional development, and extended day learning opportunities in the school and community instead of reduced class size and undereducated instructional aides.
- More specifically, train teachers and parents about what standards are and why they are important.
- Provide timely and user-friendly data to the school and family about student achievement. The fast-growing use of school report cards along with the new national literacy and math tests proposed by President Clinton should help achieve this goal.
- Get systems of state support, assessment, and accountability up and running soon. They must

include assessments for second-language learners. It is crucial that states and districts focus their "helping" resources on those schools and districts most in need of improvement if we are ever to have fair and equitable education as measured by student results in this country.

We need students who leave American schools very literate, well versed in applying mathematical and scientific concepts, and technologically proficient. Federal funds can be used in a multitude of ways to help fund and leverage effective teaching and learning practices in our schools to reach these goals. There are very few programmatic constraints on how district and school officials use these funds. It's a people problem—one of bad choices and little accountability, not bad or inadequate federal legislation.

In summary, the American Educational Research Association (AERA) Research *Policy Notes* of February 1997 reported the comments of Richard Elmore, Harvard University, to the National Goals Panel regarding where we are today with standards-based reform and equity.

> Elmore called attention to the 'enormous gap between what we expect to do in standards-based reform and what we are prepared to do.' He noted that professional development appropriate to the new standards would require substantial investment in human resources and incentives. Elmore observed that a likely result of the standards movement would be an increased variability in the achievement of schools—inequities for schoolchildren—because schools have dramatically different capacities for taking advantage of standards. Secretary Riley asked, if this were the case, whether there was an alternative to standards-based reform. Elmore's reply: 'No, but we must assure reciprocal capacity to meet the demands of this approach.'

As NAEP data and such analyses as Elmore's make clear, we have a long way to go to provide a truly equal opportunity for high-quality education to all our nation's children. Federal funds can help, but they alone will never make it happen. It's a system's responsibility, from the classroom to the state education agency and beyond.

The Bureau of Indian Affairs School System and School Reform

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The Office of Indian Education Program (OIEP) is located within the Bureau of Indian Affairs (BIA) in the U. S. Department of Interior. OIEP provides technical assistance to and has oversight of 187 Bureau-funded elementary and secondary schools and two postsecondary colleges, provides support for 24 tribally controlled community colleges, and acts as an advocate for American Indian and Alaska Native children enrolled in public schools. The Bureau of Indian Affairs school system is one of two federal school systems in the United States, the other being the Department of Defense school system. The BIA school system was established as a result of various treaty provisions that promised educational services to Indian Tribes.

Today, the Bureau of Indian Affairs school system serves over 49,000 elementary and secondary Indian students. The population is growing by 1,600 per year, mainly as a result of an increase in the general Indian population. Approximately 11,000 of the students also reside in dormitory programs and attend school away from their homes. Of the 187 schools, 12 are dormitory programs only, where Indian students reside in the dormitories but attend public schools. Thus, there are actually 175 academic school programs funded by the Bureau of Indian Affairs. Many of these programs also have dormitories. These schools are located on 63 reservations in 23 states. Students are from 238 different Tribes, each with its own language and cultural background.

The schools are small, with 53 percent of them having 250 or fewer students and the smallest school having 50 students. Seventy-five percent (130) of the 175 schools are elementary schools only. Forty-five of the 130 elementary schools have grade ranges of K-only to K-6. Bureau-funded schools are LEAs for federal program purposes; all have Title I programs.

The Office of Indian Education Programs' Central Office provides policy, budget, planning, and administrative functions for the BIA school system and also provides direct supervision on a daily basis to 24 line offices, which oversee 82 school programs. The other 105 schools are operated by Tribes or local school boards through contract or grant mechanisms. All schools are empowered through the Bureau's policy of local control which is based upon the federal government's policy of Indian self-determination.

The OIEP Central Office operates as a State Education Agency, and the Bureau is recognized as the 51st state for the U.S. Department of Education program. Ten Central Office staff members have been reorganized into two school reform teams to fulfill the requirements of Goals 2000 and the Improving America's School Act (IASA) in the Bureau school system. Twenty-four line officers across the country assist school reform as part of their technical assistance and oversight duties.

Goals 2000 and IASA are especially timely and important to Bureau-funded schools. These pieces of legislation will take Bureau-funded schools to a higher level of reform as they are natural extensions of the Bureau's Effective Schools school improvement program of 1988-95.

The Bureau of Indian Affairs welcomes the opportunity for school reform and especially for providing more challenging curricula and a more appropriate authentic assessment system. The Bureau will allow its schools to choose to: 1) follow the content standards of the state in which the school is located; 2) follow the national standards; or 3) create their own standards as long as they are as stringent as the state and national standards. The Bureau has adopted the national standards as its "state" standards for the purposes of Goals 2000 and Title I because the national standards are the most generic for covering schools in so many different states. The Bureau has developed corresponding sets of Indian content standards that infuse Indian cultural content into the national standards. These Indian standards can also be used with other state standards. They provide cultural, real-world relevance and can be made tribal-specific.

For assessment purposes, a Bureau-funded school will utilize the new assessment system of the state in which it is located or an adaptation of the California Learning Record. The Learning Record is used to summarize information about student learning and is designed to be used for students of different ethnic backgrounds. It is endorsed by Fair Test (National Center for Fair and Open Testing). This is an especially exciting part of school reform for the Bureau's schools. The well-documented, inherent cultural bias in norm-referenced tests and the on-demand nature of them has never been a fair evaluation of what Indian children can do.

Bureau-funded schools are presently aligning their curricula with new math and language arts standards; other standards will follow. They are receiving training in new assessment systems, including portfolio documentation, the Work Sampling system for early grades, and the California Learning Record.

All schools are involved in extensive staff development in order to improve teaching and learning. Many Bureau-funded schools are engaged in partnerships to enhance their staff development. Miccosukee Indian School in Florida is included in staff development programs provided by Dade County Public Schools. Tiospa Zina Tribal School in South Dakota is involved with the University of South Dakota and public schools in a staff development model that has received national recognition. Turtle Mountain Schools in North Dakota are involved in a joint staff development initiative with the National Science Foundation's Rural Systemic Reform project. Ten Bureau-funded schools in a consortium led by Gila Crossing School in Arizona are involved in ongoing staff development provided by the University of Arizona.

The Bureau is encouraging its schools to use resources available through the Bureau, Goals 2000, and IASA to purchase hardware and software to enhance the use of technology, especially for instruction, and to provide staff development in this area. The Office of Indian Education Programs is actively seeking resources for connectivity and has succeeded in being selected as a participant in Vice President Gore's Access America initiative. A consortium of 18 Bureau-funded schools is the recipient of one of the Department of Education's Challenge Grants. This project is called the "Four Directions Project" and focuses on culturally relevant curriculum development and the use of technology for math and science instruction.

All Bureau-funded schools are involved in school reform and have developed school reform plans with community input. The Bureau recognizes that schools and the entire school system must have parents, communities, and tribes as true partners in the education process. Through Goals 2000 grassroots reform, parents, communities, and tribes are having greater input and will continue to have input into reform plans. The Bureau is stressing that schools must become more accountable to their local communities and tribes and strive to meet locally determined goals.

The Bureau school system will continue to encourage a greater role for parents in the instructional process. It will encourage the participation of parents in staff development activities and in activities that teach them how to assist their children in school. The Bureau's Family and Child Education (FACE) program is a national model that has blended the National Center for Family Literacy's PACE program, the Missouri Parents as Teachers (PAT) program, and the High Scope Educational Foundation's early childhood instructional program. The FACE program includes an extensive parent component, which includes parenting training and literacy instruction, as well as having parent-child time when parents work with their children to enrich their learning opportunities.

There are 22 FACE programs for children from birth to five years of age and their families in Bureau-funded schools. The Bureau will encourage other schools to utilize their resources to provide these types of activities and to partner with early childhood programs in their communities, such as Head Start.

The Bureau recognizes that children must have a safe and drug-free environment in order to have the greatest opportunity to learn. It further recognizes that educational institutions must partner with the community and other service organizations in this effort. The Office of Indian Education Programs will continue to encourage schools to provide networks and services for parents to assist them in meeting the needs of their families and addressing the needs of the whole child. All Bureau-funded schools have developed comprehensive plans to address substance abuse and violence within their school reform plans. The schools participate in the Youth Risk Behavior Survey conducted by the Center for Disease Control. As a result, they will be able to track their progress toward a safe and drug-free environment by using indicators of substance abuse and violence.

In the Bureau's reform effort, the Office of Indian Education Programs will work more closely with state departments of education, especially in states which have a significant number of Bureau-funded schools. The purposes for this collaboration will be to share successful practices from the Bureau's reform effort with public schools with Indian students. It will promote the sharing of resources, facilitate a system for tracking students who transfer between the two systems, and ensure that Bureau-funded schools and tribes are benefiting from state initiatives.

Bureau-funded schools have embraced the reform effort. Many changes in the use of time, staff, and resources have already occurred. Schools have broken down walls that were created by the various programs and are working to provide one total school program. Schools are more actively gathering and tracking data that will be used to determine the results of the Bureau's reform program.

A Closer Look at SMT Special Education Programs and Resources

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I. Introduction

Both the National Science Foundation and the U.S. Department of Education are concerned about increasing the participation of children with disabilities in regular preK-12 classes, particularly science and mathematics. According to the Office of Special Education Programs (OSEP), during the 1996-97 school year about 5.8 million children with disabilities were in the public school system. From *Women and Minorities and Persons with Disabilities: 1996*, we get some idea about the participation of children with disabilities in science and mathematics classes for the 1992-93 school year. Of the 4.6 million children ages 6-21 with disabilities, over 50% had specific learning disabilities and over 20% had speech or language impairments (see Table 32). Students with speech and language impairments were more likely to be in regular classes (see Tables 33 and 34).

As indicated in Table 34:

- While a little over 50% of grades 1-4 science and mathematics classes reported having children with learning disabilities, only 31% of grades 9-12 science classes and 24% of the mathematics classes reported having students with disabilities.
- In grades 1-12, students with physical disabilities were in 4% to 6% of science classes and 2% to 6% of the mathematics classes.
- In grades 1-12, students with mental disabilities were in 2% to 9% of the science classes and 1% to 5% of the mathematics classes.

Table 32 Students age 6-21 in federally Supported Programs for Students with Disabilities

Disability	Number	Percent
All Disabilities	4,633,674	100.0
Specific Learning Disabilities	2,369,385	51.1
Speech or Language Impairments	1,000,154	21.6
Mental Retardation	533,715	11.5
Serious Emotional Disturbance	402,668	8.7
Multiple Disabilities	103,215	2.2
Hearing Impairments	60,896	1.3
Orthopedic Impairments	52,291	1.1
Other Health Impairments	66,054	1.4
Visual Impairments	23,811	0.5
Autism	15,527	0.3
Deaf-Blindness	1,425	0.0
Traumatic Brain injury	3,903	0.1

Notes: Because of rounding, percentages may not add up to 100. Includes students served under Chapter 1 of ESEA (SOP) and IDEA, Part B.

