Technology and Teacher Development: The Federal Role

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SUMMARY OF KEY FINDINGS

- The federal government has played a limited role in technology-related teacher development compared with states, universities, and school districts. In addition, the federal investment in technology-related teacher development has been less than that for educational technology hardware and software.
- Even so, past federal programs have piloted innovative educational applications of technology for teachers by providing significant support for professional development for particular groups of teachers, including mathematics, science, and special education teachers, and by providing funding for technology-related professional development in school districts that could not have supported it on their own.
- From the 1950s through the 1970s, the federal government funded several efforts to influence teacher training in technology-related areas; key programs included National Science Foundation teacher institutes, programs to improve teacher training and materials for children with disabilities, programs to familiarize teachers with instructional media and educational television, and initiatives to reform teacher preparation or spur innovation in K-12 education. These programs hold lessons for future federal policy.
- The federal role in technology-related teacher development has grown considerably since 1988 as a result of several new and expanded programs for math and science education and educational technology development. Federal actions in 1994 have created new opportunities for federal leadership in overall policies for education technology and in technology-related professional development. Key initiatives include the creation of an Office of Educational Technology in the U.S. Department

of Education, the state technology planning grants and other provisions of Goals 2000: Educate America Act, the expanded Dwight D. Eisenhower Professional Development program, the Title III programs for educational technology in the revised Elementary and Secondary Education Act, and programs to promote educational networking in the National Science Foundation and the Department of Commerce.

- The federal government has tended to focus more attention on inservice education rather than preservice education, channeling more support to K-12 schools than to colleges of education—an approach that seeks to address current needs but does not greatly influence teacher quality over the long term.
- The types of professional development activities supported with federal funds run the gamut from courses for teacher certification, to summer institutes, to one-shot workshops on specific topics. The role of technology in training also varies from short-term training on a specific type of software to semester-long projects that engage teachers in telecommunications networks. Federal projects include training *with technology* as well as training *about technology.*
- Much of the federal support for technology-related teacher development is optional in nature and small in amount, provided through competitive grant programs, or as part of programs with larger purposes. As a result, federal support for this purpose has been highly variable from year to year, piecemeal in nature, and lacking in clear strategy or consistent policy. Depending on how the federal government implements new initiatives for technology leadership, this situation could be improved.
- Federally funded programs are beginning to address several challenges implicit in providing technology-related teacher development. These include the need to train with higher intensity and longer duration, to translate exposure to cutting-edge technologies into viable classroom learning experiences, to provide extensive followup after the end of formal training, and to improve evaluation and dissemination of projects developed with federal funds.
- Projects helping schools develop access to the emerging National Information Infrastructure could provide resources and access to high-quality professional development activities for teachers. These grant programs have yet to focus on professional development as central issues, but offer great potential.

INTRODUCTION[1]

For several decades, the federal government has provided various forms of support to improve the preparation and professional development of elementary and secondary school teachers. Over the years, a small portion of this support has focused on helping teachers learn more about educational technologies, beginning with early projects to acquaint teachers with educational television and audiovisual technologies and continuing through current projects to train teachers to use computer models to teach physics.

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[1] Much of this chapter is taken from Nancy Kober, "Teachers and Technology: The Federal Role," contractor report prepared for the Office of Technology Assessment, May 25, 1994. The contractor report was based on a review of the research literature and of the United States Code, compilations of federal education laws, the Code of Federal Regulations, the *Federal Register*, the *Catalogue of Federal Domestic Assistance*, federal budget documents, reports of the Congressional Research Service and the General Accounting Office, reports of the Federal Coordinating Council for Science, Engineering, and Technology, and a variety of federal agency publications. To determine which programs actually were supporting technology-related teacher training and to gather specific information on program activities, the contractor talked with federal program administrators, state and local project directors, and other experts, and reviewed federal evaluations, award abstracts, and federal and local project materials.

Federal support for technology-related teacher development[2] has grown considerably in recent years. But because it has come in small amounts from multiple programs with different purposes, this support has been somewhat haphazard and lacking in a clear strategy. **This situation may improve in the near future, however, as the Department of Education (ED) implements new educational technology programs under Public Law 103-382 (the Improving America's Schools Act), as states complete federally supported technology plans under Public Law 103-227 (the Goals 2000: Educate America Act), and as Congress and the executive branch confront critical decisions about educator access to the emerging national information infrastructure.**

As the federal government prepares for new leadership roles, it is important to examine current and past federal efforts to influence technology-related teacher development. This chapter:

1) describes and analyzes the current and emerging federal role in technology-related teacher development, including the major programs, activities, and strategies;
2) reviews historical federal efforts to improve teacher training in general and technology-related teacher development in particular;
3) examines the implications and lessons from current and past federal programs; and
4) discusses some key issues to be considered by Congress and the executive branch in formulating future federal policies in this area.

BACKGROUND ON THE FEDERAL ROLE

Primary authority for teacher preparation, licensing, and certification rests with the states, not the federal government. Substantial responsibilities also rest with colleges of education as regards preservice education and with local school districts as regards inservice education. **Given these constraints, the federal government has played a limited role in both the preparation and professional development of the average teacher.** Most federal efforts to influence teacher training over the past four decades have been confined to areas in which Congress has perceived an urgent need, such as strengthening American competitiveness through better mathematics and science instruction or improving education for children with disabilities and other special needs. Occasionally, the federal government has initiated broader reforms aimed at the general teaching force, with mixed results, as discussed later in this chapter.

Nevertheless, there are spheres in which the federal government has significantly influenced teacher training. Although federal training programs have never reached more than a small percentage of the total teaching force, over the years they have helped millions of teachers improve their knowledge, skills, and career advancement. It might even be said that the federal government helped give credence to the whole notion of inservice education and professional renewal through such early efforts as the teacher institutes sponsored by the National Science Foundation (NSF) in the 1950s, 1960s, and 1970s or authorized by the National Defense Education Act (NDEA) from 1958 to 1968 (see table 6-1).

In mathematics and science, enough teachers have participated in federally funded training to have had a significant effect on instructional quality or teacher supply. It has been estimated that past NSF institutes reached half the math and science teachers in the nation at some point; more recently, it has been estimated that one-third of all math and science teachers took part in some type of activity funded by the Eisenhower Professional Development program in 1988-89. The numbers

[2] As used in this discussion, *technology-related teacher development* means preparation and professional development for K-12 teachers and other education personnel that 1) aims to help them become familiar with any of several educational technologies and learn to integrate them into instruction, or 2) uses technology as a tool for providing training of any kind. Resources for technology-based training include telecourses, electronic networks, or computer- or video-based teacher training.

TABLE 6-1: Past Major Federal Programs in Support of Technology-Related Teacher Development

Program	Dates	Purpose	Costs[a]		Numbers Trained[b]	
			Total	Period	Total	Period
Training Teachers In Critical Subjects						
NSF Teacher Institutes	1954-75	Improve teacher skills in math and science.	$750 million	1958-74	350,000	1953-68
National Defense Education Act	1958-68	Improve teacher skills in critical subjects, including instructional media.	$148 million	1958-68	90,000 trained in NDEA institutes	1958-68
Training Teachers of Students with Special Needs						
Special Education Media Services	1964-86	Produce and disseminate materials for persons with disabilities, train teachers in their use.	$182 million	1966-80	15,000	1964-74
Part D Personnel Preparation (Special Education)	1966-present	Prepare teachers to teach children with disabilities.	$811 million	I966-90	5,000-7,000 annually in preservice; about 20,000 annually inservice	
Bilingual Education Personnel Training (Title VII, ESEA)	1974-present	Prepare bilingual education teachers.	$409 million	1975-91	36,000 per year	1977-78
Increasing the Supply of Educators and Recruiting New Teachers						
Higher Education Act Fellowships and Traineeships	1965-68	Increase number of teachers and improve their preparation.	$67 million	1966-68	4,140 fellowships and 3,850 traineeships	1966-68
Library Career Training	1965-present	Provide preparation and professional development for librarians, including school librarians.	$14 million	1966-91	4,309 fellowships	1966-91

Reforming and Improving Teacher Education					
Teacher Corps	1965-81	Prepare teachers to teach in low-income areas; provide more field experiences for teachers in training.	$460 million 1965-81	61,478 educators and 10,155 interns	1965-81
Education Professions Development Act	1967-76	Coordinate and expand federal teacher training programs, improve federal leadership.	$800 million 1967-76	300,000 trained	1967-76
Teacher Centers	1978-8"1	Enhance teacher skills through teacher-directed professional development centers.	$47 million 1978-8"1	Not available	
Training Teachers To Stimulate Innovation and Reform					
National Diffusion Network	1974-present	Promote adoption of exemplary K-12 programs through teacher training and other means.	$145 million 1974-91	*60,000* educators in 7,000 schools	1974-77
Title III, ESEA Title IV-C	1965-81	Encourage innovation in education through teacher training and other means.	$1,443 million 1966-76	35,000	1968
Chapter 2, ECIA	1981-94	Support locally determined education reform efforts.	Not available	Not available	

[a]Costs are given for the years in which figures are available; costs are not available for years other than those listed.
b Numbers trained are given for the years in which data were collected; numbers are not available for years other than those listed.

SOURCE" Office of Technology Assessment, 1994. Based on Nancy Kober, "Teachers and Technology: The Federal Role," contractor report prepared for the Office of Technology Assessment, May 25, 1994.

of teachers receiving federally supported professional development in math and science could be considered potentially a critical mass for improvement within these disciplines.

Federal programs have also been a major force in the creation and growth of several teaching subspecialties, including special education, educational media, assistive technology for children with disabilities, and bilingual education.

Federal fellowships, scholarships, and other financial aid—beginning with the first fellowships under the Higher Education Act in 1965 and continuing through the Paul Douglas Teacher Scholarships, Perkins Loan Cancellations, and minority teacher recruitment programs of today—have changed the composition of the teaching force and attracted talented people to the profession who might have pursued other careers. Innovative federal programs such as the Teacher Corps helped develop new approaches to teacher preparation.

Similarly, over the past four decades the federal government has also undertaken efforts to develop, promote, and expand the use of educational technologies. However, these initiatives have received a very small slice of the federal education budget and have fluctuated greatly with changes in leadership and shifting goals and priorities in education. These programs have been research and development efforts, devoting more attention to promoting the development of and access to technology than they have to preparing teachers to use technology well.

Here, too, however, there are ways in which the federal government has influenced the training of teachers with and about technology. Some of the most innovative applications described elsewhere in this report—such as national telecommunications testbeds for students and teachers, video modeling of effective classroom interactions for teachers in training, or hands-on teacher research opportunities involving advanced technologies—have been developed, piloted, and disseminated with federal money. Federal dollars have helped develop and implement distance-learning telecourses for professional development and have exposed thousands of teachers to new uses and new ways of thinking about technology in the classroom.

CURRENT FEDERAL SUPPORT AND COMMITMENT

Sources of Federal Support

Many different federal programs currently support or could support technology-related teacher development. They range in size from large formula-grant programs that reach most school districts, such as ED's Eisenhower Professional Development Program, to small discretionary grant programs that serve a select number of teachers, such as the Summer Teacher Enhancement workshops administered by the Department of Energy (DOE) at research laboratories across the federal government. They range in mission from programs aimed at developing particular kinds of teachers, such as special education personnel development, to those aimed at enhancing the use of particular kinds of technologies, such as Star Schools distance learning. They range in directiveness from programs in which technology-related professional development is an integral requirement, such as the new state and local technology grant program under Title III of the Elementary and Secondary Education Act (ESEA), to those in which it is an entirely local option, such as Title VI of the ESEA program for educational innovation (formerly Chapter 2). And they range in target population from programs that focus on teachers only, such as the NSF Teacher Enhancement program, to those that involve both teachers and students, such as the Aerospace Education program administered by the National Aeronautics and Space Administration (NASA).

The federal government also promotes technology-related teacher development through means other than direct grant programs. For example, several federal laboratories and facilities donate personnel, time, space, and equipment to provide on-site training, research, and mentoring opportunities for K-12 teachers and students; many of these efforts involve advanced technologies. NASA and ED also have developed technology

demonstration centers, or "classrooms of the future," where teachers can experience exemplary applications of educational technologies.

Federal agencies also sponsor electronic networks and databases aimed at teachers, students, and others interested in sharing or obtaining educational information, materials, and resources. The Office of Educational Research and Improvement (OERI) in ED has developed an Institutional Telecommunications Network serving all major OERI-supported research and development institutions. NASA has a Spacelink electronic information system to exchange information about aeronautics and space exploration. Other telecommunications networks are sponsored by NSF, the National Institutes of Health, and other agencies. In addition, federally sponsored clearinghouses often include technology-based materials among their resources or encourage potential clients to access their collections electronically.

The President, the Cabinet, Congress, and other federal officials also exercise leadership in educational technology by publicizing and rallying support for technology-related issues, by promulgating policy directives and executive orders, by establishing interagency committees or advisory groups, or by making high visibility technology appointments. Examples of federal leadership activities include the appointment of a Director for Educational Technology in the Office of the Deputy Secretary in the Department of Education, the announcement of an executive branch technology policy for the United States,[3] and the establishment of a Committee for Education and Training under the White House Office of Science and Technology Policy.

Level and Scope of Federal Commitment

It is difficult to know exactly how many federal programs are supporting technology-related teacher development in any given year and to what extent.[4] A starting point is to look at federal programs for professional development (teacher or administrator training) in general. A 1994 internal inventory of ED professional development programs identified 20 funded programs, with total funding of over $474 million in FY 1994, whose sole or major purpose was personnel development, plus another 44 that authorize significant resources for personal development.[5] Several more professional development programs are administered by other agencies.

In nearly all of the relevant programs, support for technology-related teacher training is an option rather than a requirement, and often a local decision. At the local level, there are probably thousands of federal grants and funded projects that might involve some form of technology-related teacher training, but getting precise information on these projects is a complex undertaking. With few exceptions, the federal government does not collect data from grantees in the format or detail needed to discern which projects are actually supporting technology-related training and how much they are spending for it.

Based on a review of federal program legislation and regulations, agency reports, project abstracts, discussions with federal and state officials, and other information, the Office of Technology Assessment estimates that at least 58 federal programs are currently supporting, have recently supported, or are likely to be supporting

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[3] See Executive Office of the President, *Technology for America's Economic Growth: A New Direction To Build Economic Strength* (Washington, DC: Executive Office of the President, 1993).

[4] There is also a semantic complication: namely, how one defines "program," especially in the case of agency-initiated activities below the budget line-item level.

[5] U.S. Department of Education, "Department of Education, Activities That Support Teacher and Administrator Training and Improvement," unpublished document, 1994.

technology-related teacher preparation or professional development to some degree.

Most of these programs are small by federal standards; a number have appropriations under $10 million. They differ by major purpose. Some focus primarily on *teacher development*. Many of these are programs to improve teacher skills in math and science, obvious subjects for infusion of technology because of the real-world links between science and technological applications. Others focus primarily on *developing and expanding the use of educational technologies*, with professional development authorized as a means toward this end.

Other relevant programs concentrate on *educating children with special needs*, such as Title I of the ESEA for disadvantaged children, the Individuals with Disabilities Education Act (IDEA), and the Bilingual Education Act. Technology is used frequently to deliver services in these programs, and *professional development for teachers of participating children* is an allowable use of funds. Also pertinent are certain programs that foster general school reform and allow *support for professional development as a vehicle for change*.

From this broad list of relevant programs, it is possible to identify 23 key programs that form the core of federal support for technology-related teacher training (see table 6-2*)*.

Most of the key programs are administered by the Department of Education. Several are overseen by NSF, consistent with the agency's science orientation and long-standing involvement in technology-related research and development.

