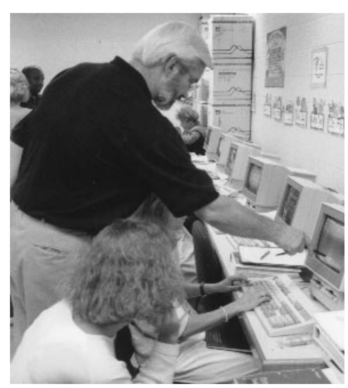
Technology and the Preparation of New Teachers 5

SUMMARY OF KEY FINDINGS

- The need to prepare new teachers to use technology effectively is beginning to receive more attention in state certification standards for teachers, in accreditation standards for colleges of education (COEs), and in various efforts to reform and upgrade teacher education. State policies and leadership still vary widely, however, as does the extent of attention to technology in teacher preparation programs. Moreover, there has been little incentive to link reforms in colleges of education with reform of K-12 schools.
- Technology is not central to the teacher preparation experience in most colleges of education. Consequently, most new teachers graduate from teacher preparation institutions with limited knowledge of the ways technology can be used in their professional practice.
- Most technology instruction in colleges of education is teaching *about* technology as a separate subject, not teaching *with* technology across the curriculum. The majority of teacher education faculty do not model technology use to accomplish objectives in the courses they teach, nor do they teach students how to use information technologies for instruction. Seldom are students asked to create lessons using technologies or practice teaching with technological tools.
- Placing student teachers with technology-using teachers in technology-rich environments can provide valuable apprenticeships and can extend the quality and quantity of "hands-on" technology experience for many teacher candidates. Many K-12 schools have better technology facilities, and more experienced technology-using staff than do colleges of educa-



tion; however, technology is not always considered as a factor for student placements. Furthermore, schools where students do practice teaching may not be located near the colleges of education, increasing the difficulty of placing teacher education candidates in classrooms with the teachers who best model effective technology use.

- Video can extend the range of student observation into classrooms with the best teachers, wherever they are located. Whether live broadcasts from a classroom or tapes, they can provide teacher education students with models of effective teaching and the opportunity for reflection on what constitutes good teaching. Video can also document case studies and record observations for teacher education students to discuss and reflect upon in greater detail after a lesson has been presented.
- College of education administrators—especially deans—are key players in any effort to improve teacher preparation programs. Yet they are often constrained by the fact that colleges and universities have not provided the financial support necessary for supplying COEs with the state-of-the-art equipment needed for preparing their graduates. Furthermore, as in the K-12 schools, investments by COEs in hardware and software are rarely matched with those for faculty training and support.
- Models of change exist and can provide lessons for those seeking to build a bridge between reform of K-12 education and reform of teacher education, using technology as a resource for change and as a solution to some common problems in teacher preparation. However, the diversified nature of teacher education makes dissemination of these models difficult without federal leadership and support.
- Technology can forge stronger connections among student teachers, mentor teachers in classrooms, and university faculty, whether through lab schools, professional development schools, or traditional student placement activities. Students can connect to mentoring and information resources over great distances, expanding opportunities for apprenticeships.
- Electronic networks can provide a safety net for communication, knowledge, and experience for student teachers in the field, as well as for new teachers launching their careers. The loneliness and anxiety of the first teaching experiences can be mitigated through contact with professors and peers via electronic networks.
- If coverage of information technologies is to break out of the isolated role it plays today and become an integral part of the teacher education curriculum, several things must happen. K-12 and university educators must work together to integrate technology into curriculum and classroom practice; teacher educators and K-12 staff must receive considerable technology training and support; models must be developed with technology supporting specific content areas; and teacher education faculty incentives must be revised to encourage greater use and integration of technology for instruction.

INTRODUCTION

There are approximately 1,300 institutes of higher education preparing future teachers in this country. In the 1990-91 school year, nearly 100,000 students graduated with a bachelor's degree in teacher education in the United States.[1] In the next decade, the nation's schools will need to hire about two million teachers.[2] (See box 5-1.)

Ideally these new teachers should be able to use a range of technological tools to provide effective instruction and help their students become comfortable with and knowledgeable about technology. The most direct and cost-effective way to

[1] National Center for Education Statistics, *Digest of Education Statistics 1993*, U.S. Department of Education, OERI, NCES 93-292 (Washington, DC: October 1993), p. 250.

[2] Ibid.

BOX 5-1: Factors Affecting the Demand for New Teachers

The number of teachers needed in our nation's schools is greatly affected by population changes such as those caused by birth or immigration rates. Projections indicate that the school-aged population is growing. As a result, if current policies such as pupil-teacher ratios remain the same, schools will need about 3,3 million teachers by 2003—1.4 million more than are currently employed. Furthermore, the amount of teacher turnover,[1] which accounts for the largest proportion of the demand for new teachers, is projected to increase each year between 1993 and 2000. Much of this IS due to increasing retirement rates as the teacher workforce ages.[2] Even retirement rates, however, are not predictable.