Source: U.S. Department of Education, Office of Special Education and Rehabilitative Services. 1994 Sixteenth Annual Report to Congress on the Implementation of the Individuals with Disabilities Act. From *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1996,* page 132

Table 33 Students age 6-21 with Disabilities Receiving Special Education Services

Disability	Percent Distribution Regular Class	Resource Room	Separate Class	Separate School	Residential Facility	Homebound/ Hospital
All Disabilities	34.9	36.3	23.5	3.9	0.9	0.5
Specific Learning Disabilities	24.7	54.2	20.0	0.9	0.1	0.1
Speech or Language Impairments	85.5	9.1	3.9	1.4	0.1	0.1
Mental Retardation	5.1	25.4	59.2	8.8	1.2	0.3
Serious Emotional Disturbance	15.8	27.8	36.9	13.9	4.0	1.5
Multiple Disabilities	6.2	18.1	47.1	22.6	3.8	2.2
Hearing Impairments	27.0	20.5	31.2	9.6	11.5	0.1
Orthopedic Impairments	32.4	21.0	34.3	7.3	0.9	4.1
Other Health Impairments	35.3	27.6	21.4	3.3	0.5	11.8
Visual Impairments	39.6	21.2	19.6	8.5	10.6	0.4
Autism	4.7	6.9	48.5	35.9	3.1	0.9
Deaf-Blindness	5.8	6.2	36.3	21.2	28.6	1.8
Traumatic Brain injury	7.8	9.0	23.7	53.4	3.7	2.4

Notes: This table reflects a compilation of data reported by the states. There are some reporting variations (e.g., estimates or incomplete data and nonstandard definitions) from state to state. Data exclude U.S. territories. Because of rounding, percentages may not add up to 100.

Source: U.S. Department of Education, Office of Special Education and Rehabilitative Services. 1994 Sixteenth Annual Report to Congress on the Implementation of the Individuals with Disabilities Act. From *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1996,* page 133.

Table 34 Science and mathematics Classes with One or More Students with Disabilities by Type of Disability and grade range: 1993

Subject and Type of Disability	Percent Distribution Grades 1-4	Grades 5-8	Grades 9-12
Science			
Learning Disabled	53	54	31
Mental Disability	9	7	2
Physical Disability	4	6	5
Mathematics			
Learning Disabled	52	40	24
Mental Disability	5	2	1
Physical Disability	6	4	2

Notes: Standard errors are included in source publication.

Source: Modified from National Science Foundation/EHR. 1993 National Survey of Science and Mathematics Education. From *Women, Minorities, and Persons with Disabilities in Science and Engineering: 1996,* page 134.

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

In addition, fewer 9th -12th grade science and mathematics classes reported having one or more students with disabilities (see Table 34). The *OSEP 1996 Annual Report* indicates that efforts to place secondary students in regular classes have been generally less successful because of the departmentalized structure, the academic demand, and competitive culture at the secondary level. Also, many of the students with a speech or language impairment (a group that makes up a substantial proportion of disabled students in regular classes at the elementary school level) do not require special education services at the secondary level.

II. Barriers and Some Solutions to SMT Study and Careers

The Equal Access to Software and Information (EASI) project, a joint venture of the Rochester Institute of Technology and the American Association for Higher Education (AAAE), has identified both social and technical barriers that keep students with disabilities from studying or working in SMT areas.

As noted on the "EASI Street To Science, Engineering and Mathematics" (http://www.rit.edu/~easi/easisem/semintro.html):

> Historically, people with disabilities have faced social and technical barriers that have deterred them from studying or working in the fields of science, engineering and mathematics. While the barriers can be daunting, researchers are developing new tools and methodologies that are allowing people with disabilities to study and work in these fields. In particular, the National Science Foundation is funding several projects that focus on these issues.
>
> There are three basic barriers that people with disabilities must confront.
>
> First, individuals with disabilities have faced negative social attitudes from educators and from potential employers. Second, disabled individuals who are trying to study and work in the science, engineering and mathematics fields, encounter difficulty with physical barriers in laboratories and with standard lab equipment. Third, many disabled individuals have problems accessing and manipulating information that is specific to science, engineering and math – such as charts, diagrams and scientific notation.

Social Barriers

Disabled individuals have faced negative attitudes – both in education and in the workplace – about their abilities to study and work in the fields of science, engineering and math. Professors ask "how can I have a disabled student in my class without lowering my standards," and employers ask "how can a person who can't see tables and charts work with statistical material."

There are answers to both of those questions, and this overview will explain some of the technology and other compensatory strategies that are available to people with disabilities. In the process of introducing the technology, we hope to ease some of those attitudinal barriers.

Physical Barriers

The physical barriers that people with disabilities encounter in the fields of science, engineering and math are more easily identified than the attitudinal barriers. Individuals with disabilities face difficulties maneuvering in the traditional lab and classroom setting. Generally, these are structural barriers that include lab tables that are too high for a person in a wheelchair, instruments that are difficult or impossible for a person with a mobility or vision impairment to manipulate, and lectures and multimedia presentations that are inaccessible to people with hearing or visual impairments.

Science, Engineering and Math Barriers

Individuals with disabilities have difficulty accessing mathematical and scientific notation, graphs, charts, drawings and three-dimensional models that are prevalent in the science, engineering and mathematics fields.

Specific Problems by Disability Category

The specific problems and barriers that individuals with disabilities face are easier to understand and address if they're discussed by disability category.

Mobility Impairments

People with mobility impairments encounter difficulty using standard laboratory equipment, handling books and writing tools, and using computer equipment that has not been appropriately adapted.

Hearing Impairments

People with hearing impairments have problems getting information from traditional lectures, laboratory instruction, quiz sections, and other real-time oral communication. They also have difficulty accessing videos, movies and other multimedia. They may also have difficulty understanding mathematical and scientific abstractions because of language limitation.

Specific Learning Disabilities that Involve Visual Processing Disorders

Some people have learning disabilities that negatively influence visual processing disorders. Such people would have problems understanding many materials that are presented in visual format, such as traditional text materials, videos and movies, graphs and charts. For people with visual processing disorders, there are barriers to understanding visual materials presented in lectures, labs, quiz sections and other real-time events, and problems completing homework assignments and exams.

Low Vision

People with low vision have trouble reading traditional computer screens and computer print-outs. They also have problems reading printed materials. People with visual impairments have problems getting information from slides and overhead projections, videos and movies, and chalkboards. Lab access barriers include encountering safety hazards while maneuvering throughout laboratories that aren't properly laid out or that don't have appropriate labels on equipment, substances and hazards.

Blindness

People who are blind have problems with computer access, getting information from slides, overhead projections, videos, movies, board drawings and other real-time events. Significant problems are encountered with structured texts, tables, equations, charts, graphs, block diagrams and other graphic displays of quantitative information. There are also problems with writing and manipulating mathematical notations while taking lecture notes, and safety and usage barriers encountered in laboratories.

Some Simple Solutions

Many individuals with disabilities use adaptive computing technology in their classes and in the workplace. This technology can be particularly helpful in science, engineering and mathematics study and employment. There are many simple, inexpensive solutions already available that can help individuals get past barriers that keep them out of the science, engineering and mathematics fields.

- Information generated by biology laboratory instruments can be converted into ASCII files and then read by a voice synthesizer or converted into Braille.
- Individuals with mobility disabilities can use word-predictive software to reduce the number of keys to type long physics-related words correctly.
- Individuals with visual impairments or learning disabilities can use special computer screens that expand the size of the type so that mathematical equations or scientific formulae can be read more easily.
- Mathematical information on computer monitors can be expanded or reversed to white letters on black background or other color combinations for individuals with low vision or learning disabilities that affect visual processing.
- Individuals studying or working in engineering and mathematics can use control codes in literal Braille to produce Nemeth Code.
- Graphical information can be converted into a raised line format and then captioned in Braille to provide charts and graphics for people with visual impairments.

- Special lighting can be used to allow individuals with hearing impairments to see the speaker during a slide show or computer presentation.
- Videos can be close-captioned for individuals with hearing impairments.
- Special computer input devices can be used by people with mobility impairments. ■

111. Resouces for Science Technology and Disabilities

Most of the resources for science, technology, disabilities are funded by the NSF Program for Persons with Disabilities. This program is committed to bringing about change in both the academic and political climates and to this end supports projects designed to:

- provide improved learning environments for all students through new methods of teaching science and mathematics,
- change the attitudes of science and mathematics faculty regarding the needs and capabilities of students with disabilities,
- promote the accessibility and appropriateness of instructional materials, media and educational technologies,
- increase the availability of student enrichment opportunities and mentoring resources for students with disabilities through direct contact and via the Internet, and
- provide specialized equipment and assistance allowing students, scientists, engineers, and mathematicians with disabilities to participate fully in NSF-supported research activities.

As noted on the NSF homepage, some of the programs funded by the NSF Program for Persons with Disabilities, arranged by state, include the following:

Scientific Visualization Using Tactile Feedback For Visually Impaired Students

Scientific visualization provides scientists with tools to model and visually observe three dimensional data. This technique has advanced scientific understanding in numerous scientific fields such as biology, chemistry and engineering. The traditional method of visualization is to model the data into one of the many surface modeling schemes and display the data on a computer screen. This approach has obvious limitations for people that are visually impaired. This project will test a novel way to provide analogous information to these individuals whether they are students, scientists or researchers. Data are modeled in the normal manner, but instead of displaying the model on a computer screen, a three-dimensional wax-based model will be created. The data, after being geometrically modeled, will be converted into a physical model using a Layered Manufacturing (Rapid Prototyping) machine. The tactile model will maintain the appropriate ratios so as not to distort the proportions of the data. A Scanning Probe Microscope (SPM) has been chosen as the test-bed to provide 3D data. A SPM is used to probe objects on a nano scale and its output is inherently three dimensional. The only way to currently observe experiments and data performed on SPM is a visual display on a screen. With the proposed technique, a visually impaired student will be able to feel the surface representation of the 3D data on the physical model as seen on a SPM.

The use of 3D physical models for tactile feedback is being developed in three Arizona State University classes: a junior level course in Chemical Engineering, a sophomore level course in Physical Science for in-service and preservice teachers, and a junior level interdisciplinary science course. Activities will be created to demonstrate the viability, importance and success of this project. Workshops are organized to bring educators, scientists, special education teachers and students to both evaluate and provide input to this project. The project has broad implications for science education for all students because they will be able to touch, feel and observe tangible three dimensional data models.

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Information Dissemination Projects Using Adaptive Computer Technology in Science, Mathematics, and Engineering

Children who do not get a solid foundation in science and mathematics during their K-12 years will not be properly prepared to study science, mathematics, engineering or technology (SMET) successfully in college. Too often students with disabilities fall into this group of being under-prepared for SMET study in higher education. This project is designed to help educators prepare K-12 students with disabilities for further study and work in the SMET fields. The project includes a component that focuses on transitions from high school to post-secondary institutions so reference is frequently made to K-16 students as well as K-12 students.

The mission of EASI (Equal Access to Software and Information) is to develop, organize, and disseminate information and to provide guidance about using adaptive computing and electronic information resources to help students and faculty with disabilities participate fully in academic life. EASI has acquired an almost ten-year reputation for compiling and distributing the latest information about adaptive technology for people with disabilities.

Since January of 1995, EASI has been working on an NSF project that compiled and disseminated the best available information about adaptive computer technology use in the SMET fields in post-secondary education. EASI is now extending this previous work, with a strong focus on K-12 and the transition between secondary and post-secondary education. Additional consultants with greater expertise in K-12 adaptive computing and SMET teaching strategies are helping to build a new foundation of information and create new dissemination materials and services. Outcomes will include conference presentations, print materials, online workshops, etc. focusing on:

1. Adaptive computer technology appropriate for use with effective teaching strategies for students with disabilities in SMET courses in K-12;
2. Teaching strategies that help students learn both the adaptive technology and the academic disciplines;
3. Motivating K-12 students with disabilities for success in SMET;
4. Providing information on strategies and tools that will help students with disabilities meet the emerging national standards for K-12 mathematics and science; and
5. Promoting better transition from high school to post-secondary education for students with disabilities.

The materials that AAHE/EASI develops for this project are designed primarily for the use of K-12 Individualized Education Plan coordinators, SMET faculty, K-16 administrators, and special education coordinators (and for those schools of education who work directly with current and potential K-12 teachers).