Relevant programs are also administered by the Departments of Energy, Commerce, Health and Human Services, Agriculture, Defense, and Transportation, as well as NASA, the National Endowment for the Humanities, the National Endowment for the Arts, the Smithsonian Institution, and other agencies. These programs tend to be much smaller in scope and funding than the ED and NSF efforts. Many have a math and science orientation and offer institutes, workshops, or research opportunities for K-12 teachers at laboratories and other facilities. A smaller number improve teacher content and pedagogical knowledge for other disciplines.

Eligible grantees vary by program and include state educational agencies (SEAs), local educational agencies (LEAs), institutions of higher education (IHEs), and other public or private organizations. Several programs require or encourage collaboration among more than one entity, such as school districts and higher education institutions.

The remaining programs are smaller or less dependable sources of funding for technology-related teacher development (see table 6-3*)*. They include programs that authorize teacher training as one of many different allowable activities; that could support technology-related training under current guidelines but have not done so to any notable extent; that focus primarily on technology research and development, with small teacher training components; or that do not collect sufficient data to determine whether technology-related training is actually funded.

Estimating the level of federal expenditures for technology-related teacher development is not possible. In most of the 23 key programs listed in table 6-2, a small portion of total expenditures goes toward technology-related training. At the same time, unknown levels of support come from programs not listed in table 6-2, or table 6-3. **Because there are so few programs where specific data on technology-related training are available, OTA finds that there is no reliable estimate available for overall federal funding support for this purpose.**

Key Points

Whatever the current amount, several points can be made about federal funding for technology-related teacher development.

- **The amount of federal support for this kind of teacher training lags behind federal spending on educational technology hardware, software, equipment and facilities.** As one indicator, expenditures for computer hardware and software under a single program, Chapter 2 of the ESEA (now Title VI), have

ranged from $50 million to about $100 million annually in recent years.[6] Star Schools projects have spent an average of 35 percent of total funding on equipment, or about $5 million to $8 million per year.[7] The amount for professional development in either of these programs is much less. Several million dollars more for infrastructure have come from the Public Telecommunications Facilities Program and other federal sources; again, teacher support for using these resources is extremely limited.

- **From all indications, federal support for technology-related teacher development has grown considerably since OTA first looked at educational technology in its 1988 report *Power On! New Tools for Teaching and Learning*.** Funding for the Eisenhower program, a vital source of support, more than doubled between FY 1988 and 1994, from $120 million to over $250 million. According to a government-wide inventory, 117 new federal programs for science, math, engineering, and technology education were created between 1988 and 1993, yielding a total of 290 such programs, of which 29 had teacher enhancement as their primary purpose.[8] Technology-related teacher projects have been designated as an absolute priority[9] in recent annual grant competitions under several programs—among them, the Fund for Innovation in Education (FIE), the Eisenhower National Program, the Star Schools program, and the technology and media program for individuals with disabilities.
- **Funding for technology-related teacher training is likely to grow**. The FY 1995 appropriations include $40 million for educational technology programs under the new Title III of the ESEA and an extra $70 million for the Eisenhower program. And, as explained below, technology-related training is given greater encouragement and more explicit attention in several ESEA programs, including Title I Eisenhower, Title VI (formerly Chapter 2), and bilingual education.
- **Support for technology-related teacher training is optional in most programs.** Although diverse funding sources for technology-related teacher development may appear to offer an abundance of opportunities, accessing federal funding for technology-related teacher development is not always easy. Many programs leave it up to state or local grantees to decide whether technology-related training—or for that matter, any kind of professional development—is supported and in what form. For example, although the Title I of the ESEA program for disadvantaged children, the IDEA state grant program for children with disabilities, and the Perkins Vocational Education Basic Grants program encourage funds to be used for professional development, local project directors must weigh the need for teacher training against other priorities, most notably direct student instruction. Often technology-related training and, in general, professional development are viewed as niceties rather than necessities. Even in competitive grant programs at the

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[6] M.S. Knapp and C.H. Blakely, *The Education Block Grant at the Local Level: The Implementation of Chapter 2 of the Education Consolidation and Improvement Act* (Menlo Park, CA: SRI International, 1986); and Ruskus Joan et al., *How Chapter 2 Operates at the Federal, State, and Local Levels* (Washington, DC: U.S. Department of Education, 1994).

[7] About 130 separate staff development activities were offered in the 1992-93 school year. For the most part, general staff development consisted of a number of short "one shot" workshops presented as a teleconference, rather than a sequenced set of activities. Naida C. Tushnet et. al., *Star Schools Evaluation Report One* (Los Alamitos, CA: Southwest Regional Laboratory, July 1993), p. 49.

[8] Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources, *The Federal Investment in Science, Mathematics, Engineering, and Technology Education, Where Now? What Next? Sourcebook* (Washington, DC: August 1993), pp. 10-17.

[9] An *absolute priority* means that only those projects that address a particular issue or activity (as announced in the *Federal Register*) will be funded in a given year. Priorities in national discretionary programs often change from year to year.

TABLE 6-2: Key Current Programs for Technology-Related Teacher Development

Program	Funding*	Purpose	Treatment of Technology-Related Training
Department of Education			
Title III, ESEA, Technology for Education	$40 million	Provide federal leadership and financial support to expand access to and use of educational technologies.	Secretary develops long-range technology plan; state and local grants must provide for ongoing professional development to integrate technologies in education.
Goals 2000: Educate America Act	$403 million	Encourage states to develop comprehensive school reform plans based on standards for student learning.	States must develop educational technology plans as part of overall improvement plans; act also established Office of Educational Technology in U.S. Department of Education.
Eisenhower State Grant	$321 million	Improve teacher knowledge and skills in math, science, and other core academic subjects.	Funds may be used for professional development in effective use of technology as instructional tool.
Eisenhower National Program	$39 million	Develop models of national significance in professional development in core subjects.	Funds may be used for training teachers in innovative uses of technology.
Star Schools	$30 million	Support acquisition and use of distance-learning technologies for education.	Funds may be used to develop and provide preservice and inservice distance learning for teachers and to train teachers to integrate telecourses for students into instruction.
IDEA Part D, Special Education Personnel Development	$91 million	Provide preparation and professional development to help teachers educate children with disabilities.	Technology-related training programs authorized; emphasis on assistive technologies.
IDEA Part G, Technology, Educational Media, and Materials	$11 million	Support research and development and technical assistance to advance technologies for persons with disabilities.	FY 1994 priority on organizational support and professional development.
Title I (Chapter 1) ESEA	$7,232 million	Provide educational services to help low-achieving children in low-income areas meet high standards.	Schools must devote sufficient resources to professional development; may include instruction in use of technology.
Bilingual Education Training Grants	$25 million	Support teacher preparation and professional development for bilingual education teachers.	Some projects involve technology; no specific encouragement for technology-related training in law.
Library Personnel Development	$5 million	Train and retrain school librarians and other library personnel.	Training in new technologies encouraged.
Christa McAuliffe Fellowships	$2 million	Provide fellowships for outstanding teachers to continue education, develop innovative programs, train colleagues.	Several fellows develop technology-related projects.

Title Vi/Chapter 2, ESEA	$347 million	Provide grants for range of state and locally determined school improvement activities.	Funds may be used for technology-related professional development at state/local option.
National Diffusion Network	$15 million	Disseminate and encourage adoption of exemplary education programs through staff training and other means.	Some current projects available for adoption have technology focus; professional development is primary strategy for helping schools adopt programs.
National Science Foundation			
Teacher Enhancement	$101 million	Fund teacher training programs in math, science, technology.	Many programs involve technology.
Teacher Preparation	$18 million	Support projects to improve undergraduate teacher preparation.	Projects must address preparation in new technologies.
Applications of Advanced Technologies	$10 million	Fund research and demonstration in revolutionary technologies for education.	Some projects have components for teacher support and development.
National Education Infrastructure for Networking	$15 million	Demonstrate innovative applications of networking for education.	Teacher support and development integral part of all projects.
OTHER FEDERAL AGENCIES			
Department of Commerce (NTIA)			
Public Telecommunications Facilities Program	$29 million	Supports innovation and capacity building of the nation's telecommunications infrastructure.	Supports distance-learning activities for teachers and students.
Telecommunications and Information Infrastructure Assistance Program	$64 million	Accelerate the use of telecommunications and information technology.	Supports telecommunications networks that can provide professional development for teachers as well as new teaching opportunities in K-12 classrooms.
National Endowment for Children's Educational Television	$2.5 million	Supports creation and production of television directed toward development of children's intellectual skills.	Much of the programming can be used in the classroom.
Department of Energy			
Summer Teacher Enhancement	$2 million (FY 1994)	Provide teacher training and research opportunities in federal laboratories.	Many projects involve training teachers in high technology applications in science
Teacher Research Associates	$1,9 million	Provide teacher summer laboratory experiences and training in science.	Some projects involve training in technology.
Environmental Protection Agency			
Environmental Education and Training	$2 million (FY 1994)	Train teachers and improve materials in K-12 environmental education.	Use of technologies encouraged.

[a]Funding levels are for the entire program, not just the technology-related teacher training projects or components All figures are FY 1995 unless noted otherwise.

SOURCE Office of Technology Assessment 1994 Based on Nancy Kober, "'Teachers and Technology' The Federal Role, " contractor report prepared for the Office of Technology Assessment, May 25, 1994.

TABLE 6-3: Additional Current Sources of Federal Support for Technology-Related Teacher Development

Department Of Education

- *Perkins Vocational and Applied Technology Education Act:* For basic state grants, states must include support for professional development for vocational teachers. "Tech-prep" projects linking secondary and postsecondary vocational education must include teacher training in tech-prep curricula. Teacher and administrator training and leadership development are among activities of National Center for Research in Vocational Education.
- *Part B IDEA State Grants:* States must have comprehensive systems of personnel development; may use federal grants for teacher training.
- *IDEA Special Purpose Programs:* Training for special education personnel is authorized under special purpose programs (i.e., Severely Disabled, Severe Emotional Disturbance, Deaf-Blindness, Early Childhood Education, and Transitional Services).
- *Regional Resources Centers, IDEA:* Services include teacher training, assistance to states regarding comprehensive systems of personnel development.
- *Indian Education Personnel Development and Special Projects:* Projects train Native Americans for careers as teachers; special projects support teacher professional development, including some technology-related training.
- *Territorial/ Teacher Training:* Preparation and professional development for teachers in U.S. territory schools.
- *Emergency Immigrant Education:* Inservice training is one of many activities to improve education of immigrant children in heavily impacted schools; some projects involve technology.
- *Javits Gifted and Talented Education:* Research, demonstration, and training projects to improve gifted and talented education; some involve technology.
- *National Writing Project:* Teacher training in writing instruction; encourages technology infusion.
- *National Science Scholars:* Scholarships to talented science, math, computer science, and engineering majors; recipients must teach in K-12 schools or pay back the award amount.
- *Fund for the Improvement of Postsecondary Education* (FIPSE): Projects to promote reform and innovation in postsecondary education; infusing technology and strengthening teacher education are among priorities.
- *Regional Education Laboratories and Educational Research Centers:* Research, dissemination, and teacher training on effective teaching and learning; improving instructional uses of technology is among priorities.
- *Language Resource Centers:* Teacher training is among the activities to develop better methods of teaching foreign languages; new technologies are an area of emphasis.

National Science Foundation

- *State Systemic Initiative:* State planning for systemic reform in math, science, and technology education.
- *Urban and Rural Systemic /initiatives:* Systemwide improvement plans in math and science education for cities with highest numbers of children in poverty and for rural areas; technology can be included.
- *Research in Teaching and Learning:* Basic and applied research on science and math education, including research on teacher uses of technology.
- *Mathematics and Science Teaching Perspective Component:* Teacher lab experiences with scientists and student Young Scholars.
- *Research Opportunity Grants:* Teacher research experiences with NSF principal investigators.
- *Advanced Technological Education:* Teacher preparation and professional development are allowable activities under the program to improve training of technicians for high-performance workplaces.

Department of Defense

- *Department of Defense Dependents' Schools:* Current activities target DODDs schools as a testbed for telecommunications networks.
- *Summer Associateships for High School Science and Mathematics Faculty* Research opportunities for outstanding teachers at U.S. Army labs.

National Aeronautics and Space Administration

- *NEWESTINEWMAST Programs:* Offer inservice training at NASA Centers to improve teacher knowledge in aerospace technologies.
- *Aerospace Education Services:* Teacher workshops on integrating aerospace topics into curriculum.
- *Education Satellite Videoconferences:* Teleconferences for inservice use on scientific topics.

Department of Agriculture

- **4-H** *Leadership Centers:* Land-grant colleges and universities train teachers and others to implement science-technology curricula.
- *Teacher Research Fellowship Program:* Teacher research opportunities with Agricultural Research Service scientists.

TABLE 6-3 (cont'd.): Additional Current Sources of Federal Support for Technology-Related Teacher Development

Department of Health and Human Services
- *Minority High School Student Research Apprenticeship Program:* Inservice and preservice training to minority teachers, teachers in largely minority schools, and minority undergrads interested in science teaching careers.
- *Summer Fellowship Program:* Inservice and preservice teacher training in microbiology lab techniques and electronic databases, summer internships in National Institutes of Health laboratories, workshops on incorporating new skills into curriculum.

National Endowment for the Humanities
- *Summer Seminars for Teachers:* Summer humanities studies for K-1 2 teachers; technology may be a resource.
- *Elementary and Secondary Education in the Humanities:* Program to improve humanities teaching in K-12 schools; includes teacher institutes in which technology may be a resource.
- *Special Opportunities in Foreign Languages:* Teacher institutes and other activities to improve foreign language instruction at all levels; technology may be a resource.

OTHER AGENCIES

Department of Transportation
- *Aviation Education Workshops:* Familiarizing teachers with aviation education curricular materials.

Department of Energy
- *Laboratory Partnerships, Local Programs, Regional Systemic Efforts:* Variety of lab-based teacher training and K-1 2 education improvement projects in science and technology.

Smithsonian Institution
- *Project SPICA* (Support Program for Instructional Competency in Astronomy): Summer institutes and teacher-leader training in astronomy for K-12 teachers and college faculty.

Environmental Protection Agency
- *Environment/ Education Grants:* Support can include teacher training to develop and implement models for environmental education.

National Endowment for the Arts
- *Arts in Education.'* Teacher professional development is one of many activities.

Interagency Initiative: NASA, NSF, and National Oceanic and Atmospheric Administration
- *GLOBE Program:* Grants for developing curricula, data collection and communication technologies, and teacher training in support of worldwide environmental science experiments.

This list is meant to be illustrative and is not a complete inventory of all federal programs with components for technology-related teacher training.
SOURCE: Office of Technology Assessment, 1995.

national level (e.g., the NSF Teacher Enhancement Program), the amount of support for technology-related teacher development varies from year to year, depending upon the priority given to technology or the kinds of proposals submitted. Until the passage of the Improving America's Schools Act, the two pieces had not come together: programs devoted to professional development did not mandate or recommend that grantees consider technology as either a topic for training or a mode for delivery, while programs that provide funds to acquire technology or expand its use did not always require attention to teacher training needs.

In part because of these characteristics, federal support for technology-related teacher development has tended to be highly variable, fragmented, and lacking in a unifying strategy or clear leadership. As a subcommittee of an ED steering group concluded in 1992, "Since the establishment of the Department in 1980, very little initiative or coordinated effort has been taken by ED to promote or guide educational technology

efforts in the schools."[10] As discussed in detail later in this chapter, this situation has begun to change.

NEW OPPORTUNITIES FOR FEDERAL LEADERSHIP

The federal government is starting to exert stronger leadership in educational technology and teacher training, as signaled by several new legislative and executive initiatives. **As a result of new legislation, the Department of Education now has greater authority and stronger directives to develop and implement a coordinated federal policy for educational technology.**

Goals 2000: Educate America Act

The major purpose of Goals 2000 is to encourage states to establish content and performance standards for student learning in core academic subjects and then to develop comprehensive school reform plans based on these standards. These state improvement plans must include "a process for providing appropriate and effective professional development, including the use of technology, distance learning, and gender-equitable methods, necessary for teachers, school administrators, and students to meet state content standards and state student performance standards." Furthermore, the act also authorizes grants to states to develop systemic plans, as part of their broader state improvement plans, to increase use of educational technologies for student learning and staff development. For FY 1994, $5 million was appropriated for this purpose.