The teaching force is unbalanced with respect to age and experience. Younger teachers—those under 35—are a smaller portion of the teaching force than at any time in the last 25 years, and half of all teachers are over 42, making them eligible to retire at age 55—within 13 years. An important supply-and-demand question is how soon these retirements will occur, and thus when replacement will be needed. Current retirement patterns show a strong tendency for teachers to stay until 62 or 65. If this is the case, then demand for new teachers will increase more slowly. Budget problems in states could make early retirement offers very attractive—in fact, epidemic. Replacing older teachers with younger teachers significantly reduces education costs, even with somewhat increased retirement costs [3]

What about newly qualified teachers? How many of them go into teaching and for what reasons? About 32 percent of newly qualified teachers who were teaching in 1987 reported that they became teachers because they enjoyed working with children, 30 percent because they found teaching satisfying, and 28 percent because they had always wanted to be a teacher. However, despite their training, 28 percent of those newly qualified for teaching did not apply for a teaching job.[4] An examination of all 1985-86 bachelor's degree recipients who were newly qualified teachers suggests that 58 percent were employed as teachers the year after they graduated, 31 percent were employed in jobs other than teaching, and 11 percent were not employed.[5]

[1] Defined as the number of teachers leaving current positions.

2 National Center for Education Statistics, projections of education statistics to 2003 (Washington, DC December 1992), pp. 72-76.

[3] National Research Council, *Teacher Supply Demand, and Clarify* (Washington, DC. 1992), pp. 275-276

[4] National Center for Education Statistics, *American Teachers: Profile of a Profession* (Washington, DC May 1993), p. 125

[5] Ibid., p. 27.

educate teachers about technology is through the preservice education they receive in colleges of education or other institutions.

What is the role of technology in current teacher preparation programs? To what extent do states, COES, and national bodies for reforming teacher education recognize the potential and importance of technology? How do the COES that are leaders in technology approach preparation? This chapter seeks to address these questions.

HISTORY AND CURRENT CHALLENGES OF PREPARING TEACHERS

One of the most important tasks of society is to ensure that each successive generation acquires the knowledge, technologies, skills, and customs essential to maintain that society. For over a century, the primary responsibility for carrying out this task has rested with the *institution* of the American public school—and more specifically with the American school teacher.[3]

The history of teacher preparation has been one of changing expectations. In the 17th and 18th century teachers—like doctors and lawyers—had no formal educational requirements as prerequisites for practice. Those who taught elementary subjects were expected to know how to read, write, and do basic arithmetic so they could teach these skills to their charges. The most highly educated were those who taught in the private secondary schools, a group made up predominantly of clergy. During colonial times, teacher quality was variable; some teachers were barely literate while others possessed a college degree. The importance of religious orthodoxy was one noteworthy constant. Few considered teaching their primary career or goal in life.[4]

In the first decades of the 19th century, the "common school" was established in New England. Common schools created a tradition of education that was free, supported by taxes, and universally available to all students. With the surge in students attending common schools, it became clear that a formal, institutionalized approach to preparing teachers was necessary.

Although the first documented school for the training of teachers in the United States opened under private auspices in Concord, Vermont, in 1823,[5] it was the development of "normal schools" by Horace Mann in 1839 that promised to fill the glaring shortage of qualified teachers and to define teacher competence. Mann's vision aimed for "a new kind of school, a new kind of profession, the principle of taxpayer support and a new vocation for women."[6] With these innovations, the Lexington Normal School opened in July 1839.

Although growing numbers of 19th century teachers attended normal schools, others took part-time or short courses, and some continued to have little or no formal preparation for teaching. In the Midwest and West, the line between normal schools and post-elementary schooling blurred, as the normal school became a place where parents sent their children for a higher education, a sort of academy or high school rather than an institution for training teachers. As normal schools evolved into the model for general secondary schooling in the Midwest and West, their contributions to teacher training grew uneven.

Later, when normal schools evolved into teachers' colleges and then into colleges of education within larger institutions of higher education, differences of opinion emerged about whether the colleges' main goal should be the preparation of teachers or education theory and research. It might be said that normal schools evolved from single-goal institutions to lower-level institutions within the higher educational hierarchy. As one educator observed, "Thus, the normal school developed into a pale imitation of the university, doing what the university does, namely research, less well than the university, and not wishing to do well what it historically did—prepare teachers."[7]

Even after normal schools, and then teachers' colleges, had become widespread, a sizable pro-

[3] See, e.g., James Bosco, "Schooling and Learning in an Information Society," OTA contractor report, Washington, DC, November 1994.

[4] Wayne J. Urban, "Historical Studies of Teacher Education," in W. Robert Houston et al. (eds.), *Handbook of Research on Teacher Education* (New York, NY: Macmillan, 1990), p. 60. See also L.A. Cremin, *American Education: The Colonial Experience 1607-1783* (New York, NY: Harper & Row, 1970).