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Engaging, Recruiting, Retaining Students with Disabilities in Science, Engineering and Mathematics

This Experimental Project addresses the inclusion of individuals with disabilities in SEM education. The goal of the project is to engage, recruit, and retain students with disabilities in SEM educational programs so that their current under-representation will be reversed. The project is demonstrating a model comprised of specific activities that will eliminate the attitudinal, physical, and curriculum barriers that combine to keep individuals with disabilities from pursuing SEM studies and careers.

Six project tasks have been designed to attack the barriers to full inclusion.

1. Regional outreach programs: families, counselors, and faculty are being involved in awareness training, solutions seminars, and abilities

demonstrations. In addition, individuals and their schools will receive technical assistance in overcoming their barriers.

2. Extra-curricular SEM programs: existing SEM programs are being updated to allow participation by all students. Students with disabilities will be enrolled in the updated programs and camps.
3. Electronic mentoring: a mentoring program based on electronic communication is being established. Students, faculty, and professional with disabilities and SEM interests are exchanging ideas and accessing SEM resources through the Internet.
4. Virtual laboratory: a virtual SEM laboratory is being designed and tested. This computer based laboratory will minimize the physical requirements and allow all students access to laboratory equipment through the integration of instrumentation and the use of simulation software with powerful workstations. This laboratory will be used to offer laboratory experiences to a wide range of students. It will not be a special laboratory restricted to individuals with disabilities.
5. Development of accessible inquiry based SEM educational experiences: an inquiry based approach to SEM problem solving that is accessible to all students is being developed. The problem solving approach to pre-college level SEM education will be packaged and widely disseminated.
6. Conduct of information dissemination: the approach taken throughout this project is to maximize the use of existing programs that can be modified and made accessible. The design of new laboratories and curricula will be disseminated to a number of organizations interested in improving SEM education for the population in general.

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Developing Accessible Science Experiments

The project develops resource materials to assist science teachers to provide students with disabilities the ability to participate in the conduct of science laboratory experiments. Staff from Georgia Tech's Center for Rehabilitation Technology worked with the institution's Chemistry and Physics Departments to set up twelve computer controlled lab experiments that are representative of first year chemistry and physics lab exercises. Staff are testing the combination of computer access and computer controlled laboratory technology and developing a resource guide that will permit teachers to learn to operate these technologies independently. The resource guide will provide teachers the information they need for modifying existing labs and for operating computer controlled systems. It will also cover use of computers equipped with software needed by blind, visually impaired and mobility impaired students. The project's activities and resulting resource guide should be valuable as well to the many schools that do not have modern science laboratories. Many teachers are developing simulations of laboratory experiments to use as supplements to, or substitutions for, chemistry and physics laboratory experiments. Although simulations are not a replacement for fully accessible laboratories, they may be a good alternative in the absence of well-equipped laboratories, and they should be appropriate for some students with severe disabilities who would not otherwise be able to participate in laboratory experiments. Project staff will identify and document existing laboratory simulations and low tech tools and techniques for making laboratory experiments accessible. Staff will test a sample of twenty simulation programs with computer access software to be sure that the simulations are fully usable by students with disabilities. The resource guide will contain a comprehensive list of these simulations and other low tech tools and techniques used as laboratory accommodations.

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The Curriculum Development in Teaching Science to Students with Disabilities Project

The Curriculum Development in Teaching Science to Students with Disabilities (CDTSSD) project is a two-year effort designed to provide training to teachers and teacher educators to improve their skills and knowledge in teaching science to students with disabilities. The project trains professionals who provide services to students with disabilities about effective resources and teaching/assessment strategies. Participants are exposed to effective instructional practice through model hands-on, multi-modality science lessons, which include the use of adaptive materials and suggestions for accommodating students with disabilities. The disability areas addressed will include motor/orthopedic impairments, deaf and hard of hearing, visual impairments, learning disabilities, cognitive impairments, and behavioral disabilities.

The project uses a "training the trainers" approach. It begins with the development of training materials: an in-service training module consisting of a publication entitled *Guidelines for Teaching Students With Disabilities*, print materials and video tapes related to providing services to students with disabilities in the regular science classroom, and hands-on science investigations that allow trainers to demonstrate five proven methods of delivering science instruction with accommodations to students with disabilities. These materials are tested and disseminated through two routes:

1. Training of science educators and content specialists in higher education. The mode of delivery is pre-conference programs presented at NSTA and AETS (1997-1998), Annual Meetings. Participants in the sessions are required to prepare an action plan and deliver a program for faculty and staff at their institution of employment.
2. Training of science teacher/special education teacher teams in a geographical region where access to specialists is limited. Collaboration of science teachers and special educators as active teams strengthen the base of expertise and services to students with disabilities in science education. Participants in these sessions are required to prepare an action plan and will deliver a program for teachers at their teaching location.

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Promoting and Retaining in Mathematics, Engineering and Science

This project is designed to address the underrepresentation of persons with disabilities in science, engineering and mathematics (SEM) careers and those actively pursuing degrees in these fields. PURSUIT has two main goals: increasing the enrollment and retention of students with disabilities in SEM at the high school and college levels, and increasing the understanding of the factors which contribute to this inequity.

The first goal is addressed through three activities.

1. Workshops are conducted for high school mathematics and science teachers and guidance counselors, high school students with disabilities and their families, and state vocational rehabilitation counselors. The workshops discuss methods to overcome handicapping conditions in an academic pursuit of SEM. The students with disabilities participating in the workshops are targeted for recruitment by SEM college departments. Internet and e-mail access is provided for the high schools via the University of Illinois in order to facilitate support among students in different high schools, and mentoring is taking place by college students with disabilities who are enrolled in SEM and people in SEM careers.
2. The SEM faculty at the University of Illinois are involved in educational workshops on how to teach for students with disabilities. Mini-grants to college professors and high schools are offered to improve the quality of the SEM education for students with disabilities. One professor in each SEM department is functioning as a mentor for the students with disabilities in the department.
3. A region-wide awareness program is being implemented. A poster illustrating persons with disabilities successfully engaging in SEM fields at

the high school, college and post-graduation levels is sent to high school mathematics and science departments and guidance counselor offices in Illinois and to children's and science museums in a five state region.

The second goal is addressed by collecting and analyzing data from interviews and surveys of PURSUIT participants. The surveys ask participants to express their experiences with and attitudes about people in SEM careers with disabilities. The most important issues are integrated into future workshops and disseminated nationally via various media and the World Wide WEB server.

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An Audiotactile General Chemistry Course For the Visually Impaired

The objective of this project is to create standard reference materials for a freshman-level chemistry course that will be accessible to blind and visually impaired students. The "reference packet" will consist of braille, tactile diagrams, audiotactile diagrams, and a tactile model kit. Standard procedures for producing tactile and audiotactile diagrams are being created, refined, and disseminated to educators of visually impaired students. The project uses the latest advances in adaptive technology for blind and visually impaired people. Several different tactile media are used, including high-grade vacuum-molded plastics, the flexible tactile imaging paper produced by Repro-Tronics, and various textured media as part of the model kit. Hardware such as the NOMAD™ touch tablet and the Edmark Touch Window™ are used to display the information contained in audiotactile graphics. The software consists of AudioCAD®, AudioPiCS®, AutoCAD®, and some custom software developed as part of the project.

The project should provide significant assistance to blind students in several areas. First, blind students at many institutions will have access to standard reference materials that can be used as a supplement to almost any General Chemistry course. Second, standards for tactile and audiotactile diagrams will be developed. Third, a document detailing the process by which these diagrams can be made will be developed and disseminated.

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Girls With Disabilities Get SMART

Girls Incorporated, a national youth-serving organization, is undertaking a three year project to modify its highly successful Operation SMART (Science, Math and Relevant Technology) program, designed to address the underrepresentation of girls and women in science and mathematics, so that it is accessible to girls and young women with diverse disabilities. Recognizing that girls with disabilities face a double set of barriers based on disability and gender to mathematics and science experiences, courses and careers, the overall project goals are to provide access for girls with disabilities to needed skills, attitudes, and opportunities so that they will choose and can persist in science and mathematics courses in school, and pursue mathematics and science careers and interests in adult life.

The project objectives are to develop basic principles for incorporating the needs and experiences of girls with diverse disabilities into science and mathematics curricula; revise the materials and manuals of Operation SMART so they are inclusive of girls with disabilities; and assist other science and mathematics programs and curricula to become inclusive of girls with disabilities.

Through field testing in several sites throughout the country, and consultation with experts in the field, the project is developing a science curriculum on a specific set of topics from the ground up to understand the basic principles of inclusion as it relates to science, and the contributions of the experience of disability to scientific exploration and learning. These principles will then be used to alter existing SMART curricula and materials.

Finally, the project will generalize from the process of revising SMART to develop guidelines for modifying other science and mathematics curricula so they can be used in mainstreamed settings.

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Teaching of Mathematics for Students with Attention Deficit Disorder

The purpose of this project is to develop a mathematical environment for students with Attention Deficit Disorder (ADD). These students tend to be easily distracted and tend to disrupt the typical classroom, thus they tend to be several years behind their appropriate grade level. For this reason, few ADD students enter careers in mathematics and science. The project is including the following two components.

1. Adaptation and/or design of innovative instructional and motivational mathematics activities specifically for students in grades K-12 with ADD. Particular emphasis will be placed on the use of technology, writing, cooperative learning, experimentation, and manipulatives in mathematics education. The National Council of Teachers of Mathematics standards will be applied throughout.
2. Teachers will be trained in the use of these techniques and materials will be made readily available for classroom use.

By meeting these objectives, the project will benefit students with ADD by accelerating the development of their mathematical capabilities and putting them on a level with their peers. The improvement also should change their attitudes toward the study of mathematics so that it ceases to be a chore and becomes more of an interest. Implementation of this project is intended to result in methodology for teaching mathematics to children with ADD so that students with this problem will have better educational outcomes.

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Enabling Students to Undertake the Challenge of Careers in Engineering and Science in School (Enabling SUCCESS)

The Biomedical Engineering Department of Louisiana Tech University, through its Center for Rehabilitation Science and Biomedical Engineering, is conducting a three-year project directed at increasing the awareness of career opportunities in science, engineering, and mathematics for middle school students with disabilities. The overall goal of this project is to work with middle school students, their parents, and their science teachers to increase the number of students with disabilities that pursue science, engineering, and mathematics career fields. The specific goals of the project are to:

1. stimulate student interest in science, engineering, and mathematics;
2. heighten the awareness among middle school students, their families, and their science teachers of the opportunities for persons with disabilities in these fields; and
3. provide them with an understanding of the importance of career exploration and taking appropriate college preparatory courses in high school.

Students often begin to make career preparation decisions in the middle school grades as they prepare to enter high school where college preparatory electives require decisions in earlier grades. This is especially true in science and math where a sequence of courses must be followed from the earliest possible grade level. Students with disabilities and their parents need to be prepared for these decisions and to realize that these choices will influence subsequent educational and career development activities. For students with disabilities, neglecting fundamental skills may exclude them from the opportunity to enroll or succeed in SEM curricula when they enter college.

Primary components of the proposed project are:

1. Assistive Technology and Careers in SEM Workshops,
2. Adapted Classroom and Student Science Kits,
3. Teacher Awareness Seminars,
4. Study and Career Guidance Mentoring Program,
5. Super Summer of Science Showcases.

A unique feature of this project is its focus on middle school students with disabilities, their parents, and their teachers. For the purposes of this project, middle school grades include grades six through nine. Through the mentoring and counseling program, the project addresses the educational transition from late elementary school through high school. The project provides training for middle-school teachers in methods of including students with disabilities in all aspects of classroom and laboratory learning experiences. Activities designed to stimulate students with disabilities to explore science projects and courses are undertaken and evaluated. Information regarding available assistive technologies that make SEM activities accessible to students with disabilities are provided to science teachers, students, and parents.