The act also required ED to establish an Office of Educational Technology. This office is responsible for reviewing, coordinating, and overseeing federal educational technology policy.

With encouragement from the Goals 2000 Act, national groups are developing voluntary national content standards in core subjects, including standards for what teachers should know and be able to do. The mention of technology in these standards could send a strong signal, while the omission of technology could constitute a setback. Together the provisions of Goals 2000 could give stronger federal encouragement to states and school districts to use technology both to support curricular reforms and to provide professional development.

Improving America's Schools Act

The Improving America's Schools Act extends and amends most of the major federal elementary and secondary education programs supported under the Elementary and Secondary Education Act. It also contains far-reaching amendments affecting educational technology, most significantly the new Title III of the ESEA—the most comprehensive federal education technology legislation to date and a turning point in the federal role in educational technology. Title III authorizes several new federal leadership activities and grant programs in ED aimed at expanding access to and use of educational technologies, strengthening the technology infrastructure, and supporting technology-related technical assistance and professional development (see box 6-1). For FY 1995, the first year of funding, $40 million has been appropriated for the legislation. The Department has committed $27 million of this amount to a Technology Challenge grant competition. This program encourages schools, districts, research labs, nonprofit organizations and businesses to propose technology solutions to educational challenges and problems.

A key provision of Title III charges the Secretary of Education with developing a national long-range technology plan by October 1995 that includes strategies to:

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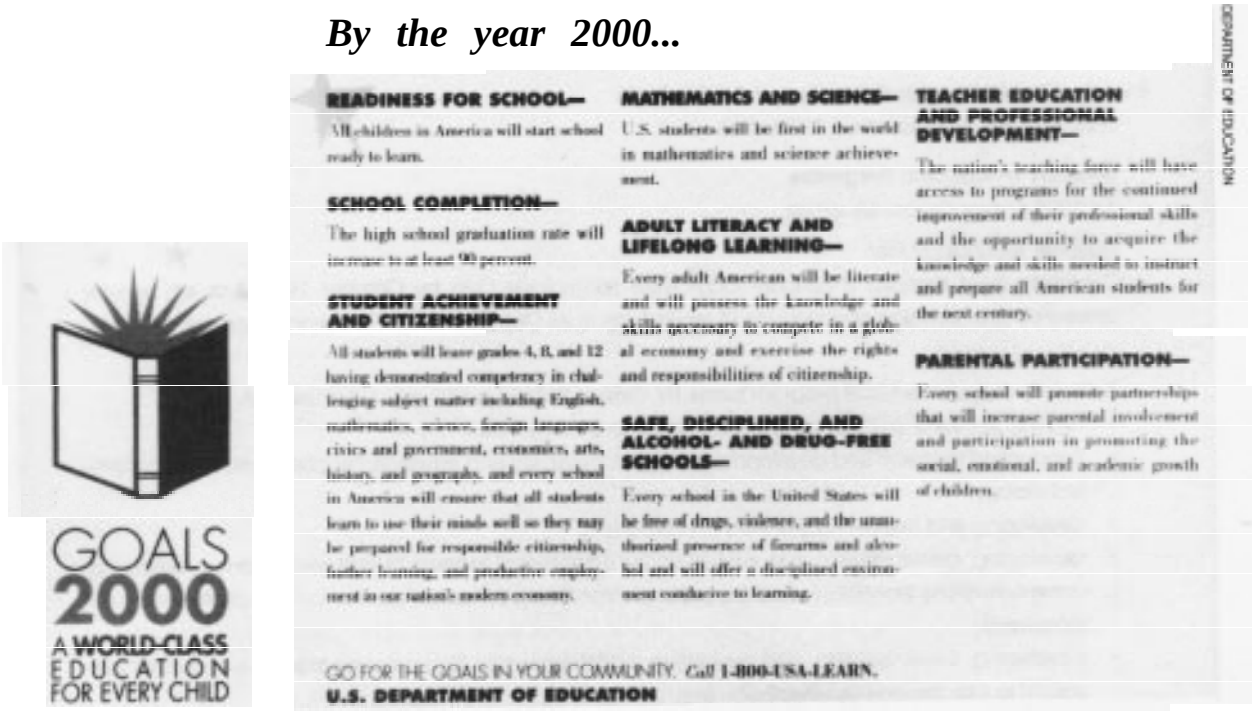
[10]See Tom Hanley (ed.), "1992 Report of the Subcommittee on Educational Technology to the Steering Committee on Math and Science Education, U.S. Department of Education," n.p., November 1992, p. 98. This report noted that ED is quite limited in what it can do without congressional authorization or appropriation—a debatable point since in FY 1994 the Department designated technology-related priorities for several discretionary programs without changes in law.



Goals 2000 *legislation encourages states to increase the use of technologies for student learning and staff development, and requires that school districts provide professional development to meet state content and student performance standards.*

- encourage effective use of technology in all ED programs,
- facilitate technology use through joint efforts with other federal agencies,
- work with state and local agencies and the private sector,
- promote increased opportunities for teacher professional development in the use of new technologies, and
- accomplish other long-range goals.

This plan could provide focus and strategic planning for the federal role in educational technology, not only in ED but across government.

Also noteworthy is the new state and local technology grant program authorized in the new Title III, which has stronger recognition and mandates for technology-related professional development than any current federal program School districts receiving funds under this program are required, to the extent possible, to use funds to provide "ongoing professional development in the integration of quality educational technologies into school curriculum and long-term planning for implementing educational technologies."[11] Funds are also required to be used to expand technology applications to support school reform and ensure that schools have meaningful access to hardware, software, and connectivity, among other activities. School districts also must describe in their grant applications how they "will ensure ongoing, sustained professional development for teachers, administrators, and school library media personnel"[12] to further use of technology.

11 Section 3134 (4) of the Improving America's Schools Act.

12 Section 3135 (1) (D) (i), ibid.

BOX 6-1: Title III, ESEA—Technology for Education Act: Major Provisions Affecting Teachers

Part A—Technology for Education of All Students

Total FY 1995 Appropriation: $40 million

Subpart I—National Programs

FY 1995 appropriation: $3 million

National Technology Plan

Secretary must develop a national long-range technology plan by October 1995 that will include strategies to encourage effective use of technology in all Department of Education programs.

Federal Leadership

Secretary may use national program funds for various federal leadership activities such as:

- helping technical assistance providers improve their services;
- conducting research and development on interoperability and advanced applications of educational technology;
- developing and evaluating software and products;
- developing, demonstrating, and evaluating the educational aspects of high performance computing, communications technology, and the national information infrastructure in providing professional development;
- developing, demonstrating, and evaluating model strategies for preparing teachers and other personnel to use technology effectively; and
- encouraging collaboration with other federal agencies.

Subpart 2—State and Local Programs for School Technology Resources

FY 1995 appropriation: $27 million

Grantees

In years in which less than $75 million is appropriated (i.e., FY 1995), Secretary makes "challenge grants" to local consortia that include at least one district with a high concentration of low-income children. (If more than $75 million is appropriated, funds go to state education agencies based on Title 1, ESEA formula and states make subgrants to school districts).

Statewide Technology Plans

States must develop statewide technology plans (or use their Goals 2000 technology plan or a similar one) that must address long-term strategies for financing educational technology and serving districts with low-income children and high-technology needs.

Local Use of Funds

School districts shall use grant funds, to the extent possible, to:

- develop, adapt, or expand applications of technology to support school reform;
- fund projects of sufficient size and scope to improve student learning and, as appropriate, support professional development;
- acquire connectivity, hardware, and software to ensure that schools have meaningful access;
- provide ongoing professional development in integration of quality educational technologies;
- acquire connectivity with wide area networks; and
- provide educational services for adults and families.

Local Applications

School districts must describe how they "will ensure ongoing, sustained professional development for teachers, administrators, and school library media personnel served by the local educational agency to further use of technology."

BOX 6-1 (cont'd.): Title III, ESEA—Technology for Education Act: Major Provisions Affecting Teachers

Subpart 3-Regional Technical Support and Professional Development
FY 1995 appropriation: $10 million

Grantees
Educational laboratories and other regional entities, to develop regional programs in professional development, technical assistance and information dissemination.

Regional Professional Development
Regional professional development activities may include intensive school-year and summer workshops, video conferences, distance professional development, repositories of professional development resources, and more.

Subpart 4-Product Development
(No appropriation for FY 1995)

Purpose
Secretary makes competitive grants or loans to consortia to develop, produce and distribute technology enhanced instructional resources and programming for student instruction or professional development.

Part B—Star Schools
FY 1995 appropriation: $30 million
Star Schools program extended through FY 1995.

Part C--Ready-to-Learn Television
FY 1995 appropriation: $7 million
New program of grants to nonprofit entities to develop, produce, and distribute video programming promoting school readiness for preschool and elementary children and their parents.

Part D-Telecommunications Demonstration Project for Mathematics
FY 1995 appropriation: $2.25 million
New program of grants to telecommunications entities to conduct a national telecommunications demonstration project to help teachers prepare all students to meet content standards in mathematics. Grantees must use public telecommunications to train teachers in standards-based curriculum.

Part E—Elementary Mathematics and Science Equipment Program
New program, not yet funded, of formula grants to states and school districts to provide equipment and materials for hands-on math and science instruction in elementary schools. Funds shall not be used for computers and peripherals or for staff development.

Part F—Elementary and Secondary School Library Media Resources Program
New program, not yet funded, of grants to states and school districts to acquire school library and media resources.

SOURCE . Office of Technology Assessment, 1995.

A Title III program of grants to regional educational laboratories for technical assistance authorizes regional professional development activities in technology use. As discussed below, the Improving America's Schools Act also amends several other federal education programs to strengthen technology use.

1 Telecommunications Legislation Potentially Impacting Education

Congress has also been debating federal policy that would affect educational access to emerging information infrastructure. A number of bills were submitted in the 103d Congress, with varying ap-

proaches to regulation of access; it is expected that similar bills will be submitted in the 104th Congress. The final outcome of these debates will have a significant impact on the affordability, availability, and access to information resources for educational users. These bills could set in place a new system of educational services and materials for teacher and student use. Clearly teachers will need training and support if they are to derive maximum benefit from the new resources available.

However, as suggested by the past experience of many of the programs described below, ambitious initiatives do not always translate into better programs or stronger leadership. Budget ceilings can limit funding of new programs and appropriations increases for existing ones. New programs can be implemented effectively or poorly. Furthermore, a special office within an agency does not automatically guarantee better administration or coordination. Federal administrators must have the authority, tools, funding, and congressional and White House support to carry out the ideas embraced on paper in a technology plan.

MAJOR TECHNOLOGY-RELATED TRAINING PROGRAMS

As discussed above, there are two important ways that technology-related teacher training can be viewed: technology *as a subject for teachers to learn about or use* (i.e., as a resource for a range of K-12 instructional goals) and technology *as a mode for delivering teacher training of any kind*. This analysis looks at both these emphases in several key programs supported by the major players in this area: the Department of Education, the National Science Foundation, and, most recently, the Department of Commerce.

Department of Education Programs

Eisenhower Professional Development Program—FY 1995 Funding: $359 Million

The Dwight D. Eisenhower Professional Development program, originally authorized by Title II of the ESEA in 1988 and reauthorized under the Improving America's Schools Act, is now the largest federal program aimed at improving professional development. The program has two components: 1) the state grant program allocates funds by formula to states for grants to school districts (LEAs) and institutions of higher education (IHEs) for training K-12 teachers, and 2) the national program provides competitive grants from the federal level for innovative projects of national significance.

Until this year the program has focused on improving mathematics and science instruction through inservice and preservice teacher training. New amendments in the Improving America's Schools Act will extend Eisenhower professional development activities to other core academic subjects beginning in FY 1995, as long as math and science activities are funded at a level of at least $250 million per year.

Eisenhower state grant funding reaches 83 percent of the school districts in the nation—more than any other federal teacher training program.[13] It also reaches more teachers. In 1988-89, an estimated one-third of all math and science teachers in the nation took part in some type of activity funded by the Title II program.[14]

The forerunner of the Eisenhower program was the 1984 Education for Economic Security Act. This act allowed teacher training in "computer learning and foreign languages" only if math and science training needs had already been met. This wording presumed that learning about computers

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[13] U.S. Congress, General Accounting Office, *The Eisenhower Math and Science State Grant Program*, GAO/HRD-93-25 (Washington, DC: U.S. General Accounting Office, 1992), p. 26.

[14] Michael S. Knapp et. al., *The Eisenhower Mathematics and Science Education Program: An Enabling Resource for Reform, Summary Report* (Menlo Park, CA: SRI International,1991), p. iii.

(the dominant technology of the time) was considered a separate topic, not a means for teaching math or science. Revisions in 1988 expanded the policy to permit training in and instructional use of technologies (not just computers) as part of a math and science program and to allow purchase of hardware and software *if all other teacher training needs had been met*.

The 1994 amendments to the ESEA give much stronger encouragement to technology-related professional development. In their Eisenhower plans, states now must describe how they "will use technology, including the emerging national information infrastructure, to enhance the professional development of teachers." State and local Eisenhower grants may be used to provide professional development "in the effective use of educational technology as an instructional tool." Under the national program, the Secretary may fund efforts "to train teachers in the innovative uses and applications of technology to enhance student learning."

Both the state program and the national program are key sources of federal funding for technology-related teacher training. The most recent national evaluation of the state program, conducted in school year 1988-89, found that 20 percent of all LEA Eisenhower projects and 14 percent of all IHE projects provided support for computer education not connected to math or science; well over half of these computer education projects (62 percent) focused on staff development. In addition, a notable share of math- and science-oriented projects involved use of educational technology—in math, about 38 percent of the LEA projects and 41 percent of the IHE projects.[15] Support for technology-related training has continued in more recent years. A 1992 compendium of model programs funded through the state program included several technology-related training projects, such as helping teachers use laser holography to teach about light or use computers to model decisionmaking about natural resources.[16]

Under the national program, the FY 1994 grant competition designated three absolute priorities, one of which encourages model professional development projects that help teachers effectively use technologies in teaching math and science; electronic networking among teachers is required in all projects.[17] The 10 Eisenhower regional consortia funded by the national program to disseminate exemplary materials and provide technical assistance have also provided technology-related training to teachers.[18] Other national program grants are supporting projects to establish an online network to enable teachers to communicate with the National Clearinghouse for Mathematics and Science Education, implement statewide telecommunications networks for teachers, develop video teacher training modules, help teachers use networks to enhance instruction, and train teachers to integrate computer technologies into math instruction for Indian children.[19]

What impact has the Eisenhower program had? A recent evaluation found that the quality of LEA-supported training varied, from well-designed staff development that clearly influenced teacher thinking and classroom practices to "ad hoc training that appeared to contribute little to improved practices."[20] The study also uncovered mixed results regarding the impact of Eisenhower program participation on teacher classroom practices and

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[15] Ibid., pp. 15-18.

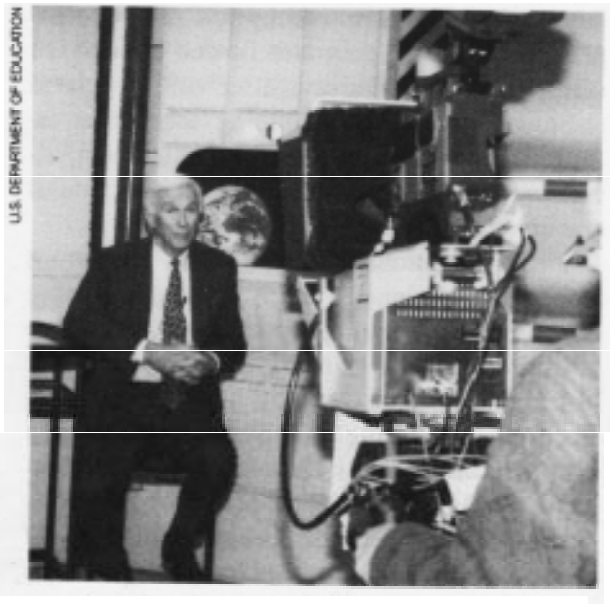
[16] Triangle Coalition for Science and Technology Education, *State Model Programs* (College Park, MD: Triangle Coalition, 1992).

[17] *Federal Register*, vol. 59, No. 84, May 3, 1994, p. 22910.

[18] Keith M. Kershner, "Eisenhower Regional Consortia Progress Update," *Dwight D. Eisenhower Mathematics & Science Education*, vol. 3, No. 3, fall 1993, pp. 6-7.

[19] U.S. Department of Education, *Dwight D. Eisenhower National Program for Mathematics and Science Education: Project Abstracts* (Washington, DC: 1994).

[20] Michael S. Knapp et. al., op. cit., footnote 14, pp. iv-v.



Star Schools funding has brought experts into even the most remote classrooms. Here Gene Cernan, the last astronaut to walk on the moon, discusses space exploration with students and teachers over an interactive instructional television network.

student learning.[21] And much of the Eisenhower-supported training was of low-intensity-an average of six hours of training per participant per year in LEA projects in 1988-89.[2]

In response to these findings, the Department of Education revised program regulations in 1992 to encourage projects of longer duration.[23] In the 1994 amendments, Congress directed all Eisenhower projects to support ''sustained and intensive high-quality professional development" that will have a lasting impact on teacher performance, become part of the everyday life of the school, and be oriented toward continuous improvement.

Star Schools, Title III-B of the ESEA-FY 1995 Funding: $30 Million

With an appropriation of $30 million for FY 1995, ED's Star Schools program makes grants to telecommunications partnerships to support the use of distance-learning technologies to improve student instruction in math, science, foreign languages, and other subjects. A large share of Star Schools funding is used to acquire and operate distance-learning equipment and to develop and deliver programming mostly aimed at students.[24]

Teacher professional development has always been an allowable activity under the program; the 1991 amendments required partnerships to offer a range of courses for educators with different skills and to train participating teachers to use telecommunications equipment and integrate distance-learning activities into the curriculum. In FY 1991, an estimated 22,600 teachers participated in Star Schools staff development activities and another 720 teachers received college credit courses through the system.[25] In 1992-93, about 130 different general staff development activities were offered by Star Schools partnerships, varying in length from l-hour to 6-hour segments, with some 10-hour telecourses. Most of these activities were "one-shot" teleconferences, and most were underused. A recent national evaluation suggests that **"general staff development was perhaps the weakest component of Star Schools** projects."[26] Many of the distance-learning staff development activities imparted information to teachers as passive recipients-in other words, old delivery in a new package. Effectiveness

[21] Ibid, p. 23.

[22] Ibid, p. iv.

[23] James B. Stedman, "Eisenhower Mathematics and Science Education Act: Overview and Issues for Reauthorization," Congressional Research Service, Library of Congress, CRS Report for Congress 93-5 EPW, December 1992, p. 12.

[24] Tushnet et. al., op. cit., footnote 7, p. 2

[25] U.S. Department of Education, ***Annual Evaluation Report: Fiscal Year 1991*** (Washington, DC: 1992), p. 614-2.

[26] Tushnet et al., op. cit., footnote 7, p.71.

would probably increase, the report concluded, if projects used the interactive aspects of the technology to foster learning communities.[27]

The 1994 amendments to the ESEA continued a move begun by ED to strengthen professional development activities through distance learning. Star Schools funds may be used to develop and acquire preservice and inservice programs "based on established research," to establish teleconferencing facilities for making interactive training available to teachers, to provide professional development to teachers, to train instructors to use distance-learning equipment and integrate programs into the classroom, and to provide teacher training for teaching core subjects. Priority for funding is given to applicants that, among other characteristics, have substantial capabilities to provide professional development and to train educators to integrate telecommunications into school curriculum.

Title I of the ESEA— FY 1995 Funding: $7.2 Billion

Title I (formerly Chapter 1) is the largest single federal education program. Nearly every school district in the nation participates in the program, which provides supplementary instruction in academic subjects to low-achieving children in high-poverty schools. Because of its size and reach, Title I is a potent force in education today.

Professional development for teachers who work with Title I students has always been an allowable activity, although the amount or percentage of funding for this activity in recent years is not known.[28] It has been found, however, that staff development supported by Title I "is generally of short duration offering cursory coverage of multiple topics."[29]

Educational technologies, primarily computers, are used in over half of Title I projects.[30] Despite large investments in hardware and software and the popularity of computer-assisted instruction in Title I projects, in the past very little Title I support has been devoted to helping teachers of Title I students use technologies effectively. The extent of Title I staff development that addresses educational technologies is unknown,[31] although it was not among the 10 most common topics covered in staff development for Chapter 1 teachers in 1991.[32] Because Title I funding is so large, however, even a 1 percent share of Title I funds for professional development would amount to a $72 million contribution. Therefore, Title I presents a potentially large untapped source for technology-related professional development.

The 1994 amendments to Title I give greater emphasis to professional development and technology use. Title I schools must now "devote sufficient resources to effectively carry out" professional development activities, and schools that do not meet state performance standards must use 10 percent of their Title I grant for professional development. In addition, a new section on professional development requires every school district receiving Title I funds to provide high-quality professional development to improve teaching in aca-

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[27] Ibid., p. 78.

[28] Case study data from a U.S. General Accounting Office review of eight local programs found that in school year 1990-91, the school districts studied used from 0 to 4 percent of their Title I budgets for in-house training. The report also noted that it is possible that more funds were used for training but were categorized as nonsalary classroom services. U.S. General Accounting Office, *Compensatory Education: Most Chapter 1 Funds in Eight Districts Used for Classroom Services* (Washington, DC: 1992), pp. 12-13.

[29] National Assessment of the Chapter 1 Program, *Reinventing Chapter 1: The Current Chapter 1 Program and New Directions Executive Summary* (Washington, DC: U.S. Department of Education, Office of Policy and Planning, February 1993), p. 21.

[30] National Assessment of the Chapter 1 Program, ibid, p. 80.

[31] Mary Jean LeTendre, Office of Compensatory Education, U.S. Department of Education, personal communication, Nov. 17, 1993.

[32] Mary Ann Millsap, Marc Moss, and Beth Gamse, *The Chapter 1 Implementation Study, Final Report* (Washington, DC: U.S. Department of Education, 1993) p. 7-7.

demic subjects, and this may include "instruction in the use of technology."[33] The Secretary of Education may also fund projects to demonstrate promising Title I practices, including application of new technologies.

Title VI of the ESEA— FY 1995 Funding: $347 Million

Title VI (formerly Chapter 2),[34] which supports state and locally determined school reform efforts, has been a major benefactor of both school technology acquisition and general staff development. In school year 1991-92, about 72 percent of the districts in the nation used Chapter 2 funds to buy computer hardware and software, according to the most recent national evaluation.[35] The school districts examined in a substudy of that evaluation spent 17 percent of their Chapter 2 allocations on hardware and software. Extrapolated nationally, this would amount to $61 million from Chapter 2 funding for technology purchases.

During the same period, about 27 percent of school districts used some Chapter 2 funding on professional development (averaging about 13 percent of their local Chapter 2 allocations).[36] Again, if these percentages were extrapolated nationally, it would come to about $47 million for professional development.[37] It is likely that additional funding for professional development was reported under other Chapter 2 spending categories.

State education agencies (SEAs) may keep a percentage of their federal money for state initiatives (the percentage was reduced from 20 to 15 percent under the 1994 amendments). In 1991-92, states used about 12 percent of their Chapter 2 SEA allocations for professional development activities, or about $11 million. Funding for technology acquisition from this pot of money was less, about 2 percent of the SEA share, or less than $2 million.[38]

The national evaluation of Chapter 2 showed that technology-related training was a common topic for professional development at both the state and local levels. Of the SEA's that supported professional development with Chapter 2, 69 percent addressed the use of technology in instruction as a professional development topic.[39] For local education agencies supporting professional development with Chapter 2 funds, 39 percent addressed technology.[40]

In addition, the Chapter 2 legislation specifically authorized the use of funds for innovative technology education programs for students (which might also involve professional development for teachers). Although this initiative comprises only a small portion of SEA and LEA support,[41] it has encouraged interesting applications. For example, Maryland developed an interactive computer and video system that teachers could use to explore effective teaching methods keyed to specific learning outcomes in the state's

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[33] Funding for this need not come from Title I; they may use Title I, Title II, Goals 2000, and any other sources to provide this professional development.

[34] Although technically now Title VI, this program is commonly referred to as *Chapter 2*, therefore this is the name used in this chapter.

[35] Joan Ruskus et al., *How Chapter 2 Operates at the Federal, State, and Local Levels* (Washington, DC: U.S. Department of Education, 1994), p. 73.

[36] Ibid., p. 175.

[37] Ibid., p. 18.

[38] Ibid., pp. 17-20.

[39] Ibid., p. 143.

[40] Ibid., p. 184.

[41] SEAs in the national evaluation and LEAs in the substudy each used 3 percent of their allocations for this purpose. ibid., pp. 17-18.

central reform initiative. In another example, a district in Texas supported the One Computer Classroom program, which includes software and related staff training to make efficient use of a single computer in a whole-class setting.[42]

When funding for technology-related professional development from all Chapter 2 components is totaled, it is still likely to be far less than the investment in equipment. **The new Title VI is likely to encourage a greater emphasis on technology-related professional development, by specifying that local grants may be used for professional development to assist teachers to use technological equipment and software effectively.**

Individuals with Disabilities Education Act—FY 1995 Funding: $3.3 Billion

The federal government has recently expanded support for technology-related teacher training under the various components of the Individuals with Disabilities Education Act (IDEA)—the major federal legislation for educating children with disabilities (authorization for IDEA is scheduled to expire in the 104th Congress). An impetus for this growth is the need for teachers who educate students with disabilities to be knowledgeable about adaptive and assistive technologies.

The largest IDEA program is the **Part B State Grant** program, which in FY 1995 will provide $2.3 billion to educate children with disabilities. Part B requires states to have a comprehensive system of personnel development that includes procedures for adopting promising technology, where appropriate, and permits funds to be used for teacher preparation and inservice training. Although 90 percent or more of Part B funds are used for direct services to students,[43] 29 states used some Part B funds in 1991 to support inservice training.

The major IDEA program for teacher training is the **Part D Personnel Development** program. Funded at $91 million for FY 1995, this program provides grants to IHEs, SEAs, and nonprofit organizations to train teachers, education personnel, and related services personnel to serve children with disabilities; to demonstrate new approaches to personnel training; and to help states carry out a comprehensive system of special education personnel development. Most of the funding supports undergraduate and graduate degree training in special education, through scholarships, fellowships, and institutional aid. Less frequently, grants are used for inservice training.

In 1990, provisions were added to Part D that specifically authorized training in instructional and assistive technology services, and this has dramatically increased the number of technology-related projects. At least 16 projects in 1993 involved a significant focus on technology. Most of these were graduate programs that trained specialists in assistive technology and augmentative and alternative communications. One project, for example, is developing the competencies of assistive technologists through computer technology. Another is developing teacher training modules using interactive television.[44]

Additional support for technology-related training is available through another IDEA program, the **Part G Program for Technology, Educational Media, and Materials.** Part G subsidizes research, development, and technical assistance to advance the quality and use of technology, educational media, and materials for individuals with disabilities. To date, the focus has been on research and development. For FY

[42] Ibid., p. 57.

[43] U.S. Office of Special Education and Rehabilitative Services, *Implementation of the Individuals with Disabilities Education Act, Fourteenth Annual Report to Congress* (Washington, DC: U.S. Department of Education, 1992), p. 143.

[44] Max Mueller, Office of Special Education and Related Services, U.S. Department of Education, personal communication, Dec. 7, 1993.

1994, however, the Department of Education allocated $1.8 million from this program to fund innovative projects that combine organizational support and professional development in technology, media, and materials.[45]

Similarly, in the IDEA **Program for Children with Severe Disabilities**, one of five priorities for competitive grants in FY 1994 and 1995 was a model inservice training project to prepare personnel to educate students with severe disabilities in general classroom and community settings. Competency areas could include instructional technology and assistive technology.[46]

National Diffusion Network—FY 1995 Funding: $14.5 Million

Begun in 1974, the National Diffusion Network (NDN) is a national dissemination system to promote the sharing of K-12 education programs that have been validated as effective by a review panel. NDN projects span all subjects, specializations, and grade levels. Training teachers is one of the main strategies used by the program to help schools adopt exemplary projects developed in other sites. In school year 1990-91, more than 32,000 school districts adopted NDN projects, and nearly 91,000 educators were trained.[47]

The NDN was an early promoter of educational technology and early provider of technology-related teacher training. Several technology-related projects are included in the current roster of projects available for adoption. Examples are a program to enhance the ability of teachers to use videodiscs to teach core math concepts, a computer simulation program in environmental education, and a statewide program in Washington State that delivers training through satellite technology.[48]

The 1994 amendments outline several explicit NDN functions related to technology. NDN state-level staff must provide professional development to participating school districts; this training should help districts identify educational technology needs, secure technical assistance to meet these needs, and use technology to increase access to professional development.

National Science Foundation Programs

Teacher Enhancement—FY 1995 Requested Funding: $101 Million

Technology is embedded in the purpose of NSF's Teacher Enhancement program: "to improve, broaden, and deepen the disciplinary and pedagogical knowledge of teachers, administrators and others who play significant roles in providing quality science, mathematics, and technology education for students from pre-kindergarten through grade 12."[49] This program provides competitive grants to LEAs, IHEs, museums, and other organizations with records of excellence in professional development. In 1993, the program reached about 21,800 math and science teachers, each of whom was expected to train another four to five teachers.[50]

Many projects involve intensive summer workshops with regular followup during the school year, while others use research internships, workshops, seminars, and other inservice formats. Projects may target teachers in a single school district or in a state, region, or the nation.

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[45] U.S. Department of Education, "Technology, Educational Media, and Materials for Individuals with Disabilities Program, Fiscal Year 1994: Application for New Grants," n.p., 1993.

[46] *Federal Register*, vol. 58, No. 119, June 23, 1993, p. 34189.

[47] Several districts adopted more than one NDN project. U.S. Department of Education, *Annual Evaluation Report, Fiscal Year 1991*, p. 611-2.

[48] National Diffusion Network, *Educational Programs That Work* (Longmont, CO: Sopris West, 1993), pp. 7-17.

[49] National Science Foundation, *Guide to Programs, Fiscal Year 1994* (Washington, DC: 1993), p. 16.

[50] Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources, *Sourcebook* op.cit., footnote 8, p. 16.

Special emphasis is given to projects that lead to systemic reform in education or that provide leadership training to help effective teachers become change agents in their school or district.

Perhaps one-fifth of the current Teacher Enhancement projects focus specifically on technology, and a high proportion of the remaining projects use technology as a vehicle for teaching math and science. Recent projects have focused on helping teachers incorporate computer microworlds and simulations, new laboratory technologies, digital image processing, and telecommunications networks into their instruction. Others have trained teachers in rural areas through distance learning, encouraged teachers to develop video materials for classroom use, and promoted teacher collaboration through electronic networking.[51]

Teacher Preparation—FY 1995 Requested Funding: $18 Million

A new program within NSF, the Collaboratives for Excellence in Teacher Preparation, seeks to encourage comprehensive change in the undergraduate education of future K-12 teachers and increase the number of teachers well prepared in science and math. A reshaping of the former Teacher Preparation program, the Collaboratives strive to produce creative national models for teacher preparation that address both content and methods. Collaboratives must involve faculty from colleges of education; faculty from college departments of math, science, and engineering; and K-12 teachers and administrators. They may also include two-year colleges, community organizations, and public and private sector representatives.