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CD-ROM Access Project

CD-ROMs are the most widely used form of multimedia in schools and their use is expected to grow especially in the area of science education. People with print-disabilities (visual impairments or learning disabilities) currently are unable to use most hardware and software (including CD-ROMS) that base their information displays on a "graphical user interface" (GUI). This project is initiating a research project leading to CD-ROM-based science instructional materials that are useable by people with print-disabilities. To reach this goal, it is necessary to establish standards for multimedia accessibility. The project will develop design guidelines for multimedia accessibility concentrating on science, engineering, and mathematics instructional materials published on CD-ROM multimedia-based instructional materials. Specifically, the project will:

1. Research CD-ROM accessibility by conducting a CD-ROM Accessibility Survey Explore access solutions to technology barriers through the creation of adapted iterations,
2. Demonstrate accessibility with a model accessible SEM CD-ROM Develop Design Guidelines that recommend standards for multimedia accessibility.
3. Distribute project results through a dissemination of findings.

It is expected that this project will significantly impact blind, visually impaired, and learning disabled students by allowing them to approach academic equality of opportunity with their sighted peers in SEM education leading to increased representation in SEM careers.

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The Understanding Science Through Captioning Project

The language of science is difficult to learn for many children, but much more difficult for children who cannot hear. This project is designed to bring new technology into the classroom that can help deaf children to succeed in science by making both the language and the methods of science more accessible and engaging to them. Project objectives are:

1. To develop and implement strategies using video captioning technology to enhance student achievement in science at three schools for the deaf in New England.
2. To replicate the initial implementation in a school educating both deaf and hearing students.

3. To disseminate the findings of the research as well as the enhanced curriculum and strategies for its effective implementation.

The project is integrating three building blocks: A successful science curriculum that is already sold nationally, a pedagogical collaboration with teachers of deaf students that has already extended over three years, and a new enabling technology that has been developed and evaluated specifically for children who are deaf. The project is bringing these three components together creating a science curriculum that offers new opportunities to actively engage deaf children in doing and understanding science by reducing the pervasive barriers of time, motivation, and instructional methods that presently impede their progress. The curriculum will be elaborated and evaluated in classroom tests, modified as necessary, and then replicated and disseminated. The research design includes approximately 50 upper-school students in four schools for the deaf. Acknowledging the impossibility of adequate matching of control and experimental subjects, a full reversal (ABABAB) design will allow evaluation of whether the intervention condition is associated with enhanced learning. Both quantitative and qualitative methods will be used to maximize the generalizability of the results and to capture valuable information obtainable only from individuals. The four different pedagogical approaches of the participating schools in the study ensures broad applicability to educational settings for children who are deaf. The science curricula and methods developed in this study will have an immediate impact in the four schools within the study and on all schools that already use this science curriculum. Beyond these schools and this specific curriculum, however, the tools and methods developed in this project should have wide general applicability.

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Biotechnology Works!

Biotechnology Works! recognizes the National Science Foundation's priority to facilitate the participation of persons with disabilities in mathematics and science. During two summers and two school years (1996-1998), this project will demonstrate that an existing curriculum for high school students in biotechnology can be adapted for students with disabilities. In addition, the project will demonstrate that high school teachers, who work along side their students, are able to modify their instruction and laboratories. Specifically, the project staff will:

1. Offer intensive sessions in biotechnology, and mathematics that are related to biotechnology, for students in grades 10-12;
2. Train the students' high school biology teachers to adapt high school science course work in immunology and genetics for students with disabilities; and
3. Disseminate project information and products. The project goal is to demonstrate that students with disabilities can participate successfully in existing high school level biotechnology educational activities that have been modified and adapted to meet their needs.

Ten teachers and ten students with disabilities are participating in the project which is offered in three locations: the University of Southern Maine, Foundation for Blood Research, and the Maine Medical Center. This gives the students and their teachers the opportunity to work in real laboratories with scientists.

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Enhancement of Mathematics and Science for First Through Sixth Grade Native American Students with Disabilities

The University of North Dakota is implementing a three-year experimental program designed to increase science and mathematics studies for Native American students with disabilities who are in grades 1 through 6. The program includes participation of staff from the College for Human Resources Development, the Center for Teaching and Learning, the School of Engineering and Mines, the College of Arts and Sciences, the Graduate School, and Native American Programs. The project is designed to increase the awareness of parents, school personnel, college faculty, and students about the educational and career options in mathematics and science open to Native American students with disabilities. Efforts are being made to enhance the curriculum, teaching strategies, hands-on and culturally-appropriate experiences, and counseling options for these students. Computers, the necessary adaptive equipment, and training in their use is made available to the students. The project increases the team building among school personnel, college faculty, parents, and professionals in mathematics, science and engineering. This interaction should result in permanent changes to the infrastructure of the school system and the curriculum and opportunities open to the students. The project includes a summer institute for school personnel, parents, faculty, and mentor/role models; and two additional institutes involving these persons and 30 first through sixth grade disabled Native American students from schools on or near reservations. A hands-on, culturally appropriate project is being designed and implemented in each participating school.

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Engineering for Persons with Disabilities: RASEM—A Regional Alliance on Science, Engineering, and Mathematics for Students with Disabilities

Regional Alliance for Science, Engineering, and Mathematics (RASEM) is a Regional Center that provides leadership, coordination, assistance, evaluation, and dissemination to state departments of education, 2- and 4-year colleges, secondary schools, national research laboratories, and public and private sponsors in their efforts to encourage students with disabilities to pursue mathematics, science, and engineering careers. Participating states are New Mexico, Oklahoma, and West Texas. Broad in its scope, this multi-year program supports strategies to remove the obstacles that could handicap students with disabilities who choose science, engineering, and mathematics (SEM) careers. In addition, cooperation with the Alliance for Minority Participation, the Comprehensive Regional Center for Minorities, and other similar efforts forges a pattern that shepherds the student participants through critical educational transition.

Strategies geared at students at the secondary level produce positive reinforcement through conceptual videos, student stipends, adaptive technologies, computer networking, SEM summer camps, and supercomputer experiences. Cooperative efforts with pre-college educators and administrators identify student candidates for entry into the 2-and 4-year colleges and develop creative solutions to educational barriers confronting these students. Workshops are designed to dispel stereotypes and promote teacher involvement in support of students with disabilities. Close coordination among educators reduces mathematics and science anxiety and eases the students' movement from one level to the next.

Post-secondary strategies include financial incentives, removing impediments to effective learning, and establishing a collaboration with partners. RASEM partners, in cost share with the Regional Center, conduct summer programs, provide adaptive technologies, and foster activities aimed at retention and recruitment of students with disabilities. The collaborations between the partners result in articulation agreements, competitive mentorships, and research opportunities. RASEM intends to produce a cooperative educational process with support systems that assure steady growth in the number of persons with disabilities who select SEM career paths and to serve as a model for other centers in the country.

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Digitial Audio with Integrated E-Test Reading System

Recording for the Blind and Dyslexic (RFB&D) is conducting a three-year project with funding from the National Science Foundation to develop a unique technology to integrate computerized text files with digital human voice recording. This technology will make mathematics, science, and other educational materials accessible to print-disabled people.

The most widely used technology available to print-disabled people today for accessing information includes large print, braille, analog recordings and computerized text files. Although analog recordings offer the sound quality of a human voice, searching for information is a difficult and time-consuming process. Conversely, a book on computer disk has advanced search and retrieval capabilities but sound quality is restricted by the nature of synthetic speech. The combination of the recorded voice and a computerized text file will make mathematics and science materials more accessible due to the random access capabilities of both disciplines that digital audio offers in a more dynamic and robust format.

For the purposes of this project, RFB&D is employing several methods to achieve its previously stated objectives. They are first and foremost working to develop a software that will integrate the computer text file with a digitally recorded human voice. They will then create a non-graphically based user interface to help make mathematics, science and other technological materials accessible to print-disabled people via the computer. Digital audio books will offer the best features of both audio and E-Text formats—the recorded human voice and the ability to search and retrieve information as needed. This newly created reading system, which will run on a standard multi-media computer equipped with a sound card and CD-ROM, will revolutionize how print-disabled people read and obtain information. Most important, digital audio books will, for the first time ever, allow print-disabled people to access mathematics, science and other technological materials through natural human speech using a personal computer.

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Multisensory Calculus Program for Students with Visual Impairments

A key barrier to participation in science, engineering, and mathematics curricula for blind and visually impaired students commonly has been access to usable instructional materials in higher science and mathematics courses. The Department of Computers Science of The of College Staten Island and the Computer Center for the Visually Impaired of Baruch College, both within the City University of New York (CUNY), are working to provide an environment that will offer blind and visually impaired students equal accesses to basic education for science, engineering, and mathematics (SEM) by developing and testing instructional materials usable by these students.

This project focuses on first year college calculus, and will use the most effective current audio and tactile technology to provide access to graphical displays. The courseware being developed will be usable as well by students without visual impairments; and although the project is developing materials for college education in SEM, the methodology will be equally appropriate for primary and secondary grades.

For the basic course content, the investigators are using a successful self paced mastery course in calculus developed for SEM students under a Carnegie Foundation grant at Carnegie Mellon University. The essential prerequisite materials that would otherwise be inaccessible to blind and visually impaired students will be supplemented by specially developed auditory and tactile materials. Scanners with optical recognition software and Braille printers (or speech access systems for those who do not read Braille) can be used to read conventional printed or displayed text, and enlarged display screens are available for those with lesser degrees of visual impairment. The investigators are using audio tactile tablets that can be prepared and programmed to present the needed graphics. Tactile graphics developed by the Baruch Computer Center for the Visually Impaired, combined with new technology, the NOMAD audio tactile tablet, will permit students to trace the graphics and to hear the essential information for each point spoken audibly.

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Science Enrichment Projects: Playtime is Science for Children with Disabilities

This project is building on and expanding Playtime is Science, EEC's early childhood, hands-on, parent/child science activity program, providing a major focus on the needs and capabilities of children with disabilities. Playtime is Science has been piloted in schools and community-based settings at four national sites with funding from the NSF, the Toyota USA Foundation, and the Dewitt Wallace-Readers Digest Fund. During this pilot, Playtime is Science was found to be effective for children with disabilities. The sample, however, was small and further development is needed to adapt the program successfully in a variety of settings, and to test the activities with children with a wider range of disabilities.

The goals of Playtime is Science for Children with Disabilities are:

1. To increase the ability of teachers, staff and parents to motivate and empower children with disabilities in grades pe-K through the third grade to develop their science skills in a supportive environment;
2. To help children with disabilities build on their strengths and develop confidence and skill in science; and
3. To provide opportunities for parents of these students to become involved in their children's early science learning.

Specific objectives are:

1. To pilot test and adapt the activities in inclusive and special education settings;
2. To build science skills based on the problem-solving abilities already developed by many children with disabilities;
3. To conduct training in program facilitation for teacher, staff and parents;
4. To develop, field test, and publish a Facilitator's Guide;
5. To institutionalize the program in participating sites; (6) to disseminate project results and materials;
6. To conduct ongoing evaluation.

EEC works with teachers, staff, parents and children in three different types of setting in New York City:

1. Four early elementary public school classrooms inclusive of children with and without disabilities;
2. Three early childhood programs, including an inclusive Head Start center, a special education program serving children with a range of disabilities, and a child development center serving pre-school children with visual impairments; and
3. A large, inclusive after-school program.