The predecessor NSF program for Teacher Preparation supported several technology-related efforts, including projects to strengthen math teaching through hypermedia instructional materials, prepare K-8 teachers to use calculators and computers in teaching the fundamentals of probability, and integrate computer-based laboratory experiences into physical science courses for future middle school and high school teachers.[52]

The new program strengthens the emphasis on technology. Preparing prospective teachers to employ the latest technologies is one of the goals cited in program guidelines. Every Collaborative project must address the "preparation of students in the use of new tools and technologies." Funds may also subsidize workshops for faculty and mentor teachers to explore and design new methodologies and technologies.[53]

Other NSF programs are likely to be providing additional support for technology-related teacher preparation. For FY 1994, preparation of K-12 teachers was one of three special emphases that cut across all programs in the Division of Undergraduate Education, including programs for course and curriculum development, faculty development, improvement of mathematical science instruction, and laboratory improvement.[54]

Applications of Advanced Technologies—FY 1995 Funding: $10 Million

The Applications of Advanced Technologies program promotes research and demonstrations in "revolutionary" technologies that will be available in five to ten years, with the goal of speeding their transfer to the classroom. Although teachers are not the central focus, most projects have a

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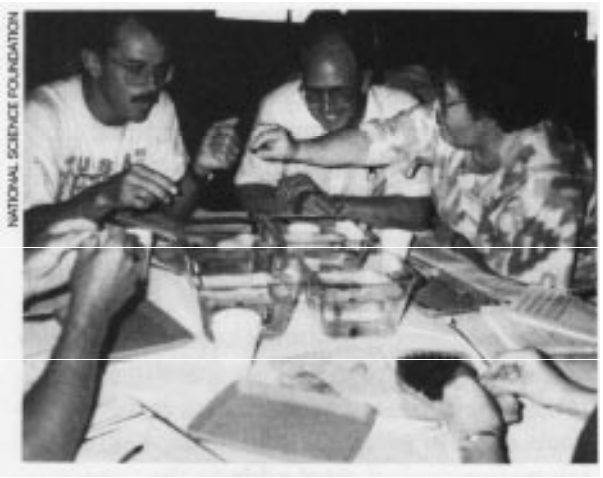
[51] Michael Haney, Teacher Enhancement Program, Directorate of Education and Human Resources, National Science Foundation, personal communication, Nov. 22, 1993; and National Science Foundation, *Directory of NSF-Supported Teacher Enhancement Projects* (Washington, DC: 1992).

[52] National Science Foundation, *EHR Directory of Awards, Fiscal Year 1990* (Washington, DC: 1992), pp. 148, 150, and 157.

[53] National Science Foundation, *Undergraduate Education, Program Announcement and Guidelines* (Washington, DC: 1993), pp. 21-22.

[54] National Science Foundation, *Guide to Programs*, op.cit., footnote 49, p. 18.



Following the standards set by the National Council for Teachers of Mathematics and those of the National Science Teachers Association, teacher training programs sponsored by the National Science Foundation encourage teaching with "hands-on" science, math, and technology activities.

component for teacher support and development.[55] These teacher activities are less formal than those sustained by NSF's Teacher Enhancement program, but are important because they yield valuable information about the kinds of support teachers need to assimilate advanced technologies into their instruction. Support has been in areas of intelligent tools and learning environments (e.g., an algebra workbench, microcomputer-based laboratories, exploration of virtual reality environments); knowledge-based systems and intelligent tutors (e.g., intelligent tutors in calculus, algebra, geometry, and science); and telecommunications and educational infrastructures (e.g., testbeds for educational networking in support of science and math education, worldwide Global Laboratory, and schoolwide Earth Lab projects).[56]

Networking infrastructure for Education–

***FY** 1995 Funding: $15* Million[57]

This program aims to demonstrate the most innovative applications of educational networking for students and teachers, with the goals of developing many different models for using networks effectively to improve education. Grants are made to consortia that include educational agencies or institutions, usually working with other public and private sector partners, and federal funds are matched with funds from other sources. Projects may address networking applications for everything from an entire state-such as a statewide educational network in New Jersey—to a single school with a teacher as principal investigator. Helping teachers learn to use networks constructively is an integral part of all the projects, as is providing ongoing professional development and support through networking.

■ Department of Commerce Programs

The National Telecommunications and Information Administration (NTIA) of the Department of Commerce funds a number of programs to support innovation and capacity building of the nation's telecommunications infrastructure. NTIA is scheduled to play a key role in fulfilling the Administration's goal of deploying an "information superhighway" as outlined by The *National Information Infrastructure: Agenda for Action.*[58] *The* distance-learning grant awards made by NTIA's Public Telecommunications Facilities Program (PTFP) since 1979 have created the underlying infrastructure for distance-learning facilities at the district and state level. The new Telecommunications and Information Infrastruc-

[55] Nora Sabelli, Applications of Advanced Technologies, Directorate for Education and Human Resources, National Science Foundation, personal communication, Dec. 8,1993.

[56] National Science Foundation, *Guide to Programs in the Division of Research, Evaluation and Dissemination* (Arlington, VA: September 1993), p. 15.

[57] $5 Million of this amount is set aside for projects in the Department of Defense Dependents' Schools

[58] U.S. Department of Commerce, ***The National Informatia n Infrastructure: Agenda for Action*** (Washington, DC: U.S. Government Printing Office, 1993).

ture Assistance Program (TIIAP) was created to accelerate the use of telecommunications and information technology in the public sector. Each of these programs require partnerships and matching funds, designed to magnify the impact of federal dollars. For example, the TIIAP FY 1994 grants were matched by state and private contributions at a 2:1 level, bringing the $24.5-million program to a $70-million total investment.[59]

Public Telecommunications Facilities Program—FY 1995 Funding: $29 Million

These grants are made to colleges and universities, school districts, public television and radio stations, and consortia of broadcasters and public agencies to develop Instructional Television Fixed Service (ITFS), microwave, satellite, or other telecommunications facilities to serve local communities. From 1979 through 1994, over 60 grants have been made to support telecommunications services benefiting K-12 school districts. Grants have ranged from $30,000 to $800,000.

Although not targeted to professional development or teacher training per se, the distance-learning projects supported under these grants offer a range of professional development opportunities for schools and districts. For example, with a NTIA grant of $72,546 the Los Angeles Office of Education constructed a satellite uplink facility for use by its Educational Telecommunications Network (ENT). ETN provides satellite-delivered programming for students and teachers in over 350 school districts in 12 counties serving 3 million students. For the 1994-95 school year, ETN's Teaching and Learning Channel is offering 180 hours of professional development for teachers, in topics including methods of teaching math and science, working with parents, and integrating ecology topics in the curriculum. Approximately 25,000 educators are reached in these programs.

Telecommunications and Information Infrastructure Assistance Program—FY 1995 Funding: $64 Million

This program supports both planning activities and demonstration projects for telecommunications networks serving nonprofit agencies and state and local governments. In the first year of this program, $24.4 million in grants was awarded to 92 projects. Eleven grants, totaling $3.72 million, were made to SEAs or school districts to provide telecommunication infrastructure development at the K-12 level. This represents 15 percent of the TIIAP FY 1994 grant support.[60] In addition, a number of other grants went to universities, state agencies, or other organizations for planning purposes or demonstration projects that will also benefit the K-12 sector. At one end of the funding spectrum is the $3,000 grant to the Hall Elementary School District No. 8 in rural southwest Montana to install an Internet connection in its two-room school building. The connection, the town's first, provided the 25 students and 95 residents of the town with access to Montana's statewide information services as well as national resources. At the other end of the spectrum, a $450,000 grant to Columbia University connects the university and the Environmental Defense Fund with students and teachers in the Harlem (NY) Economic Empowerment Zone. Environmental resources will be provided to teachers and students through the extension of high-speed networks and graphical interfaces for teaching. The project will include purchase and installation of new equipment in six schools, provision of curricular material and support, and necessary elements for connections to the university.

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[59] Emilio Gonzalez, Department of Commerce, National Telecommunications and Information Administration, Office of Telecommunications and Information Applications, personal communication, November 1994.

[60] Ibid.

National Endowment for Children's Educational Television—FY 1995 Funding: $2.5 Million

The National Endowment for Children's Educational Television (NECET) supports the creation and production of television programming specifically directed toward the development of fundamental intellectual skills of our nation's children. Although NECET primarily supports programming intended for general viewing, much of the programming it funds also has applicability within a classroom context. An example, of NECET-funded programming is "Wufniks!" This prospective series was supported by a FY 1993 grant of $157,903 for planning, development, research, scripting, and evaluation of a pilot. "Wufniks!" is intended to help 5- to 9-year-olds develop an awareness of, curiosity about, and engagement in general science, math, and technology. A followup grant of $100,000 in FY 1994 is supporting the research and development and scripting of six 30-minute episodes of the series.

SUMMARY OF FEDERAL EMPHASIS IN TECHNOLOGY-RELATED TRAINING SERVICES AND ACTIVITIES

The preceding program descriptions give a sense of the broad strategies and categories of federal support for technology-related teacher development. While there is great variety at the program or project level, some general conclusions about technology-related services and activities in federal programs can be drawn by looking at a number of factors, including the specific treatment of technology, program content and teachers served, the form of training, and uses of technology across programs.

Role of Technology in Training

Federally funded projects today use or address technology in much more diverse and innovative ways than they did just a few years ago (see box 6-2). By and large federal programs are moving away from treating technology as a compartmentalized subject or an end in itself (e.g., providing teachers with a computer "class") and toward viewing technology as a means of delivering, expanding, and changing instruction in a variety of subjects.

Often the focus continues to be educating teachers *about* technology. Activities in these types of projects vary in intensity and strategy from one-time training that acquaints teachers with a single application (e.g., how to use graphing calculators in math instruction) to ongoing support that helps teachers understand how using technology can change teaching style and instructional techniques (e.g., how to use global telecommunications to facilitate a hands-on, project approach to environmental education). In some programs, such as NASA's teacher activities in space science, real-world applications of technology also form the content being studied by teachers and students.

Some federally funded projects are exploring which technological applications are most appropriate for different types of learners, such as children with disabilities or those with limited-English proficiency. Others are exploring effective ways to integrate technologies into the teaching of particular subjects. As a result of the math and science orientation of so many federal training programs, the group that has been most served by federally subsidized training is math and science teachers at the middle and secondary school level. Recently, the math and science training needs of elementary teachers have received greater attention from these programs.

Far rarer is training that integrates technology into the teaching of history, social studies, the arts, or English. Prototypes do exist, however. For example, the National Writing Project supported by ED, which provides professional development in writing instruction, encourages the use of technologies in the writing classroom and has supported a teacher network. A project funded by the National Endowment for the Arts is training teachers to use video technologies as part of broader training in integrating media arts into the

BOX 6-2: Some Roles for Technology in Federally Funded Professional Development Projects

*Training **About** Technology*

- Acquainting teachers with the use of a specific technology, such as satellite technology, and assistive technology for children with disabilities.
- Familiarizing teachers with a variety of technology tools and applications, such as telecommunication networks.
- Training teachers to use technology to facilitate new instructional approaches (e.g., using networks to help students become investigators).
- Teaching teachers to integrate technology into a specific subject (e.g., using computer simulations in physics),
- Helping teachers learn to incorporate technology across the curriculum, such as accessing libraries, databases, and networks.

*Training **With** Technology*

- Delivering telecourses or teleconferences by satellite.
- Videotaping training sessions.
- Videotaping and critiquing of teacher performance.
- Modeling good instruction on video.
- Computer-assisted training modules for independent study.
- Using laboratory tools for research assignments or internships.
- Using telecommunications networks for research, interaction, and collegial work.
- Providing computer databases on instructional issues.
- Providing computer or video guides to accompany training materials.

SOURCE: Office of Technology Assessment, 1995

classroom.[61] A project supported through the Javits Gifted and Talented Education program used telecommunications to link civics teachers with mentors in the legal community.[62] A grant from the ED Fund for the Improvement of Schools and Teachers helped social studies and history teachers create multimedia lessons on a historical period, such as the 1920s, by accessing print, video, and studio materials with Macintosh computers and Hypercard software (see box 6-3).[63]

The expansion of the Eisenhower program to other academic subjects may expand these kinds of models of federal professional development programs for teachers of academic subjects other than math and science. Foreign language programs administered by ED, arts and humanities programs under the National Endowments, and others may have great untapped potential to reach a broader base of teachers and subject areas. To spur technology integration in other subjects, federal grant invitation guidelines could include language encouraging such projects.

Many federal technology-related training projects also address pedagogical issues, such as instructional methods and classroom management. Strategies for meeting the needs of special

[61] Vonnie Sanford, Ohio Art Council, personal communication, Dec. 16, 1993.

[62] U.S. Department of Education, unpublished 1992-93 abstracts from the Javits Gifted and Talented Students Education Program (Washington, DC: n.d., n.p.)

[63] Amanda Podane, University of California at Los Angeles, personal communication, Dec. 16, 1993.

BOX 6-3: How Some Federally Funded Projects Have Integrated Technology into Teacher Preparation and Professional Development

- Teachers learned to implement the "Jason Project" Curriculum, which uses interactive distance learning to 'lake students and teachers along" on undersea robot explorations; together they learn more about science, geography, social studies, and even Greek mythology in the process. ***Eisenhower Professional Development Program, Department of Education***
- Teachers created multimedia lessons for a thematic, interdisciplinary approach to history and social studies: a lesson on the 1920s, for example, might use photo images of the flapper fashions, readings from *The Great Gatsby,* and historical materials from newspapers. ***Fund for the Improvement and Reform of Schools and Teachers, Department of Education***
- Michigan school media specialists learned to use telecommunications technologies, to introduce networking in their schools, and help teachers in their schools develop lessons by accessing databases through the Internet. ***Library Education and Human Resource Development, Department of Education***
- A Star Schools partnership broadcast a six-session, nine-hour professional development telecourse to help middle school teachers use inquiry-based computer programs to support the kinds of math instruction called for in math teaching and learning standards. ***Star Schools, Department of Education***
- Undergraduate teacher education students learned how to produce multimedia materials for reading instruction. ***Fund for the Improvement of Postsecondary Education, Department of Education***
- Students, teachers, university faculty, and community members were linked electronically at a magnet school for math and science; teachers had continuous support through teleconferencing. ***Javits Gifted and Talented Education Program, Department of Education***
- Using McAuliffe fellowship money, an lowa teacher bought 18 electronic keyboards, and took them to area schools to show other teachers how to use them with computers for teaching music by recording accompaniments, transcribing arrangements, and coordinating playing among groups. Another teacher outfitted a school bus with computer-based multimedia technologies, and shuttling between two Kentucky schools, he showed other teachers and students how to integrate technology into all subjects. ***Christa McAuliffe Fellowships, Department of Education***

groups of children are a common theme, as is using a constructivist approach or a "discovery" approach to teaching. Sometimes pedagogical issues are the sole focus of training, as with certain teacher telecourses developed by the Star Schools partnerships. More often, pedagogy is addressed in tandem with subject-matter training. Some federal programs, such as the new Eisenhower program, require professional development to be based on solid research about effective teaching and learning.