By fostering positive science experiences, and by increasing parent and staff expertise in enthusiasm for and encouragement of science activities, this project enables children with disabilities to gain confidence and skills which will help them succeed in science. By acknowledging and building upon the individual strengths of children with disabilities, it will create an inclusive environment that says "science is for everyone".

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Access to English and Science Outreach Project (AESOP)

The Rochester Institute of Technology is conducting a three-year project demonstrating techniques to increase participation of deaf students in science education and career development. The primary premise of the project is that deaf students will progress more rapidly in science education when they have full access to the content and language of science and to information concerning the past accomplishments of deaf people in scientific professions. The primary goal of the project is to improve access to science for deaf students by fusing best teaching practices used with deaf students from both science and English language teaching. The project will consist of the design and delivery of regional workshops, the creation of a national network of science teachers, and the evaluation and investigation of change in teaching and learning science. The regional workshops will provide science teachers of deaf students in mainstream and residential schools with a set of instructional strategies and materials that integrate visual and interactive presentations of science principles with explicit and interactive uses of scientific English.

The specific goals are:

1. To develop and deliver a coherent set of instructional strategies that may be used to teach the content and language of science to deaf students;
2. To increase deaf students' access to information about the accomplishments of deaf women and men in scientific professions; and
3. To disseminate an effective intervention model for enhancing science learning by deaf students.

Regional workshops consisting of a two-day series of seven sessions will be designed and implemented. The attitude and communication barriers deaf science students and deaf scientists face will be described and the science teachers' roles in breaking down these barriers will be presented. Science teachers will learn to deal effectively with the language dimensions of science teaching when both deaf and hearing students are in the classroom. Finally, the training will focus on critical thinking skills and the importance of visual and hands-on experiences in the teaching of science principles. Participants of each regional workshop will be expected to identify target science principles (which appear difficult for deaf students to learn) and best practices (which appear successful with deaf students in science classrooms). The target principles will become the focus of prototype mini-lessons as participants begin applying the strategies learned in the regional workshop. Evaluation of the effectiveness of the mini-lessons (and strategies) will begin after each workshop. Information will be disseminated through publications, conference presentations, and a newsletter for the regional workshop participants and other interested science teachers.

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Using ASTER to Improve Math and Science Accessibility by Students with Learning Disabilities

Students with visual processing learning disabilities typically have difficulty understanding printed materials, and math and technical subjects often present the greatest difficulties. This project initiates the first phase in research designed to develop the most appropriate interface strategies needed to optimize ASTER and related audio-formatting programs for students with learning disabilities. ASTER is an innovative computer program developed initially to present math equations in an audio format for students with visual disabilities. It is important that students with learning disabilities participate in tests on ASTER navigation during the developmental phase of this software program. Commands which might be intuitive to a student who is blind might not be as easy for a sighted student with a learning disability. Student volunteers from the pre-algebra course and Adult Basic Education program at Linn Benton Community College Benton Center will be test subjects in specific experiments conducted to answer the following questions:

1. What are the most intuitive keystrokes to select sections to be read on the computer, to browse from section to section, paragraph to paragraph, etc.?
2. What kind of computer screen display do students find most helpful?
3. What additional educational features are useful?

This research project is conducted collaboratively with the Science Accessibility Program at Oregon State University which is improving ASTER as an aid to better accessibility to math and science written material for students with various disabilities. Results from this project will be used in future designs of ASTER.

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Science, Engineering, Education and Disabilities (SEED)

Information transfer is often a serious problem for students with disabilities in most academic disciplines, but it is particularly severe in science, engineering, mathematics (SEM) and other technical subjects. Students with visual impairments and learning disabilities are frequently overwhelmed by the difficulties of learning, using, and/or presenting equations, graphs, schematic and conceptual drawings, and other non-textual information encountered in SEM. The objectives of SEED are to develop inexpensive easy-to-use computer-based methods and devices to reduce or eliminate the problem with SEM information flow with the eventual result that significantly more students with disabilities can be recruited and retained in SEM education and careers.

The initial focus is development of the Audio System for Scientific Reading (ASTER) into a flexible tool for use by people with visual and learning disabilities to read, write, manipulate, and understand SEM literature. ASTER developments are considered to be critical for making SEM materials accessible to students who are visually impaired or who have learning disabilities. The ASTER program currently runs on a Unix workstation using a Dectalk voice synthesizer. ASTER's internal representation of a document is a hierarchical tree that allows the reader to easily change the style in which the document is read aloud and also allows very fine control over where the reading begins and ends. These two controls make audio reading of technical material much easier to comprehend for these students. ASTER will be rewritten in a common version of Lisp (such as CLisp) that run under DOS, OS/2, Linux, and some versions of Unix. Subsequently, ASTER will be rewritten in C++ to make it possible to port ASTER to other platforms.

SEED also will collaborate on the development and evaluation of tactile tablets on which raised images (comprised of Dotsplus and figures) can be used to display complex scientific equations with each term expandable in audio by ASTER. (Dotsplus uses raised print technology and permits embossing scientific equations, figures, and diagrams that can be read tactually and allows equation-printing methods that retain the intuitive and conceptual advantages of the standard spatial representation of mathematics equations. The system was developed by the P. I. with a prior NSF award.)

SEED is recruiting talented, motivated university students with disabilities to serve as SEED research assistants in projects. They are highly visible role models for other students with disabilities; and their successes should increase the confidence of teachers, counselors, parents, and potential employers in the ability of students with disabilities to succeed in SEM.

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Interactive Scientific Graph Analysis Project (ISGAP)

Many middle and high schools encourage students to use graphing scientific calculators to assist in mathematics and science courses. They are used widely in higher mathematics (Algebra I and above) and in the physical sciences. These calculators perform scientific functions and have built-in screens to display graphs of analyzed data. They are valuable tools both for students and teachers. Unfortunately, graphing scientific calculators are not accessible to visually impaired students. The Interactive Scientific Graph Analysis Project (ISGAP) investigates strategies for the design, development, and evaluation of technology that will provide better access for visually impaired students to graphs and scientific expressions. Investigations are conducted for the purpose of identifying and testing economical materials and procedures that will provide real time interactive independent comprehension of two dimensional graphs by visually impaired students. The project should increase the knowledge base regarding interactive graph analysis and interactive scientific calculation for visually impaired people. The project involves visually impaired students, teachers, and parents in all phases of the research project. Training is required so students and teachers understand how to operate this new technology. Online help assistance is designed into the system from the beginning. The project began with the development of customized software that will run on a PC. Off-the-shelf peripherals are used to keep final product costs low. Specific project objectives are: (1) Determine ISGAP requirements and design user interfaces, (2) Interface peripherals and design and develop software, (3) Design, develop, and test functions for interpreting graphs, and (4) Field test and evaluate product. This project should significantly impact the ability of visually impaired students to succeed in math and science courses. A successful conclusion to this project will lead to production of an economical hand-held device enabling visually impaired students to have increased equity with their peers.

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Project DO-IT

Project DO-IT (Disability, Opportunities, Internetworking, and Technology) recruits high school students with disabilities into SMT academic and career programs. The recruits are paired with mentors such as college students, faculty, and practicing engineers and scientists—most of whom have disabilities themselves—via electronic communications and joint projects which use the Internet in order to stimulate interest and achievement in SMT.

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Some other programs:

Also, as part of our SERA study, we identified several other programs—two science-based programs in Michigan and three general programs. All four focus on children with disabilities. Brief profiles follow.

Science Instruction at Work

The Old Village School in Northville, Michigan serves students with severe mental and/or multiple impairments. Many of the students have a wide range of visual, auditory, communication, and motor challenges in addition to their primary impairment. A great deal of thought and planning goes into adapting basic scientific concepts to successfully teach these students. Using a curriculum based on Life Sciences, Physical Sciences, Earth and Space Sciences, Using Scientific Knowledge, the Great Lakes, and Classroom Critters, Old Village provides meaningful opportunities for science discovery for their students. As an example, a classroom at Old Village has a business partnership with Maybury State Park's working farm. The students have experienced hands-on science at the farm in a variety of ways. Some examples follow:

- a unit on milk production called “Cow to Cup,” which culminated with students learning how to milk the cows and goats on the farm;
- a unit on planting gardens, harvesting corn, collecting eggs, and the birthing of farm animals;
- a unit on bees. Students observed a beehive; and used a coloring book (Daydant & Sons, Inc. the *Honeybee Coloring Book*), viewed a video (“The Honeybee Harvest”), used books such as Barrie Watts’ *Honeybee of the Stopwatch* Series and Eric Carle’s *Honeybee and the Robber*; and made trips to the local library to learn about bees. Students used models, discussion, and repetition in their study of bees and created “Bee Books” with drawings and written information that the students produces and gathered. The “Bee Books” contained information on bee history, anatomy, socialization, vocabulary and definitions, the process for gathering nectar and making honey, and beekeeping math (e.g. 55,000 miles is the distance a bee travels to make one pound of honey. How many round trips from New York to San Francisco does that equal?). After several weeks of study, the students returned to the farm for a lecture and hands-on demonstration of beekeeping and the honey-gathering process as well as a beehouse observation. They also had an opportunity to try on and examine the beekeeper’s gear and equipment. Students were able to ask informed, purposeful questions using their newly acquired “bee” vocabulary.

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For more information on science instruction in a center-based program, refer to David Bartlett’s article, “Science in the Special Education Classroom,” *Michigan Science Teachers Association Journal*, Fall 1995.

More Science Instruction at Work

At the Velma Matson Upper Elementary School in Newaygo, Michigan, fourth-grade special education and general education students worked together to explore the wonders of science. Using a team-teaching approach, the special education students were able to receive the benefits of varied peer modeling; the general education students were able to spend much more time with a teacher and see the information presented in different modalities. Learning was demonstrated via several facets such as tests—multiple choice and essay—and group research reports. Students recorded notes in a science notebook. Some of the hands-on activities in which students participated follow:

- Students built model shield, ash, and composite volcanoes from clay
- Students constructed a large ash volcano, which they erupted in the school yard
- Students studied igneous, metamorphic, and sedimentary rock
- Students went on a fossil dig, unearthing model dinosaurs’ bones. After removing the bones, the students assembled the dinosaurs, identified them, and brought them to life using clay.

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Access Science

Access Science, a hands-on, family-oriented education program run by the National Easter Seal Society and developed in collaboration with AAAS, enhances the traditional classroom experience of elementary and middle school disabled students through science sessions, career mentoring, and community outreach. Funded by NSF and launched in 1995 at the Easter Seal Societies of Virginia and the District of Columbia—with plans for four additional sites—Access Science provides an opportunity for disabled students and their families to gather monthly at Easter Seals to conduct experiments developed around science-related themes such as electricity, physics, or chemistry. Access Science uses curricula developed by AAAS and an advisory group of scientists with and without disabilities. In addition to hands-on workshops, students participate in field trips into the local science community. As noted in the Easter Seals Society Newsletter, disabled students are introduced to positive role models—disabled SMT professionals—and learn about the many opportunities that exist for them in the workforce.

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With respect to assisting teachers in their efforts to meet the educational needs of students with mild disabilities in content-area classes, instructional "tools" called Content Enhancement Routines have been developed by teachers and researchers at the University of Kansas Center for Research on Learning. The routines help teachers determine what content to teach, translate important content into easy-to-understand formats, and present content in memorable ways.

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Contact:
University of Kansas Center for Research on Learning
3061 Dole Human Development Center
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In terms of technology, the Living and Learning Resource Center has compiled a list of several current and new software products that facilitate the learning of mathematics by students. For more information, call the LLRC at 800-833-1996 or 517-224-0333.

Additional resources include the following:

The Science Association for Persons with Disabilities, 3322 West 2200 North, Ogden, UT 84404.

The Project on Disability, American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005.