Several federal programs expose teachers to state-of-the-art technology through research and training experiences in federal laboratories and facilities. This approach presents unique opportunities for teachers, maximizes the use of expensive federal resources, engages the expertise of federal scientists, and contributes in-kind support to training programs. Exposure to advanced technologies in a training situation creates a challenge for the teacher, however, who must figure out how to translate the new experiences and knowledge into something usable in the classroom, especially when the technology in question is neither practical for students nor accessible to many schools. Some projects have taken steps to address this problem. The Summer Teacher Enhancement Program requires teachers to develop lessons or experiments to take back to their schools and plans followup visits from scientists or research-

BOX 6-3 (cont'd.): How Some Federally Funded Projects Have Integrated Technology into Teacher Preparation and Professional Development

- At the National Wetlands Research Center in Louisiana, teachers spent four weeks in hands-on training and research projects involving light and electron microscopy, learned about the wetlands biosystem, and brainstormed ideas for incorporating microscopy into their curriculum. *Interagency Summer Teacher Enhancement Program, Department of Energy*
- Teachers learned to use the Geological Information Service natural resources database of the Columbia River Estuary to develop a project-oriented curriculum for secondary school students. *Environmental Education Grants, Environmental Protection Agency*
- Minnesota teachers focused on using constructive mathematical and computer models to study scientific phenomena. *Teacher Enhancement, National Science Foundation*
- Teachers and students in poor rural schools in Mississippi were able to access courses, Instructional support, and materials via nine multimedia Interactive Technology Centers housed at high schools across the state. *Public Telecommunications Facilities Program, Department of Commerce*
- By integrating multiple diverse computer networks across the State of Alaska, 81 percent of the population, including K-1 2 educators, will have non-toll access to a combined education/government/library network. *Telecommunications and Information Infrastructure Assistance Program, Department of Commerce*
- In the science and mathematics Teaching Teleapprenticeships program, teacher education students and practicing teachers participate in electronic network-based activities with K-12 students, teachers, university-based scientists, and teacher educators using specially developed communication tools for math and science education. *Applications of Advanced Technologies Program, National Science Foundation*

SOURCE: Office of Technology Assessment, 1995.

ers during the school year. To address this issue further, the Department of Energy is working with the Bank Street College of Education to synthesize research on effective transfer of advanced technologies into classroom settings.[64]

Federal programs are also encouraging professional development and preparation with technology—in other words, as a mode for delivering training. Federally funded projects are experimenting with the full range of options: distance learning, electronic networking, video training materials, videotaped models of effective teaching, videotaping and critiquing of novice teachers, computer-assisted training and modules for independent study, electronic libraries of instructional resources, and more. Networking, rare a few years ago, is receiving increasing attention in federal programs as a vehicle for teacher interaction with peers or students and for followup to formal training. Less common are applications that combine multiple technologies, although some of the national demonstration programs are working on this concept.

[64] Margaret Dwyer, Office of University and Science Education Programs, Program Evaluation Branch, U.S. Department of Energy, personal communication, Dec. 14, 1993.

BOX 6-4: Followup Strategies Used in Federally Supported Professional Development Programs

The value of professional development programs can be enhanced by providing followup and support after formal coursework ends. A number of approaches have been tried, including:

- newsletters, periodic mailings to participants;
- requirements for teacher participants to train or share information with others;
- requirements for teachers to develop projects or lesson plans to take back to school;
- scheduled reinforcement sessions, conferences, or meetings during the year;
- formal planning for curriculum implementation by teams of teachers;
- ongoing access to lending libraries, resource centers, materials, equipment;
- teleconferences, video conferences;
- on-site visits by trainers or colleagues; and
- electronic or video networking with fellow participants, trainers, experts, and others.

SOURCE' Off Ice of Technology Assessment, 1995.

Strategies for Followup and Support

What happens to teachers after formal training ends has been a critical issue in past and present federal programs. Recognizing this, programs such as the Eisenhower Professional Development Program, the NSF Teacher Enhancement program, and others are encouraging stronger followup. Some federal projects now require participants to make an upfront commitment to attend followup meetings during the year, develop projects and lesson plans to implement in their classroom, or share what they have learned with a certain number of other teachers (see box 6-4).

Particularly promising are approaches that use telecommunications networks or interactive video and audio to keep participants in constant connection with each other, their training leaders, scientists, or scholars. Access to networks can reduce the need for scheduled reinforcement sessions and can provide teachers with on-the-spot answers to questions. Some of the newest projects are building a requirement for followup networking into their training activities. The Department of Energy has supported the development of evaluation "templates" that local projects can use to determine whether they are including the most effective practices for training teachers; included in one template is the use of telecommunications for followup. [65]

Strategies for Magnifying Impact

To implement new technology-based knowledge and approaches in the classroom, teachers must have a number of supportive resources and conditions. These include:

- access to the technologies addressed in training;
- appropriate software, instructional materials, and equipment;
- availability of telephones in the classroom;
- complementary assessment practices;
- supportive scheduling and class assignment policies; and
- a school climate conducive to change.

Learning from some of the shortcomings of past teacher training efforts, many newer federally funded projects for professional development are attempting to address local organizational conditions in the design phase. Some programs are re-

[65] Ibid. The templates are included in National Center for Improving Science Education, *Profiling Teacher Development programs: An Approach to Formative Evaluation* (Andover, MA: The NETWORK, 1993).

BOX 6-5: Strategies Attempting To Magnify the Impact of Federal Support for Technology-Related Teacher Development

Past and current federal programs have not been funded at sufficient levels to undertake a massive upgrading of the general U.S. teaching force. However, a number of strategies have been used to expand and enhance the impact of federal professional development dollars. These include:

- training the "trainers of teachers, " such as college of education faculty or district instructional supervisors;
- improving teacher preparation in colleges of education through new or better courses, stronger links with faculty in content departments, and other institutional reforms;
- targeting key teachers or "teacher-leaders" who train peers or promote change in their schools;
- requiring teams of education personnel from the same school or district to attend training together;
- supporting model or demonstration projects that can be disseminated and adopted by other districts;
- developing new organizational arrangements for training teachers, such as field-based training or collaborative training involving school districts, institutions of higher education, and other partners, and
- coordinating professional development with current curricular reforms, such as implementing new content standards for mathematics.

SOURCE: Office of Technology Assessment, 1995

quiring administrators to participate in training, encouraging administrator-teacher teams to participate together, requiring local funding contributions, or asking administrators to agree upfront to provide certain support after teachers return from training.

Federal programs have used various strategies to attempt to magnify the effect of limited federal dollars (see box 6-5).

HISTORICAL PRECEDENTS FOR TECHNOLOGY-RELATED PROFESSIONAL DEVELOPMENT[66]

The current efforts to support technology-related teacher development are not the first time the federal government has tried to influence teacher preparation and professional development in specific directions. In the 1950s,[67] the federal government began supporting efforts in which the strands of teacher training and educational technology intersected.

Much like the present role, past support for technology-related teacher development was mostly optional and came from diverse programs, including programs to develop and expand the use of educational technologies, to train teachers in math and science, to improve education of children with special needs, or to foster educational innovation. Also relevant are certain federal initiatives to reform general teacher preparation and professional development, such as the Education Professions Development Act (EPDA) (see table 6-l).

As with recent efforts, these past federal programs did not follow a neat linear progression but rather were marked by periods of attention and ne-

[66] For a fuller description of past federal efforts to influence teacher preparation and professional development, see N. Kober, "Teachers and Technology: The Federal Role," contractor report prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, May 1994.

[67] Federal involvement in teacher preparation actually dates back to the Second Morrill Act of 1890 and the Smith-Hughes Act of 1917, both of which supported vocational teacher preparation. The history most relevant to this discussion, however, begins in 1954 with the first NSF institutes for secondary school teachers.

glect and propelled by frequently shifting congressional concerns—e.g., heading off Soviet technological threats, staffing federal programs for disadvantaged and handicapped children, or improving the educational quality. Over four decades, numerous programs were started, expanded, and revised—then later reduced, consolidated, eliminated, or allowed to expire, often for reasons that had little to do with continuing need or program quality. A review of some of the key historical efforts reveals parallels between past and present federal policies affecting teachers and technology.

Early Technology-Related Training Projects

In 1954, spurred by reports of increased Soviet production of scientists and engineers, NSF extended an existing program of institutes for college faculty to include an experimental summer conference for high school teachers. By the late 1950s, NSF was sponsoring a variety of *summer and academic-year institutes and training opportunities for high school teachers*.

Although the content of the NSF institutes was not specifically geared to technology—except for use of laboratory and other equipment—the institutes constituted a large-scale professional renewal effort that opened the door for more active federal involvement in teacher training and set a standard for quality. Early institutes were conducted on university campuses, taught by eminent scientists, emphasized disciplinary content knowledge, and targeted the most experienced or talented teachers and teachers of advanced high school subjects. Later institutes reached out to other kinds of colleges, involved content in more general science topics and teaching methods, and targeted elementary teachers, less well prepared teachers, new or re-entering teachers, and trainers of teachers.

Between 1958 and 1974, the "golden era" of NSF precollege institutes, the agency spent nearly $750 million for teacher training and upgrading.[68] **By 1974, about half of the nation's high school science teachers had participated in at least one NSF institute, according to agency estimates.[69]**

What was the impact of this investment? Studies found that the institutes generally succeeded in improving participants' subject matter competency and understanding of scientific methods and encouraged them to continue in their educational careers and assume leadership roles.[70] Research yielded conflicting findings as to whether benefits for teachers translated into improvements for their students; some studies said that pupils of participating high school math teachers had higher achievement scores than pupils of nonparticipants,[71] while others found no such relationship or insufficient evidence.[72]

Another seminal program was the National Defense Education Act of 1958, a collection of categorical programs to strengthen education in fields considered critical to national defense. Among the programs were several related to preservice or inservice training, including *loans and fellowships for undergraduate and graduate studies in education*. The Title XI program, added in 1964, authorized *inservice teacher institutes in a variety of subjects other than math and science* (under the

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[68] Victor L. Willson and Antoine M. Garibaldi, "The Effect of Teacher Participation in NSF Institutes Upon Student Achievement," Research Paper No. 10, University of Minnesota, Minneapolis, MN, 1974, p. 1.

[69] Congressional Research Service, "The National Science Foundation and Pre-College Science Education: 1950-1975," report prepared for the Subcommittee on Science, Research, and Technology of the Committee on Science and Technology, U.S. House of Representatives, Committee Print, 94th Congress, 2d Session (Washington, DC: U.S. Government Printing Office, January 1976), p. 207.

[70] K. Forbis Jordan, "Precollege Science and Mathematics Education: Experiences with the National Defense Education Act and the Teacher Institutes Conducted by the National Science Foundation," Congressional Research Service, Library of Congress, Report No. 82-214 S, December 1982, p. 19.

[71] Willson and Garibaldi, op. cit., footnote 68, p. 14.

[72] Jordan, op.cit., footnote 70, pp. 19-20.

From 1958 through the 1970s, the federal government supported many workshops and summer institutes to help math and science teachers improve their teaching skills.

purview of NSF). Of particular relevance to technology were the institutes to *train library and educational media personnel. The* NDEA also provided grants for schools to acquire laboratory equipment and authorized a program of experimentation in educational television, radio, motion pictures, and similar media; teacher training was not supported to any meaningful degree under these two programs.

Another federal program relevant to educational media and technology was Title II of the Higher Education Act of 1965, which provided *preservice and inservice training for librarians,* including school librarians; this program still exists in modified form. The Higher Education Act also inaugurated a program of *graduate fellowships in educational media.* A 1969 study concluded that the federal programs for media specialists and library training, along with the programs for instructional media for children with disabilities discussed below, encouraged institutions of higher education to revise their instructional media courses to incorporate material on television and computers and helped increase the use of instructional media in the classroom.[73]

A far-reaching federal effort to reform teacher education was the Education Professions Development Act of 1%7 (EPDA), characterized by some as "the peak involvement of the federal government in teacher education."[74] This legislation sought to coordinate and expand personnel training at all levels by combining existing and new federal teacher programs into

73 U.S. Office of Education, *The Education Professions: A Report on the People Who Serve our Schools and Colleges--1968* (Washington, DC: U.S. Government Printing Office, 1969), p. 182.

74 David L. Clark and Robert F. McNergney, "Governance of Teacher Education,'' *Handbookof Research on Teacher Education,* W. Robert Houston (cd.) (New York, NY: Macmillan, 1990), p. 101.

a single legislative package. Among its components were *programs for professional development for vocational education teachers,* new *fellowship opportunities to encourage advanced training in educational television and radio* and *to prepare instructional media specialists.*

To oversee the EPDA programs, a new Bureau of Educational Personnel Development was established in the Office of Education. Implementation of the act was hampered, however, by dissent about its purposes, contention over its administration, limited funding in light of expectations, lukewarm support from Congress, omission of several specialized training programs from the act's coordinating functions, and diffusion of resources across too many programs. A decade later, all the EPDA programs had been repealed except the Teacher Corps, and it was years before Congress again considered comprehensive reform legislation for teacher training.

The Teacher Corps program, established by the 1965 Higher Education Act then subsumed under the EPDA, was a comprehensive and intensive effort to revamp teacher training and also fill teacher shortages in low-income areas. The program recruited young college graduates who otherwise may not have become teachers to teach in teams in low-income schools under the guidance of experienced teacher-leaders. The program sought to provide teachers-in-training with more meaningful field experiences, to incorporate innovative strategies from the latest research, and to strengthen linkages among school districts, higher education institutions, and communities. Although it did not specifically address technology, it is important because it trained over 61,000 education personnel and over 10,000 interns[75] and pioneered strategies that are now commonplace, including field-based preparation, team teaching, flexible grouping, individualized instruction, multicultural education, community-based education, and collaborative decisionmaking.[76]

Special Education Personnel and Technologies[77]

The federal government played a unique role in the training of special education personnel, one that was much more influential and more receptive to the use of educational technology than the federal role in general teacher training. In fact, it was the need to prepare teachers to work with mentally retarded children that prompted the federal government to become involved in special education in the first place.

Federal support for special education personnel development began in 1958 with a program of *grants to states and higher education institutions to train teachers and other specialized personnel to educate mentally retarded children*. Initially this was viewed as a short-term endeavor, but as the federal government broadened its commitment to special education and later mandated free public education for all handicapped children, it became clear that special education personnel training would be a major and continuous undertaking.

Federal attention and funding produced swift and noticeable impacts: rapid growth in the number and capacity of university and state training programs, an equally rapid increase in the number of specialists equipped to teach handicapped children, and improvements in the quality of training offered.

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[75] U.S. Department of Education, Office of Educational Research and Improvement, *An Overview of the Teacher Corps Program, 1965-1982*, n.d., pp. 22-25.

[76] Jerome Freiberg and Hersholt C. Waxman, "Changing Teacher Education," *Handbook of Research on Teacher Education*, W. Robert Houston (ed.) (New York, NY: Macmillan, 1990), pp. 617-635.

[77] This discussion is based on Richard P. Holland and Margaret M. Noel, *A Review of Federal Legislation Concerning Special Education Personnel Preparation, Technical Report* (College Park, MD: University of Maryland, 1985); U.S. Department of Health, Education, and Welfare, *A Summary of Selected Legislation Relating to the Handicapped, 1963-1967* (Washington, DC: U.S. Government Printing Office, 1968); and U.S. Office of Education, *The Education Professions*, op. cit., footnote 73.

BOX 6-6: Early Federal Support for Training Special Education Teachers in Instructional Media and Technology Applications

The federal movement to make instructional media more available to disabled persons began in 1958 with enactment of a free loan service of captioned motion pictures for deaf persons. The popularity of this program highlighted the urgent need for better dissemination and personnel training in special education media.

In response, two types of centers were created. A network of Special Educational Instructional Materials Centers (IMCs), begun in 1964, collected materials for special education and offered conferences, workshops, institutes, and ultimately university credit courses to train teachers in their use. A parallel network of Regional Media Centers (RMCs) established in 1966 did much the same for media materials for deaf persons.

In 1968 these two types of centers were merged into an IMC/RMC network that experimented with film, television, audio, typewriting, and even computer technologies—as well as more conventional materials—for all types of handicapped persons and that provided related inservice and preservice training. A National Center on Educational Materials and Media for the Handicapped collected and disseminated information about materials and related media training.

By 1974, about 15,000 teachers had been trained in media and materials through these federal programs. Together these programs helped promote wider use of a range of educational technologies, with benefits for both handicapped and nonhandicapped learners. In 1986, the authorizations for all activities related to media, materials, and technologies for special education were grouped under a new Part G of the Education of the Handicapped Act (EHA), the flagship federal law for special education enacted in 1970. This law has now been replaced by the Individuals with Disabilities Education Act.

SOURCES: LeRoy Aserlind, "The Special Education IMC/RMC Network," Educational Technology, vol. 10., No. 8, August 1970, pp. 32-39; S.C. Ashcroft, "NCEMMH A Network of Media/Material Resources, *Audiovisual Instruction,* vol. 21, No. 10, pp. 46-47; William D. Jackson, "The Regional Media Centers for the Deaf," *Educational Technology,* vol. 10, No. 8, August 1970, pp. 45-48, and Malcolm J. Norwood, "Review of Media Services and Captioned Films," *American Annals of the Deaf,* vol. 119, No. 5, October 1974, pp. 460-465.

During the early 1960s, Congress expanded personnel preparation programs to *address other disabilities in addition to mental retardation* and to *cover all levels of inservice, undergraduate, and graduate preparation.* In 1966 the federal government enacted a major state grant program for special education, which included a Part D devoted solely to personnel development.

Developing along a parallel track, the federal government initiated several activities to furnish educational media to help deaf and blind children learn (see box 6-6). These programs included substantial training components and pioneered several innovative uses of technologies.

1 Technology Research, Development and Innovation

NSF was an early leader in developing educational technology and exploring effective ways to help teachers implement it. From 1968 to 1981, precollege technology projects received between 1 and 3 percent of NSF's annual science education budget.[78] *For example, the Precollege Teacher Devel*

[78] For a more complete description of the history of federal support for technology at the K- 12 level, see U.S. Congress, Office of Technology Assessment, *Power On! New Tools for Teaching and Learning, OTA-SET-379* (Washington, DC: U.S. Government Printing Office, September 1989), especially pp. 151-171.

opment in Science Program supported teacher institutes, predominantly for secondary school teachers, in improving the teaching of science. Many of these institutes in the late 1970s supported teacher training in computer literacy and emerging technology applications.

The Office of Education (OE), which later became the Department of Education, had an on-and-off relationship with educational technology. As early as 1967, for example, a few **Title I projects** were using educational television to deliver services to disadvantaged children, and as early as 1969, some Title I projects were pioneering computer-assisted instruction. In at least some cases, these projects trained teachers to implement these technology-based approaches. Little information is available about the nature and extent of these experiments; it appears that the training was short and largely focused on how to use specific television or computer programs with Title I students.[79]

Another early stimulant of technology innovation was the original 1965 **Title III of the Elementary and Secondary Education Act**, which made competitive grants to school districts to demonstrate the feasibility of a wide range of educational innovations. Inservice training was a key strategy for local implementation of Title III projects. As noted by a major study of sustained change in Title III and other federal innovation programs, "successful change agent projects seemed to be operating as staff development projects."[80] Title III was also a pacesetter in piloting educational applications of television, computer, and other technologies and in some cases providing teacher training in or with technology. One 1968 Title III project in rural New Hampshire, for instance, trained art teachers through televised inservice courses produced jointly by a university and a school district.[81]

The *Regional Educational Laboratories and Educational Research and Development Centers* that took shape with federal funding in the 1960s also helped expand the knowledge base in teacher education, promote redesign of professional development strategies, and explore educational applications of technology—roles that they continue to play today. In the 1960s, the Labs and Centers were early promoters of educational television, and experimented with using this medium to deliver professional development, until studies showing limited impact dampened enthusiasm. Several years later the introduction of computer instructional technologies revitalized the role of the Labs and Centers in educational technology research and development.

Between 1965 and 1971, OE drew upon the resources of more than 100 discretionary programs to channel $160 million into more than 500 computer-related projects. This scattershot approach fell short, though, according to then U.S. Commissioner of Education Sidney Marland, because it failed to produce a coherent body of knowledge about effective uses of educational technology.[82]

During the next decade, between 1971 and 1980, the federal government spent about $350 million on projects for educational technology, according to one study. If support for educational broadcasting and school audiovisual equipment is included, the figure is over $1 billion. About half

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[79] Betsy Mynhier, "The Impact of Federal Programs on Learning to Read in Appalachia," paper presented to the International Reading Association conference, Kansas City, MO, April 30-May 3, 1969; Pittsburgh Public Schools, *ESEA Title I Projects Evaluation Report 1967, Volume II* (Pittsburgh, PA: Pittsburgh Public Schools, 1967); and W. Paul Street, "Computerized Instruction in Mathematics Versus Other Methods of Mathematics Instruction Under ESEA Title I Programs in Kentucky," *Bureau of School Services Bulletin*, vol. 45, No. 1, September 1972.

[80] Paul Berman and Milbrey W. McLaughlin, *Federal Programs Supporting Educational Change: The Findings in Review* (Santa Monica, CA: The Rand Corporation, 1975), cited in McLaughlin and Berman, "The Art of Retooling Educational Staff Development in a Period of Retrenchment," Rand paper series P-5985, 1977, p. 2.

[81] New Hampshire Supervisory Union 21, "Inservice Teacher Education Courses in Art and Science for the Elementary Teachers of New Hampshire: An Evaluation Report," n.p., 1968.

[82] U.S. Office of Education, *The Education Professions*, op.cit., 73, p. 182.

the funding came from large grant programs, such as ESEA's Title I, Title IV-B (for library books and instructional materials and equipment), and Title IV-C (for educational innovation). The remainder came from small discretionary projects with a technology focus.[83] An unidentified portion went toward technology-related teacher training.

In the early 1980s, ED supported *PreCollege Teacher Institutes in Science* for elementary school teachers. Some of these projects trained elementary teachers in computer applications, before the program was consolidated into Chapter 2 block grants. (Chapter 2 consolidated several other teacher training authorities, most notably the Teacher Corps and the Teacher Centers.)

Although the block grant concept meant that no new discretionary programs were funded during this era, then Secretary of Education Terrell Bell promoted his *Secretary's Technology Initiative* aimed at pulling all technology-related projects in the Department under one umbrella. (Funding and program authorizations remained separate, however.) Teacher training to support technology use was authorized in most of these projects, but was not the primary goal. When William Bennett became Secretary of Education, the technology initiative and related emphasis on computer activities ended, remaining a low priority throughout the 1980s.

Educational Television[84]

Commencing with the *NDEA educational television program*, federal funding was instrumental in building the infrastructure and developing programming for educational television; occasionally some of this funding was spent on training the educators to use this technology effectively.

One of the best-known efforts was the Children's Television Workshop (CTW). Beginning in 1968, the Workshop received funding through the Cooperative Research Act and other OE discretionary authorities to develop a variety of education programs, "Sesame Street" being the best known. As a part of this contract, CTW developed curricular materials, teacher guides, and teacher workshops to encourage the use of "Sesame Street" in the classroom.

A federal educational television effort with a rockier history was the Emergency School Aid Act (ESAA) of 1972. This legislation provided grants to school districts that were undergoing school desegregation. At least 3 percent of the funds were reserved by law for grants to public and private nonprofit organizations to produce, promote, and distribute racially and ethnically integrated children's television programming with an educational mission. Between 1972 and 1979, the former Department of Health, Education, and Welfare (HEW) invested nearly $68 million in the ESAA-TV effort, which yielded 31 series. A national evaluation criticized the program for devoting little funding or attention to facilitating classroom use of the television series; the study recommended better teacher materials and followup.[85] Part of the problem was that OE discouraged the use of ESAA-TV funds for inservice teacher training.

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[83] Andrew Zucker, "Computers in Education: National Policy in the USA," *European Journal of Education*, vol. 17, No. 4, 1982, pp. 401-403; and Andrew Zucker, "Support of Educational Technology by the U.S. Department of Education, 1971-1980," *Journal of Educational Technology Systems*, vol. 10, No. 4, 1981-82, p. 309.

[84] This discussion is based on Cynthia Char and Jan Hawkins, "Charting the Course: Involving Teachers in the Formative Research and Design of the Voyage of the Mimi," *Mirrors of the Mind: Patterns of Experience in Educational Computing*, Roy D. Pea and Karen Sheingold (eds.) (Norwood, NJ: Ablex Publishing Company, 1986); M. Jay Douds, "The Reshaping of an Innovation: ACSN—The Learning Channel," Appalachian Regional Commission, Washington, DC, 1982; Keith W. Mielke et al., *The Federal Role in Funding Children's Television Programming, Volume 1, Final Report* (Bloomington, IN: Institute for Communication Research, 1975); Bernadette Nelson et al., *Assessment of the ESAA-TV Program: An Examination of Its Production, Distribution, and Financing* (Cambridge, MA: Abt Associates, 1980); and Zucker, op cit., footnote 83.

[85] Nelson et al., op. cit., footnote 84, p. 7.

Yet another relevant program was funded by HEW in 1974 through 1976—a *telecommunications demonstration using NASA satellites*, with projects in Appalachia, the Rocky Mountains, and Alaska. The Appalachian project made particularly strong use of this technology for teacher inservice. Accredited teacher training courses in reading and career education were developed by the University of Kentucky and transmitted throughout the region, with opportunities for live discussion. This demonstration grew into an educational cable network that continued teacher-oriented programming.

More recently, ED and NSF dollars helped develop "The Voyage of the Mimi," a science and math educational television series for classroom and broadcast use that first aired in 1984 and that included companion multimedia teacher materials. Teachers served as consultants and field testers in the development of the curriculum and helped designers determine what training teachers needed to use the series effectively. Distributors were required to provide teacher training, which was done through school-based workshops and sessions at teacher conventions.

Impact of Past Federal Programs

An ever-changing roster of programs and variable funding levels makes it hard to trace long-term effects of prior federal teacher training programs in technology. In addition, programs differed so much in structure, content, and intensity that there are few common bases for generalizations.

Many programs did not conduct adequate, timely, or objective evaluations; often there was no funding reserved for this purpose. Few conducted formal evaluations or control-group studies assessing changes in teacher behavior or student outcomes. When evaluations were conducted, they were often little more than surveys of participants' reactions to training activities. Furthermore, there was often no clear consensus about which goals and outcomes were most important or worthy of assessment. And when evidence of teacher or student outcomes did appear, it was hard to attribute it definitively to a particular federal program because of the myriad influences that affect teaching and learning.

The studies that are available look at the entire teacher training program and do not single out technology-related aspects. Still, their findings have implications for the more focused technology training efforts underway today.

Evidence is available regarding several outcomes of federal teacher training programs in a wide number of areas: numbers and kinds of participants affected; knowledge and skills acquired by teachers; changes in instructional methods and teacher effectiveness; effectiveness of teacher-leaders in reaching peers; improvements in student learning and attitudes; adoption and impact of model programs; and changes in institutional behavior, organizational structures, and strategies for teacher education. Based on these measures, results are mixed.[86] The federal government had a clear and positive impact on some of these goals and a negligible or uncertain impact on others. Moreover, impact and effectiveness varied enormously from program to program, and from site to site. And in some cases, federal programs had undesirable negative side effects. These positive and problematic outcomes are summarized in box 6-7.

LESSONS FROM PAST AND PRESENT FEDERAL EFFORTS

The history of federal programs in support of teacher preparation and professional development over 40 years holds several lessons that ought to be considered in forging future policy. **Many different approaches to improve teacher training have already been tried, leaving a record that can be plumbed before the same strategy is tried again.**

[86] See, e.g., U.S. Congress, General Accounting Office, *Precollege Math and Science Education: Department of Energy's Precollege Program Managed Ineffectively,* HEHS-94-208 (Washington, DC: September 1994).

BOX 6-7: Summary of Impacts of Federal Teacher Development Programs

Positive Outcomes of Past Federal Teacher Development Programs

- *Participation in federal training programs produced substantial improvements in the knowledge, attitudes, behavior and career advancement of many teachers.*
  For example, participants were more likely to experiment with new approaches, use technology more appropriately, use a wider variety of teaching techniques, and become more involved in school and community educational policy issues.[1]
- *Participants perceived that federal programs had positive effects at the institutional level.*
  For example, teacher education institutions added new courses, strengthened collaboration with parents, students or the community, improved "learning by doing" and by competency-based approaches, and improved or extended their student teaching opportunities. Most felt that their graduates were better prepared as a result.[2]
- *At the school district level, federal funding sometimes provided the external stimulus needed to promote change.*
  For example, training familiarized many teachers with innovative instructional approaches and integration of technologies such as audiovisual materials, educational television, and computer technologies.
- *Common goals reinforced across federal programs had a greater influence on practices.*
  For example, attention to science and math education over four decades and across many federal programs infused more discipline-specific content into teacher preparation and inservice programs. Emphasis on children with special needs heightened attention to instructional issues for these children in all teacher preparation and inservice programs.

[1] Roy A Edelfelt, Ronald G Corwin, and William I, Burke, "The Impact of Federal Funding for Research and Demonstration on Teacher Education, " *Handbook of Research on Teacher Education,* W Robert Houston (ed.) (New York Macmillan, 1990), pp. 176-177.

[2] Preston M Royster and Gloria J. Chernay, "Teacher Education: The Impact of Federal Funding" (ERIC ED 218218, 1981), pp. 169-177 Another survey of federal Impacts conducted in 1988 corroborated some of these findings Over 70 percent of the respondents believed that federal programs were responsible for many significant new practices in teacher preparation, and a majority felt that teacher preparation had become more practical because of federal programs. Edelfelt, Corwin, and Burke, op. cit., footnote 1, p 175.

(continued)

Why hasn't federal government support resuited in greater long-term changes in teacher preparation and professional development? Several characteristics of federal programs appear to hamper effectiveness and mitigate against sustained change.

Teacher preparation and professional development have been relatively low federal priorities to date. The total funding for all programs specifically targeting teacher-training pales in comparison to such high-priority programs as Title I/Chapter 1, Pen Grants and other student aid, and state grants for children with disabilities. The optional nature of many teacher training authorities has made the past federal attention to teacher development issues ring somewhat hollow.

Federal efforts to influence teacher training have been diffuse and uncoordinated. Federal policy has been carried out through dozens of discrete programs. Somewhere in the history can be found something for almost every purpose: teacher quantity, teacher quality, subject matter knowledge, pedagogical knowledge, the best teachers,

BOX 6-7 (cont'd.): Summary of Impacts of Federal Teacher Development Programs

Problematic Outcomes of Past Federal Teacher Development Programs

- *Most did not seem to yield long-term change.*
  For example, most projects reverted back to former practices after the grant ended;[3] school of education programs were particularly resistant to sustained change. Some deans and others at institutions of higher education were unconvinced that programs led to improvements in faculty teaching, better supervision of practicum experiences, and Incorporation of research findings into teacher preparation.[4]
- *Budget decisions were not always linked to project evaluations.*
  For example, the Department of Energy's Precollege Math and Science Education program did not evaluate half of its most resource-intensive projects, while other evaluations were of poor quality. As a result, many decisions to increase budgets or manage projects were based on inadequate information.[5]
- *Federal programs have not usually reached beyond a small fraction of the total teaching force.*
  For example, most programs have targeted subsets of teachers (e.g., math and science), while in the humanities and other subjects, the impact IS much less significant and, in some discipline's, negligible. The Inclusion of special needs students into regular classes creates critical demands for training but federal programs are meeting only a portion of the demand for specialists, and meeting very little of the need to train regular classroom teachers to use educational technology effectively with special needs children.
- *Involvement in multiple programs created some undesirable side effects at the local level.*
  For example, programs have expressed concern with complex and bureaucratic regulations, deficient monitoring procedures, a short-term project mentality, hasty procurements, inadequate resources, and lack of coordination among federal agencies and programs.[6] Problems arose when goals and operational requirements of various programs did not mesh well with each other or with the core local educational program, producing a clash in teaching methods or inhibiting a hollistic approach to staffing and instructional methods.[7]

[3] Roy A. Edelfelt, "The Impact of Federal Funding on Teacher Education, " *Educatioonal Horizons, vo. 67, No. 1-2,* fall-winter 1989, p 49

[4] Edelfelt, Corwin, and Burke, op cit. footnote 1, p 177

[5] U S Congress, General Accounting Office, *Precollege Math and Science Education Department of Energy's Precollege Program Managed Inefficiently HEHS-94-208* (Washington, DC September 1994)

[6] Edelfelt Corwin, and Burke op cit. footnote 1, pp. 177-178

[7] Jackie Kimbrough and Paul T. Hill, *The Aggregate Effects of Federal Education Programs* (Santa Monica, CA: The Rand Corporation, 1981)

SOURCE Off Ice of Technology Assessment, 1995

teachers most in need of improvement, preservice, and inservice have all been "priorities." Limited funding has been spread across many different goals. What has been lacking is a unifying philosophy or an overall policy strategy.