The Council for Exceptional Children's *Teaching Exceptional Children*, Vol. 27, No. 4, Summer 1995.

The Journal of Science for Person's with Disabilities, John Stiles, Editor, College of the Atlantic, 105 Eden Street, Bar Harbor, ME 04609-1105.

The GOOD Newsletter, Dr. Judy Egleston-Dodd, Editor, NTID at RIT; 52 Lomb Memorial Drive, Rochester, NY 14623.

Scoring English Language Learners' Papers more Accurately

Rebecca Kopriva, Delaware Department of Public Instruction
Julia Lara, Council of Chief State School Officers

Policy discussions surrounding the education of English language learners (ELL) have always been fraught with controversy that is often irrelevant to the educational needs of these students. This controversy is focused on the language that schools should use to instruct second language learners. Advocates and educators of ELL students believe that while the student is learning English the home language should be used to learn content matter.[1] Others believe that while some support might be provided in the home language students should be quickly immersed in English language instruction. While the issue of the language of instruction may not be easily resolved in the near future, there seems to be an emerging consensus among educators, educational researchers, and policy makers on both sides of the debate regarding the importance of holding high expectations for all students, including those for whom English is a second language.

Applying the same standards to ELL learners presents a number of challenges to states and local districts, particularly in the area of assessment. In order to know whether all students are moving toward higher levels of academic achievement, schools need to assess the knowledge and skills that students possess in various content domains. Consequently, all students must participate in a state and districtwide assessment program.

Knowing what ELLs know in the content area has been problematic because these students are generally excluded from statewide assessment programs until the students have been instructed in English for two to three years. In a survey of state education agency officials (Lara & August, 1996) researchers found that 36 states were excluding ELLs from statewide assessments. A similar pattern is evident at the local district level. The result is that ELLs are outside of the states' accountability system during the first two to three years of second language development. Although these students are receiving instruction, no information is available at the state or local level on what students know and are able to do in the content areas (mathematics, science, social studies).

With the advent of standards-based educational reform at both the state and federal levels, there has been a shift in thinking regarding issues of inclusion of special needs students in state and national assessment programs. State systemic reform initiatives and federal education legislation have explicitly called for the development of challenging content standards and an assessment system that measure whether *all* students have attained the expected levels of performance. In particular, the new federal provisions of Improving America's Schools Act of 1994 (IASA) Title I prohibit states and school districts from excluding ELL students from state assessments. [2] Specifically, the statute notes that:

> …such assessments must provide for...the inclusion of limited English proficient students who shall be assessed, to the extent practicable, in the language and form most likely to yield accurate and reliable information on what such students know and can do to determine such mastery of skills in subjects other than English.

As a consequence, state officials are motivated to design (or develop) strategies for assessing content knowledge of ELL students. Because these students have been historically excluded from statewide assessment programs, there has been limited effort and resources devoted to the development of assessment measures that are appropriate

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1 The terms *English language learners* (ELL) and *limited English proficient* (LEP) students will be used interchangeably in this paper. Both refer to the same group of students.

2 In many states, decisions regarding the inclusion of ELL students are made at the district level.

for ELL students. Accommodating second language learners would enable the states to increase the numbers of students who take part in the assessment program. Since it would be inappropriate to administer the same test to ELLs that is administered to non-Ell students, the assessment instrument or process needs to modified to accommodate these students. Accommodations involve a range of strategies, including changes in the assessment instrument, the conditions under which the test is administered, or the scoring process. In a recent (1997) report published by the Council of Chief State School Officers (CCSSO), the authors reported that fewer accommodations and alternative assessments are provided to ELL students than is the case for students with disabilities. Specifically, state assessment directors were asked whether any testing accommodations were allowed at the state level for students for IEPs and for LEP students. Forty-three states allow some form of accommodation for students with IEP, while 30 states have accommodations for LEP students. Thus, there is a considerable amount of research and development work that needs to be conducted in the area of LEP student assessment.

The Council's Project

In an attempt to assist states in meeting their obligations under Title I and their own statewide school improvement efforts, the CCSSO has been working with a group of states to develop procedures and materials for a more appropriate assessment of ELLs. These states come together as members of the SCASS LEP Consortia to find solutions to the many problems surrounding ELL student assessment. Among the many projects of interest to the states was the notion of developing a training manual aimed at the readers (or scorers) of LEP student responses to open-ended mathematics and science performance tasks. The objective is to enhance the accuracy of the scoring by providing readers with training that will increase their understanding of the second language development process.

It is typical for performance-based, "on-demand" assessments to require written responses from students. When responding to these types of "constructed response" mathematics or science items, the second language learner is asked to demonstrate not only math skills, but reading and writing skills in a language that they have not yet fully acquired. This response poses a challenge to both the student and the individual who scores the tasks. For the student the challenge is to express ideas in a language that he/she does not yet fully understand. For the scorer the challenge is to accurately evaluate the student's knowledge of math despite the barriers of second language interference.

The CCSSO *LEP Assessment Training Indicator's Manual* was developed by a group of mathematics teachers from several states–Connecticut, Delaware, California, Texas, Florida– under the direction of state education agency assessment consultants. 'This development committee identified linguistic features in the mathematics responses of LEP students that can be confusing to evaluators. They included code switching, transposition of words, phonetic spelling based on a student's first language, etc.; cultural influences such as different symbols and systems used in other countries; and stylistic writing issues, including non-standard formats used more often in other cultures. The linguistic features included in the training manual were those that teachers saw most frequently in their students' papers. Therefore, not all linguistic features that might be found in the written responses of ELL students are reflected in the manual.

For example, below are students' responses to a mathmatics item. The example shows the students use of English phonetic spelling based on their best estimate of English langauge sounds:

> The boys can say to there (their) nabor (neighbor) that they did it there selvs (themselves) and the nabor (neighbor) can give gust (just) the to (two) boys.
>
> The two boys can split it up in to (into) thirty dolars (dollars) ech (each).

To determine whether the training of readers would make a difference in the accuracy of the scoring, a study was conducted in the fall and winter of 1996-97 in Iowa City, Iowa[3]. In this paper we describe the result of

3 Since the project was using National Assessment of Educational Progress (NAEP) science items which are scored in Iowa City, the study was conducted at the site where the scoring takes place. National Computer Service (NCS) is the company that coordinates the scoring of NAEP items for the National Center for Education Statistics (NCES).

this study. The purpose of the study was to evaluate the effectiveness of training readers of open-ended science items to be able to more accurately score responses from LEP students.

Study Questions

In order to evaluate the effectiveness of providing training about LEP responses to readers who are mostly monolingual, an experimental/control group research design of English-only speakers was used. This approach was supplemented by data from interviews and observations. The key questions asked in this study follow: 1) Did the training make a difference in the scores, and did the readers think it was useful in helping them evaluate the responses? 2) What information was gleaned that would be helpful in future item and rubric (scoring guide) construction as well as provide direction for opportunity-to-learn issues in science for LEP students? 3) If found to be useful, how might this type of training be best provided to future readers?

The Study Groups

Three groups of readers were identified for this study. Papers from the 1996 administration of the NAEP science test were initially scored in the summer of 1996 by NCS readers. The readers who scored the papers during the summer of 1996 became the NCS control group. The experimental group was composed of NCS readers from the Iowa City area. These 12 NCS readers had not scored the 1996 NAEP science test. The background characteristics of the NCS control group and the NCS experimental group were similar. While these two groups were not content area specialists, they had some background in science.

The second control group was made up of 10 bilingual educators, who for the most part, had backgrounds in science. These educators were selected by CCSSO staff and were from California, Wisconsin, Pennsylvania, Virginia, and Washington, DC. The function of this group was to serve as participant evaluators of the training process. Secondarily, the bilingual group provided feedback about LEP student responses, the items, and rubrics. The NCS experimental group and the bilingual group received training in Iowa City.

Training

The LEP training was integrated into the regular training all readers receive in preparation for scoring responses to the open-ended science NAEP items. Scoring takes place in a large-volume situation. Large-volume scoring occurs when tests with open-ended items are administered to large numbers of students, and large numbers of the responses are scored, by hand, at one time. It is not unusual for readers to evaluate items at the rate of one per minute for up to eight hours a day. In these situations, readers must be trained to make accurate judgments about diverse student work very quickly.

The training was conducted by the NCS staff and CCSSO consultants. NCS staff focuses its NAEP scorer training at the item level. That is, the training for scoring items is specific to each item. It involves a detailed discussion of the rubrics connected with each item and the extensive notes and examples associated with each score point. As part of the training, readers also train on practice sets of papers and subsequently discuss the scores they gave.

Additional LEP training was provided in three ways. First, approximately one hour of introductory material was presented. It identified and explained key linguistic features that affect the responses of LEP students and that have been found to be confusing and/or misleading to readers in high volume situations. Second, this general training was augmented by specific item responses from LEP students that illustrate the linguistic feature. Third, the bilingual readers sat at tables with the NCS readers and participated in discussions that occurred as all items were scored. Some of these discussions included clarification about student work associated with the key points raised in the LEP training.

Study Materials

In addition to the material used by NCS to train readers, this study used materials written previously or developed specifically for this project. The Training Indicators Supplement for mathematics and science was written to augment the regular training of assessment readers. The manual was expanded with numerous LEP student examples of each of the points raised in the training sessions. Some examples of student work were compiled from a wide variety of sources, and from students from many backgrounds. Others were examples of LEP responses from some items used in this study. Interview protocols were developed for this study that asked detailed questions of the trained NCS readers, the bilingual readers, and the NCS and LEP trainers.

Items and student work

The items scored during the three full days of scoring consisted of 12 NAEP open-ended items that were selected to be part of this study. Some 2089 student booklets containing these items were pulled, including booklets from all LEP students nationally surveyed on the 12 items (n = 929). In addition, 1160 non-LEP booklets were randomly selected. A total of 4100 item responses were evaluated over the 12 items (several booklets contained more than one item).

Procedures

In fall 1996, the designs for this study were finalized, items selected, papers pulled, and readers identified. LEP and non-LEP responses were mixed, by item, and LEP training and scoring took place in January 1997, in Iowa City. Participants were interviewed after the scoring, and tape recordings were transcribed and reviewed. Subsequently, the scores from the non-LEP-trained control group were compiled, along with the score results from the trained groups. Data were analyzed.

Results

Score Results

Approximately 20% of the responses were scored twice by different readers in each group to ensure consistency in scores. For both the trained NCS readers and the bilingual readers, reliability correlations were high (.92 and .85, respectively), as was the percentage of time that different readers gave papers the same scores (88% and 80%, respectively). Differences in group correlations and percentages were generally thought to be a function of experience. NCS readers had scored these types of assessment items for five years on average, whereas the bilingual readers were novices.

Differences in scores given to the papers by the three groups of readers were analyzed by comparing group means. The mean for the trained NCS group was 1.85, for the bilingual group it was 1.90, and for the control NCS group it was 1.77. Results from the ANOVA test suggest that the means were significantly different (F=20.26), with further analyses indicating significant differences between each group pair. Of importance is that the difference between the NCS trained, NCS untrained groups (t=10.37), and the NCS untrained, bilingual groups (t=10.19) is larger than the two groups (bilingual, NCS trained) who received the linguistic training (t=4.2). This seems to indicate a training effect.

Interviews

Training Participants and trainers from both groups felt that this type of training was important and should be formally incorporated into large-scale scorer training programs. They also agreed that it would be important to include the special training elements into all item-specific training, including integrating examples and key linguistic points into the notes, and LEP-type student responses into the practice sets. (This study integrated only verbal training and LEP examples into the item-specific training, and it did so in only 3 of the 12 items.) The readers and trainers said that this type of training reminded them to attend more carefully to diverse student responses.

The NCS readers and trainers said that they had learned most of what was presented

in the previous training–through informal means–through earlier scoring experiences where these types of issues were discussed with NCS staff and other readers during the actual scoring of student responses. However, they felt it would be important to have this type of training formally integrated into the regular training for novice readers. They also felt that they, or other experienced readers, would also benefit from this integration because it reminded them to attend to these issues on an item-by-item basis. Further, integrating the points and examples into the notes and practice sets would provide tangible as well as verbal references, which they felt would be helpful.

NCS participants also emphasized that this type of training is useful not only for scoring LEP papers but other non-standard responses. They cited examples from Black English and from students they suspected were learning disabled. Even in this study, they found the training useful in scoring responses from students they thought were probably not LEP.

They had two specific recommendations. First, the more examples, with interpretation, the better. Discussion would occur during general training and in all item-specific training. Second, they wanted more guidance on what words are and are not exchangeable. That is, when is it acceptable for a student to substitute words or phrases to get his/her idea across, and when is it not permissible? (For instance, when should students know and/or have to use specific science vocabulary?)

The bilingual readers and the LEP trainer raised several points regarding training. They felt they played a significant role in clarifying the formal portion of the training at their tables during scoring. Therefore, they felt it would be important to have at least one bilingual reader at each table so he/she could be part of the ongoing discussion during scoring. In addition, they all felt strongly that a separate training session should occur for the table leaders (those who oversee the scoring, by table, and make final decisions). Agreement among scorers needs to be constantly negotiated. Having a decision maker who is knowledgeable about these issues is crucial, they said.

Understandably, these readers and the trainer were also concerned about how to score responses from items and rubrics that have some confounding problems for LEPs and that were not caught during the item/rubric development process. Item problems include unclear words and phrases that mean something different when translated from a first language. Rubric problems often result from not anticipating some answers that are relatively common from students coming from different cultures or from not permitting certain ways of expressing knowledge. They pointed to several examples of problems from the 12 items and their rubrics. These participants requested that some kind of overriding or appeal process be set up to deal with these problems. The current process did not appear sufficient.

Other Issues Two major issues were discussed during the interviews. One had to do with augmenting the item and rubric development process so problems can be more likely caught at the beginning of the assessment process in the design phase. The other was the opportunity to learn issues. The first was addressed primarily by the bilingual readers and the LEP trainer, the second was discussed by all participants.

Bilingual educators found a number of problems in the items and rubrics that confused the scoring of LEP responses. They suggested that a better development process be established to minimize the changes that it will occur in the future. This includes affecting item and rubric development as well as the assembly of the detailed notes, examples, and training sets that occur after test administration. Lack of opportunity to learn is certainly not just an LEP issue. However, it was obvious to many of the readers, NCS and bilingual, that the LEP students did not have access to the types of curriculum that NAEP items are supposed to measure, such as problem-solving and hands-on science experiences.

Discussion and Implications

So what do the scoring results show? It appears that training makes a difference, but does this mean that the readers are scoring more accurately, or is it more of a halo effect, that is, are they simply scoring more liberally? Future studies need to be done to determine if the scores are really more accurate representations of what students know and can do. Perhaps researchers can use concurrent qualitative inquiry into what the student is trying to express when the student responds they way they do. This can be done using think aloud and/or stimulated recall approaches. Other work can also be collected to independently determine the level of student knowledge and skills.

Of no small consequence to the study's results was the fact that the readers thought they were scoring more accurately. There was quite a bit of discussion about the impartial manner in which the scoring was conducted. Readers did not want to, and did not think, they were reading into the responses answers which were not there. Both groups were concerned about simply being more liberal, and they consciously guarded against it. The specific notes and examples associated with each item helped constrain guesswork. While all the readers wanted more examples and guidance in the notes regarding how to deal with non-standard responses, none of them wanted to ignore the notes, or even expected more license from them.

Several good points were raised concerning how to refine the training. There was an unanimous request from participants that this type of training be integrated into not only the verbal training of all the scoring of all items, but also into the notes and practice sets. The researchers agree, and the challenge will be to integrate the training in such a way that is not terribly time-consuming for scoring contractors who have deadlines. By providing information, by item, more guidance can also be given regarding exchangeability in the specific contexts.

The researchers have noted that many of the points addressed in the training are not only specific to LEP but might also be useful for scoring other populations. Kopriva (in progress) has found some similar types of response concerns while working with special education students and students who have significant strengths in some of Howard Gardner's "intelligences," other than linguistic. Work needs to be done to ensure coverage for other populations and to possibly develop a diverse needs training. What is important, of course, is to retain the integrity of training for each of the non-standard populations while still developing consolidated training that is as useful for as many populations as possible.

Training table leaders may have an effect on bilingual readers' concerns about a better appeal process. It may also offset a need to have as many educators who work with non-standard populations at each scoring table. It appears to be a good idea worth further exploration.

The issue of better development practices for items and rubrics is very important. It was clear that several of these items and rubrics had problems that could have been circumvented with a better process of item/rubric development or assembly of notes. Unfortunately, this problem is not unique to NAEP, but to large-scale construction in general. Kopriva, in a handbook commissioned by CCSSO (in progress), is outlining a number of intervention points in the development process that will affect the quality of items and rubrics and make them more valid for all students, including LEPs. It will also provide guidance in pulling student work for practice and training sets and for developing a more thorough set of rubric notes.

Lack of appropriate opportunity to learn remains the center and core of many problems in assessment reform. How do we know if we are measuring a student's lack of knowledge or his/her lack of opportunity to be taught to challenging standards? Assessment reform needs to work at accurately asking the right questions, in ways in which we know we are getting data about important student knowledge and skills. This will be for naught, however, if students are not taught the important knowledge and skills to begin with. It will only wrongfully suggest lack of ability, whereas lack of access is the real issue. Work needs to continue to be done to leverage ways to assess which issue we are measuring.

References

Kopriva, R.J. (1994). *Validity issues in performance assessment for low, mid, and high achieving ESL and English only elementary students.* Report for the California Department of Education, California Learning Assessment System Unit, Sacramento, CA.

Kopriva, R.J. (In progress). *A conceptual framework for the valid measurement of all students.*

Kopriva, R.J. (In progress). *Reconceptualizing test specifications in large scale assessment: Defining item coverage as a function of content, performance and accessibility.*

Kopriva, R.J. and Lowrey, K. (1994). *Investigation of language sensitive modifications in a pilot student of CLAS, the California learning assessment system.* Report for the California Department of Education. California Learning Assessment System Unit, Sacramento, CA.

Lara, J. and August, D. (1996). *Systemic reform and limited English proficient students.* Washington, DC: Council of Chief State School Officers.

Roeber, E., Bond, L., and Braskamp. (1996) *Annual survey of state student assessment.* Washington, DC: Council of Chief State School Officers.

Wiley, D.E., Kopriva, R.J. and Shannon, A. (1997). *Standards-based validation of performance assessments.* Pittsburgh, PA: New Standards Project.

Highly Successful Schools in Communities Challenged By Poverty

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High levels of academic achievement are no longer the exclusive province of schools in affluent communities. Some schools in Texas have broken the mold. Schools in communities where almost all of the children live in poverty are achieving levels of academic accomplishment that compare favorably with many of the most affluent schools in the state. Many of these schools have large percentages of African American and/or Hispanic students. These include schools in urban Houston, San Antonio, Dallas, and El Paso, and poor rural communities in all parts of the state. Yet, substantial percentages of students in these schools are achieving at levels in mathematics, reading, and other curricular areas that make thousands of other schools envious.

Through a grant provided by the Texas Education Agency and funding support from the U. S. Department of Education's Region VIII Comprehensive Center: the STAR Center (Support for Texas Academic Renewal), the Charles A. Dana Center at the University of Texas at Austin studied schools in Texas that met the three following criteria:

1. In the 1994-95 school year, the schools had a high percentage of students whose families met the federal income criteria to receive free or reduced-price lunches. Most of the schools had over 75 percent of the students meet this criteria.
2. The schools received Title I funds and were implementing Title I schoolwide programs (an approach involving the use of Title I funds to improve the entire school).
3. In the spring of 1995, at least 70 percent of the students in each school passed the reading and mathematics sections of the Texas Assessment of Academic Skills (TAAS). In 1995, few Texas schools reached this level of academic achievement.

These criteria were key elements used by the Texas Education Agency in identifying schools as "recognized" in the state's accountability system.

The criteria led to the identification of over 50 schools. Twenty-six of these schools were studied. Using case study research methodology, a team of researchers and educators spent the spring semester of 1996 visiting these schools, interviewing staff and parents, observing classrooms, and reviewing data. After visiting all of the schools once, more in-depth visits were conducted at five of the schools. The team of researchers met frequently to compare notes and discuss findings. New understandings emerged as schools were visited and the researchers reached a deeper understanding of the common characteristics among the schools.

There were more differences than similarities in the instructional programs and approaches used in the 26 schools. Some schools used whole language approaches, while others focused more on phonics. Some used constructivist learning approaches, while others engaged in direct teaching. Some of the schools had joined Henry Levin's Accelerated Schools Project. Some were becoming engaged in the Success for All Program from John Hopkins University. Some were using Reading Recovery approaches. Others seemed to take pride in not having a clear allegiance to any specific program or methodology.

The common characteristics among these schools can be grouped into seven areas or themes. These themes describe the common attitudes, activities, and aspirations of the schools studied. The themes are closely related and to some extent interdependent, making the division of the themes seem artificial; however, they provide a framework within which to discuss the complexities of the schools studied.

Theme 1: *Focus on the Academic Success of Every Student*

These schools did not merely have mission statements; their sense of mission was articulated in every aspect of their planning, organization, and use of resources. Similar to schools studied by Reyes and Scribner (1996), almost every decision about the selection of instructional materials or strategies; the adoption of staff development strategies; the use of fiscal resources; the scheduling of the school calendar; the assignment and use of staff; the use of classroom, playground, and building space; or the use of any other resources was guided by a focus on the mission of ensuring high levels of academic success of every student.

The focus on the academic success of every student was evident in individual teachers' planning, just as it was evident in whole school planning activities. Teachers planned lessons with a focus on getting each and every student to succeed academically. Teachers were attuned to the special ways in which individual students learned best. They exploited this knowledge to create learning environments that allowed many students to attain challenging academic skills.

In almost all of the 26 schools, teachers were supported in their planning through extensive school and/or district efforts to align curriculum, staff development, and technology purchases with the objectives of the TAAS. Almost all school decisions about the use of important resources were tied to a consideration of "What's best for the students?" For example, teacher guides were used as tools for accomplishing instructional objectives rather than as scripts to be followed. Teachers knew what objective they were teaching and why a particular instructional approach was most likely to work with their students. Formative assessments allowed teachers to accurately determine areas of strength and need, and then to participate accordingly in the planning and delivery of professional development. Teachers contributed to the decision-making process regarding the use of other resources.

Teachers consistently reported that they were actively supported by their principals as they attempted to focus on the academic success of every student. "She'll get us whatever we need" was articulated by many teachers in many schools as they spoke of their principals. Teachers felt supported with adequate instructional materials and relevant staff development. Similarly, principals often indicated that they felt supported by their superintendents and central office colleagues. In addition, there was often strong support from the community through volunteer activities and school-business partnerships. As such, the mission seemed to be shared by everyone, including teachers, support staff, parents, central office staff, and community leaders.

Theme 2: *No Excuses*

Educators at these schools tended to believe that they could succeed with any student, regardless of the nature of the home situation, regardless of the student's previous performance or diagnosis, regardless of resource difficulties, and regardless of whatever other constraints might confront the school. Ultimately, there were no excuses for low student performance. Ouchi (1981, p. 40) referred to such an attitude as a "collective sense of responsibility."