Coordination has been a particular problem, beginning with the early years when both NSF and OE were operating teacher institutes. Attempts to bring more coherence have not been very successful, often because aspects of the legislative process undermined them.

Federal attention to and support for teacher preparation and professional development has been sporadic and lacking in continuity. Programs have come and gone, waxed and waned, in response to the latest perceived crisis or the most recent data on teacher supply and demand. Laws

have been enacted that have never been funded,[87] funded inadequately, funded late, or funded for just a few years. This mentality has hindered meaningful and sustained commitment required to solve substantial national problems.

Many programs were "disrupted by fickle political forces" before they were able to achieve momentum,[88] and others were discontinued for political reasons even when they seemed to be working. The lack of deep interest in teacher training issues in Congress has been reinforced by the indifference of the public to teacher needs. Administration support has been variable and often weak, and advocacy by those with a direct interest has not always been successful.[89]

Many programs have had goals that were too ambitious, in light of their funding levels, project periods, or chosen strategies. Filling teacher shortages, reforming schools of education, and training regular classroom teachers to work with children with disabilities are examples of ambitious goals that would seem to necessitate sustained federal attention, considerable resources, and well-designed strategies. Yet these factors have seldom been present. The rhetoric accompanying new federal initiatives sometimes promised "more than [was] possible within the limits of the existing knowledge base, technology, and resources."[90] Often programs were expected to accomplish too much too quickly, or tried short-term solutions to persistent problems.[91]

With some exceptions, such as the Teacher Corps, federal programs have tended to operate at the margins, avoiding the larger state, local, and institutional policies and organizational issues affecting teacher preparation and professional development. The most common mode of training has been a short-term institute or workshop in the context of a specific project—the type of effort that could be easily marginalized by the sponsoring institution. Less frequently have projects addressed local factors found to be associated with sustained changes. The Rand Change Agent study noted that two of the most important factors influencing longer-term change were institutional support from administrators and a well-considered local implementation strategy, yet these factors were lacking in many of the programs examined.[92]

Insufficient funding and attention has been devoted to evaluation. Most past programs did not conduct evaluations needed to determine classroom impact or national impact or discern which practices were most effective. Some programs had no national or formative evaluations, and some did not even have descriptive assessments. When evaluations were conducted, they were not always used to improve programs in subsequent years.

Many of these problems persist. The quality, extent, and timeliness of evaluation practices vary

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[87] Even today Title V of the Higher Education Act authorizes several programs focused on teacher preparation and professional development that have never received appropriations.

[88] Roy A. Edelfelt, Ronald G. Corwin, and William I. Burke, "The Impact of Federal Funding for Research and Demonstration on Teacher Education,"*Handbook of Research on Teacher Education*, W. Robert Houston (ed.) (New York: MacMillian, 1990), p. 183.

[89] David H. Florio, "Federal Policy and the Improvement of School Personnel," *Viewpoints in Teaching and Learning*, vol. 54, No. 4, October 1978, pp. 154-155.

[90] Edelfelt, Corwin, and Burke, op. cit., footnote 88, p. 182.

[91] K. Forbis Jordan and Nancy B. Borkow, "Federal Efforts To Improve America's Teaching Force," Congressional Research Service, Library of Congress, L.B. 2842 A, March 1984, p. 2.

[92] Berman and McLaughlin, op. cit., footnote 80, pp. 2-3.

substantially among current science, math, engineering, and technology education (SMET) programs.[93] Practices run the gamut: formal evaluations, descriptive reviews, case studies, self-evaluation questionnaires, or anecdotal reports.

A federal interagency review found that of the 116 federal programs for K-12 science, math, engineering, and technology, only 30 (or about one in four) had been evaluated.[94] "For a majority of federal SMET programs, no evaluation information is available at all, or no serious inquiry beyond anecdotal or self-reported data has been made."[95] The review further found that less than one-half of 1 percent of the budgets of the relevant programs was spent on evaluation.[96] As a result, federal programs often lack a rational basis for strategic planning decisions or spending decisions.

The impact of "demonstration" programs intended to produce effective models that can be replicated often has been limited by inadequate funding, variable quality, lack of evaluation, or inattention to administrative mechanisms to promote wide-scale dissemination. Many past and present "demonstration" projects have not developed approaches that are particularly innovative or exemplary, and many do not have very effective dissemination strategies. A federal interagency committee found that in federal SMET programs, less than 1 percent of the funding was used for dissemination. "Valuable education resources developed with federal funding . . . have not been shared effectively," the committee concluded, recommending improved dissemination and better "marketing" of programs to target particular audiences (see box 6-8).[97]

This situation is improving, however. Steps have been taken to improve dissemination through the Eisenhower National Clearinghouse and Regional Consortia, through new multipurpose technical assistance centers authorized by the 1994 ESEA amendments, through guidelines for the Teacher Enhancement program, and through several technology-based initiatives.

There has been little attention to the continuum and interaction between preparing new teachers and enhancing the skills of those already on board. Again, based on supply and demand, federal support has been focused at some periods of time on preservice and at others on inservice teacher development, usually one at the expense of the other. In general, more support and attention have been focused on upgrading the skills of teachers already in the classroom, rather than on developing new teachers through support for schools and colleges of education, signaling what may be a short-sighted approach to influencing teacher quality in American schools.

KEY ISSUES FOR FUTURE FEDERAL POLICIES FOR TECHNOLOGY-RELATED TEACHER DEVELOPMENT

As the executive branch proceeds to implement the major educational technology legislation passed by the 103d Congress, it is useful to identify some issues to be addressed to improve existing programs and effectively carry out new ones. Federal leaders now have the tools to expand and greatly improve technology-related teacher devel-

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[93] Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources, *The Federal Investment in Science, Mathematics, Engineering, and Technology Education: Where Now? What Next? Executive Summary* (Washington, DC: June 1993), p. 31.

[94] Federal Coordinating Council on Science, Engineering, and Technology, *Sourcebook*, op.cit., footnote 8, p. 62.

[95] Federal Coordinating Council for Science, Engineering, and Technology, *Executive Summary*, op.cit., footnote 93, p. 29.

[96] Ibid., p. 6.

[97] Federal Coordinating Council on Science, Engineering, and Technology, *Sourcebook*, op.cit., footnote 8, p. 11.

BOX 6-8: Factors Associated with Greatest Impact in Prior Federal Teacher Development Programs

Research on sustained change in federally funded projects found that the projects that produced the greatest impact on teacher change tended to share the following administrative features:

- a sharp focus on an area where strong federal leadership could make a difference,
- teacher training as their primary purpose,
- consistent and adequate funding over several years,
- clear and realistic program goals, and
- willingness to change in response to evolving needs and evaluation findings.

Furthermore, at the project level, the following characteristics seemed to be associated with success:

- well-defined objectives,
- more intensive training experiences,
- ownership and commitment among teachers,
- relevance to teacher needs and everyday concerns,
- varied and flexible training format,
- practical and hands-on training experiences,
- an emphasis on individual and small group learning,
- parity among participating institutions,
- active support of administrators, such as deans or principals,
- regular opportunities for planning during all phases of the project, and
- concrete staff training throughout the project.

SOURCES Dale Mann, "The Politics of Staff Development, " paper prepared for the Annual Conference of the American Educational Research Association, Washington, DC, Mar. 31, 1975, pp. 14-16; Paul Berman and Milbrey W McLaughlin, *Federal Programs Supporting Educational Change: The findings in Review* (Santa Monica, CA: The Rand Corporation, 1975), cited in McLaughlin and Berman, "The Art of Retooling Educational Staff Development in a Period of Retrenchment, " Rand paper series P-5985, 1977, pp. 2-3, and Donald C. Orlich, "In-Service Education: Fiscal Implications for *Policy-Makers," Planning and Changing,* vol. 13, No 4, winter 1982, p. 215.

opment. For example, many critical issues could be addressed in the long-range educational technology plan being prepared by ED.

Implications for long-term legislative improvements should also be considered.

■ Setting Priorities

A critical set of issues revolves around how to give more focus to a diffused federal role. Since there is unlikely to be adequate funding to meet the technology-related training needs of all U.S. teachers, and since the role of the federal government in support of teacher preparation and professional development is a limited one, it makes sense to establish some priorities for federal support.

An ongoing question is whether federal programs should try to serve many teachers and districts, asunder the Eisenhower program, or to demonstrate national models for teacher training that could be picked up by other districts, as in the NSF Teacher Enhancement program, or both. Another way to frame the choice is whether to support only the best new ideas and those schools and districts ready to move ahead with them, using them as models for others; or to help districts and teachers who have the most urgent technology-related training needs. Findings from current studies suggest that the two types of programs—focused demonstration programs and broad service programs—play

different and complementary roles,[98] and that there may be a continued need for both. Demonstration programs generate more intensive and innovative strategies and can lead the way for comprehensive reform; but broad service programs are necessary to build awareness among large numbers of teachers. The 1994 amendments continue both strategies. However, in practical terms, it may be difficult to do both. Broad-based support may be so expensive that funding is shallow and diffuse, seeding the field so thinly that a rich outcome is unlikely. Providing comprehensive training at a level that could make a significant difference is likely to be beyond the range of available funding. For example, a study of the Eisenhower program in 1991 suggests that the sustained training endorsed in that study would cost roughtly $890 a year per participating teacher. Extending this model to provide training in educational uses of technologies for the entire K-12 teaching force would be substantial—reaching a quarter of all precollege teachers a year with this level of training would cost approximately $1 billion year.[99] Yet equity concerns may argue against focusing efforts on the already well-positioned, even if leaders can have a broader impact by sharing their experiences with others. In making recommendations, the federal educational technology plan may need to take a clearer stance on this issue.

A related key issue is what kinds of teachers should have priority for technology-related training. Should resources concentrate on supervisors and teacher-leaders, or on those most in need of improvement? On math and science teachers, since technology applications are proceeding rapidly in these fields, or on humanities and other fields, since they have been somewhat neglected to date? On specialists who work with children most at-risk, or on "regular" teachers who work with all children? On elementary or secondary school teachers? Preservice or inservice teachers? Faculty in schools and colleges of education? The current federal role tries to cover nearly all of these target groups, although some very superficially.

Also related is the question of which kinds of institutions should receive priority for federal support—local schools and districts serving the inservice needs of teachers already in the classroom, or schools and colleges of education preparing new teachers to enter tomorrow's classrooms. As discussed elsewhere in this report, many colleges and schools of education are behind school districts and individual schools in terms of faculty expertise, technological resources, and understanding of the potential of technology for education. Given the expected growth in the number of teachers needed in the next decade, it may be cost-efficient to support the development of technology expertise in teacher candidates as they prepare to enter the classroom so that less inservice training will be required once they are on board. Furthermore, federal support encouraging greater connection between colleges of education and K-12 schools may result in partnerships benefiting both, as they share their teaching and technology resources and expertise.

Maximizing the Impact of Reform Efforts

The history of federal teacher training efforts suggests that it is very important to address the broader organizational context in which teachers work. This effort begins with the school site as a locus for change, but it does not end there. Equally important in the U.S. educational system are the state and local institutions that have the main responsibility for teacher policies and that must be relied upon to carry out federal priorities from several layers removed.

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[98] Knapp et al., op. cit., footnote 14, p. vi.

[99] James B. Stedman, U.S. Congress, Congressional Research Service Issue Brief, "Information Technologies in Elementary and Secondary Education: Background and Federal Policy Issues," Washington, DC; 1993, p. 14.

A key issue, then, is how to use federal leadership to integrate technology into existing national, state, and local systemic reform efforts—the most obvious being the reforms fostered under Goals 2000: Educate America Act (Public Law 103-227). If effectively implemented, this legislation has the potential to bring about major interrelated changes in teacher preparation, certification, and professional development, as well as curriculum and testing. The standards that emerge will receive high visibility and could set the direction for most education reforms for the rest of the decade and beyond. The 1994 legislation provides a solid framework for coordinating several different efforts around a similar set of goals and standards, if the opportunities are seized.

A related issue is how to improve coordination and interagency strategic planning among the various federal agencies involved in professional development and technology. Improving coordination is one of the new ED leadership responsibilities under Title III of the ESEA.

Focusing on Necessary Services, Activities, and Support

What are the most effective kinds of federal support to help teachers learn about and apply technology? Should funding allow purchase of hardware and software for teacher use, at home or at school, in order to assure access and use of technology? What are the costs of linking up to or using telecommunications networks for continuing support? Typically, these costs have not been covered in training programs but may be essential components for success.

How could access to telecommunications networks change the nature of programs and services available for training teachers? Although most schools today do not have this access, opportunities to connect and use networks are growing. If current trends continue, one of the most significant uses of telecommunications resources will be teacher's professional use—connecting with other teachers, seeking and sharing information, learning and keeping abreast of changes and developments in their fields. If these networks become used more generally, they could significantly change the nature and form of teacher training and professional development in the future.

Leveraging Resources for Improving and Expanding Training Through Technology

Technology itself can play a critical role in leveraging federal resources. Government networks, resource centers, satellite conferences, and video libraries can extend the sweep of ideas, models, materials, and curricula. If the federal government or other entities choose to emphasize the development of national models, this type of dissemination becomes extremely important.

New funding sources (e.g. the Department of Commerce) and collaborative partnerships with other public sector agencies and with businesses in support of shared use networks can leverage scarce federal dollars in areas benefiting education and the broader community. This is one of the important lessons learned from the Star Schools experience.

Telecommunications and networking technologies can extend the duration of training and provide almost continuous followup and support. Options for building these capacities into all federal training programs need to be explored, along with evaluations of the effectiveness of these telecommunications training and support models.

Aggressive research and development is needed to determine which types of education technologies work best in which settings and for which teachers. Another area for research is whether technology-related training is more effective when delivered in the context of a specific subject area or as a general pedagogical technique, or in some combination. However, because the technologies are changing so rapidly, funders should

not require that grantees be locked into any one model.

CONCLUSION

Recent authorizing legislation and federal leadership have set the stage for greater emphasis on technology-related teacher preparation and professional development than ever before. Congressional budget concerns and proposed executive branch funding limits, however, could limit the potential of these initiatives. Nevertheless, the problems associated with overlap, lack of information, and erratic and changeable support across a range of programs could be ameliorated by the technologies themselves, which could offer robust and flexible resources for coordinating information and streamlining the delivery and continuing support for teacher preparation and continuing growth. Whether the promise of these new opportunities is realized will depend on federal, state, and private commitment and effective implementation of new proposals.