In spite of the difficult living situations endured by some students, teachers persisted in believing that they could create learning environments that would allow those students to be highly successful. Teachers would do whatever was necessary to counterbalance the effects of poverty, whether by calling home to provide a wake-up call on mornings when the mother worked the night shift, modeling to a mother how to read a story to her preschool child, or taking children on a field trip to experience an elevator ride.

A lack of resources was not accepted as an excuse for providing any less than an excellent academic program. When funds were needed for professional development activities, instructional technology, or other instructional materials, educators demonstrated both persistence and creativity in finding the needed resources. Some schools sought new funding from state, federal, or private grant sources. Others developed new business partnerships. In many cases, schools carefully assigned priorities to the use of their discretionary resources, including their Title I dollars. They made tough choices and eliminated less effective expenditures, so they could afford items that would more likely result in greater student achievement.

Rules sometimes impede a school's ability to respond to the unique situations of students. While some schools might accept such barriers as legitimate excuses for failure, many of the 26 schools took a different approach. In essence, these educators assumed that rules must be negotiable if they impaired the school's ability to meet the needs of students. Principals were willing to debate with the food services director, the city fire marshall, the transportation director, or whoever seemed to be imposing a rule that did not serve students well. Often, their persuasiveness and persistence were rewarded with compromises, waivers, or other efforts to relax requirements.

In schools where the motivation to achieve was so strong, one might have expected to see more blaming when results did not meet expectations. However, educators at the 26 schools did not blame their students, parents, outside forces, or each other. Instead, they reflected upon their own efforts to find opportunities to improve.

Theme 3: *Experimentation*

In these schools, careful experimentation was encouraged. Educators felt a strong responsibility for ensuring the academic success of students, so they eagerly sought ways to improve teaching and learning. If an approach was not working with one student or any group of students, teachers were allowed, encouraged, and even expected to try different approaches. Thus, experimentation flourished as individual teachers, grade-level teams, and entire school staffs considered new ways to stimulate the achievement of students. In Henry Levin's Accelerated School Model, this is referred to as the inquiry process (Hopfenberg et al., 1993, pp. 95-137).

Educators were very careful in their choice of experiments. They evidenced a great sense of responsibility for selecting courses of action that had a high likelihood of leading to improved student performance. Nonetheless, when experiments did not lead to the desired result, there were no reprisals. Instead, educators were expected to use the failure experience as part of the improvement process. Teachers and other school staff had the opportunity to make a good try, fail, learn from the experience, and make modifications or refinements that led to improved results.

Experimentation was evident at many levels. Schools often engaged in pilot tests of materials or strategies before considering adoptions by the entire school. Schools experimented with the organization of the school day, the acquisition and use of technology, the use of intersessions, and the assignment of support staff. Teachers often shared and cooperated in each other's experiments and discussed their findings. They learned from each other's successes and failures.

Theme 4: *Inclusivity*

In the 26 schools studied, job titles (or lack therof) did not matter as much as one's potential to contribute. Thus, teachers at all grade levels in both regular and special programs, professional support personnel such as nurses and counselors, bus drivers, campus administrators, custodians, school office staff, cafeteria workers, instructional aides, librarians, parent volunteers, part-time personnel, community leaders, and students were often enlisted to be a part of the team that would lead a student to success at school. As such, everyone who worked at the school, attended the school, or sent children to attend the school had a strong sense of ownership.

Beyond their traditional designated roles, school personnel had broader roles as members of the school team. It was not unusual to see secretaries listening to students read, special education teachers problem-solving instructional strategies with grade-level teams of general classroom teachers, or librarians supporting parental involvement initiatives. The broadly defined roles allowed many individuals to assume leadership roles.

Some studies of effective Title I schools have emphasized the importance of parental involvement (Schenck & Beckstrom,1993). At these schools, personnel did not wait passively for parents to become involved in various aspects of the school. In almost all of the schools there was a multifaceted outreach to families that constantly encouraged and supported parents in ways that nurtured greater involvement in their children's education. Educators made special efforts to make parents feel welcome. Open-door policies and open-door attitudes were common. School personnel assumed responsibility for creating an environment in which parents wanted to become involved.

Often in these schools, students were utilized as important resources for improving their own and each other's academic achievement. Students had important roles in directing their learning experiences and had input into a variety of decisions that influenced their school experience. In addition, students often were involved in cooperative learning or peer tutoring strategies in which they worked together to facilitate their learning.

Theme 5: *Sense of Family*

Overwhelmingly, the most common metaphor observed in these schools was the school as a family. Statements such as "We're a family here," or "These are all my children," were heard frequently. Moreover, the actions of teachers, principals, students, parents, and other members of the school community frequently reflected the concern, dedication, involvement, respect, and love that one would expect to find in the healthiest of families. The school personnel saw the school less as an institution and more as a family. This view is consistent with the findings of Scheurich (1997) as he examined similar (including some of the same) schools.

Students were treated with respect and concern. Teachers were concerned with the child's total development, not simply with student test performance. As such, attention was focused beyond traditional academics and included music, art, and physical education. Similarly, attention was given to the social and emotional needs of students. Counselors, nurses, social workers, and family liaisons often took leadership roles in ensuring that students' basic needs were met. Traditional school roles were often blurred because educators were willing to do whatever was needed to ensure that their students were doing well physically, emotionally, and socially.

In many ways, the schools strove to communicate to students that they were valued individually and collectively. School activities, bulletin boards, and curriculum materials reflected and celebrated the cultural and linguistic diversity of the students. Similarly, hallways, classrooms, doors, and ceilings were often used to display student work. School personnel often created opportunities to recognize the academic and non-academic accomplishments of students.

Like family, the school provided a safe place for students to grow and learn responsibility. School personnel were able to empathize with students and relate to their personal experiences. In many of the schools, teachers and other staff grew up in the same neighborhoods and had similar backgrounds. Adults at the schools acted in ways that showed they were happy that the students were there. When disciplinary issues arose, they were handled consistently, quickly, fairly, and in a manner that demonstrated respect for the individual student.

Just as students were treated as valued members of the school family, so were their parents. In many of the schools, parents were provided a special place to help make them comfortable when they came to school. To help make sure that parents felt at home, office staff, principals, teachers, and other school personnel greeted parents warmly, usually by name. Parents at these schools knew they were welcome; they knew that they belonged as part of the school family.

It is hard to feel like a family member if you cannot understand the language. Therefore, school personnel made many efforts to accommodate parents who did not speak English. Bilingual office staff, interpreters, bilingual signs and banners throughout the school, and bilingual newsletters were among the strategies used to help parents feel comfortable at school, even when they did not speak English well. Similarly, the tone and words used to communicate with parents reflected respect for the parents' language, dialect, and background. Teachers did not expect parents to understand educational jargon nor did they talk to parents in ways that were condescending.

Even when parents were having difficulty assuming traditional parenting roles, school personnel responded in ways that demonstrated respect for the challenging situations confronting parents, empathized with the difficulties faced by parents, and supported parents as they worked to improve their involvement in their child's academic life. School personnel focused more on seeking solutions than on blaming parents for the academic or social difficulties that students encountered.

The sense of family extended beyond students and parents to all members of the school staff. All school personnel, regardless of position or tenure, were perceived as important members of the school family. New teachers were valued for their fresh ideas and perspectives. Veteran teachers were valued for their experience and expertise. The importance of each staff member was based in part on his or her contribution to the mission of the school; moreover, their importance was based on their worth as individuals. Staff members cared about each other's lives beyond the school, in addition to caring about their performance at the school.

Often principals found a variety of ways to let staff know they were appreciated and respected. School personnel were acknowledged for their accomplishments, their expertise, and just for their membership as part of the school family. The schools found ways to utilize both the personal and professional strengths of staff members, often beyond their traditional job descriptions.

Theme 6: *Collaboration and Trust*

Openness, honesty, and trust characterized most of the interactions among school personnel. School personnel openly shared concerns and successes with each other. They provided assistance to each other and learned from each other. Teachers seemed to prefer working in teams and did so frequently. Team teaching arrangements were used often. Thus, when problems arose, school staff generally did not need to respond alone. They had colleagues who discussed issues and provided ideas, feedback, and encouragement.

Although there was cooperation, there was also disagreement. Teachers and other school staff reported that they felt free to express their concerns about ideas or actions. Staff members could disagree and work out their disagreements in constructive manners. Although the schools typically acted as teams, they still respected each individual's right to disagree.

Cooperation at these schools extended beyond their grade-span groupings. Frequently, teachers worked with those who taught subsequent grade levels to improve their understanding of each other's curricula and expectations. Even when the next grade level was at a different school, teachers often assumed responsibility for reaching out and establishing the collaborative relationships that would allow them to better ensure their students' future success.

Administrators at these schools made sure that teachers and other school personnel had many opportunities to meet, collaborate, plan, and work together. There were many formal and informal forums that provided school personnel with opportunities to openly discuss programs, policies, and programs. School personnel were encouraged to express their concerns freely. Often school personnel credited administrators for setting the tone that helped the school become a place where staff worked well together toward common goals. The importance of collaboration was emphasized in other studies of effective Title I schools (U.S. Department of Education, 1994).

Theme 7: *Passion for Learning and Growing*

Although many lofty goals had been set and attained, these schools refused to rest. They were not complacent with their current ways of teaching, organizing, or leading. Although schools clearly took time to celebrate their successes, they continued to challenge and push themselves toward the attainment of higher goals. Teachers sometimes expressed concerns about ceiling effects and similar measurement phenomena, but the "no excuses" attitude generally prevailed.

Experimentation did not stop when desired results were attained. Instead, school staff focused on how they could improve upon strategies or identify new strategies that would allow them to succeed with even more students or that would allow them to take students to even higher levels of success. There was a continuous seeking of new horizons, new opportunities, new ways of operating. The process of such discovery and learning on the part of all participants was considered the central business of the school.

Professional development was not an event at these schools: it was part of the culture, part of the way of life. School personnel were frequently engaged in extensive efforts to bring new information into the school. Federal, state, and local resources were used to send staff to attend conferences, to visit highly effective schools, and to critically observe promising programs. At the same time, teachers and other personnel shared journal articles and discussed educational literature that enriched their discussions about how to improve.

These schools can truly be characterized as communities of learners. As school personnel learned and grew, so did parents, and so did students. Learning, growing, and improving were the focus of thousands of interactions among students, parents, and school personnel. Nonetheless, these schools did not fail to remember that every participant in the community of learners was first an individual, an important and valued member of the school family. This constant reaffirmation, support, and validation was probably responsible for individuals finding the strength to confront daunting barriers, overcome those barriers, achieve impressive goals, and then re-focus their sights on even higher goals for student performance.

References

Hopfenberg, W. S., Levin, H. M., Chase, C., Christensen, S. C., Moore, M., Soler, P., Brunner, I., Keller, B., and Rodriguez, G. 1993. *The accelerated schools: Resource guide.* San Francisco: Jossey-Bass.

Ouchi, W. G. 1981. *Theory Z.* New York: Avon.

Reyes, P., and Scribner, J. D. (Eds.) 1996. *Final report of research findings: Effective border school research and development initiative.* Edinburg, TX: Region One Education Service Center.

Schenck, E. A., and Beckstrom, S. 1993. *Chapter 1 schoolwide project study.* Portsmouth, NH: RMC Research Corporation.

Scheurich, J. J. March 1997. *Highly successful and loving, public, preK-5 schools populated mainly by low SES children of color: Core beliefs and cultural characteristics.* A paper presented at the American Educational Research Association Conference, Chicago, IL.

U. S. Department of Education. 1994. *An idea book: Implementing schoolwide projects.* Washington, DC: Author.