[5] Richard J. Altenbaugh and Kathleen Underwood, "The Evolution of Normal Schools," in John I. Goodlad et al., *Places Where Teachers Are Taught* (San Francisco, CA: Jossey-Bass Publishers, 1990), p. 137.

[6] Ibid., p. 138.

[7] Urban, op. cit., footnote 4. See also Cremin, op. cit., footnote 4.

portion of teachers still lacked much formal training well into the 20th century; as recently as 1940, less than 50 percent of the teachers in the United States held a bachelor's degree.[8]

The education of educators has obviously reached higher ground in recent decades; today, almost all teachers (99 percent) have at least a bachelor's degree, and almost half (46 percent) have a master's degree or higher.[9] Nevertheless, other factors bedevil teacher preparation programs, including misconceptions about teaching as a profession; misinformed perceptions of the intellectual capabilities of teachers; and negative stereotypes of women and minorities, who traditionally make up a large part of the teaching force.[10]

Teacher education programs today must address countless areas-usually within a time frame of three to four years, at best. Teacher education graduates not only need to be skilled in content, methods, cognitive development, assessment practices, pedagogical theory, education history, technology, and classroom management, but they may also need to know about drug education, AIDS, environmental issues, social and family issues, and whatever else the public decides schools should handle. Although, ideally, "the mission for teacher education should arise out of the mission for schooling," the problem is that the mission of schooling is itself unclear, indeed, schools in general operate under "fragmented goals."[11]

Schools have a difficult task keeping up with changes in what society asks of them. For colleges of education to anticipate these redefinitions in their teacher preparation programs is a daunting task.

Technology may present an extra burden to some colleges of education, but many find it essential to a strong teacher education program.

REFORM IN TEACHER EDUCATION

The way that new teachers are prepared is often under public scrutiny-in the media and press,[12] as well as by educators themselves. Many colleges of education across the country have tried to implement reforms that address public concerns, yet

[8] Richard I. Arends, "Connecting the University to School," in Bruce Joyce (ed.), *Changing School Culture Through Staff Development* (Washington DC: Association for Supervision and Curriculum Development, 1990), p. 118.

[9] Natioal Center for Ecucation Statistics, *Schools and Staffing in the United States: A Statistical Profile,* 1990-91, OERI, NCES 93-146 (Washington, DC: U.S. Department of Education, July 1993), pp. 39,42.

[10] Judith E. Lanier, "Choices for the Twenty-First Century: Will Universities Strengthen or Close Schools of Education?'' vol. LXXIII, No. 4, Phi Kappa Phi Journal, fall 1993.

[11] John I. Goodlad, *Technos,* vol. 2, No. 3, fall 1993, p. 5.

[12] See, e.g., Thomas L. DeLoughry, "EDUCOM conference Focuses on Ways To Improve Teaching," *Chronicle of Higher Education,* vol. XLI, No. 11, Nov. 9, 1994, p. A21. Also, David L. Clark and Terry A. Astute, "Redirecting Reform" Phi Delta Kappan, vol. 75, No. 7, pp. 513-520.

the skepticism persists: some think undergraduate programs produce classroom teachers with limited expertise in the subjects they are expected to teach, while graduate schools prepare specialists who spend little time in classrooms; others find the form and format of teaching in colleges of education antithetical to "real" learning, with those who prepare classroom teachers modeling the "chalk and talk" lecture teaching style. Many observe that there is never enough time for students to be exposed to good teaching or for student teaching under the watchful eye of a competent supervising teacher, nor enough top-notch teachers in model classrooms close enough to the college of education to provide enough successful student teaching placements.

In November 1994, the National Commission on Teaching and America's Future began an 18-month exploration of the profession. It bemoaned "shortfalls" and "woeful neglect of teaching" while addressing new approaches to the problems teachers face amid "challenging new education demands." The commission plans to "identify successful strategies to resolve teacher shortages, especially in urban areas and in math and science, as alternatives to hiring unprepared teachers."[13]

Unprepared teachers are only part of the problem. The interaction between K-12 schools and teacher education programs is an important, generally overlooked variable. In the words of one educator,

> If schools are to be good, the general and professional education of those who teach in them must also be good. If teacher education is to be good, the schools in which future teachers receive a significant part of their preparation must also be good.[14]

Colleges of education, state departments of education, and professional associations have tried many approaches over time to standardize, improve, and professionalize teacher preparation. For example, the National Council for the Accreditation of Teacher Education (NCATE) has developed a "Continuum of Teacher Preparation" that includes quality-assurance measures in three phases—preservice, extended clinical preparation and assessment, and continuing professional development. The continuum depends upon cooperation and coordination with the state education authorities, school districts, and other professional organizations, such as the National Board for Professional Teaching Standards (NBPTS).[15] Additional reform efforts involve developing new models of interaction between COEs and K-12, improvements in teacher certification and licensure procedures, and changes in the accreditation of schools and colleges of education. Technology can play a role in all these efforts.

Rallying Calls for Teacher Education Reform

The release of the report *A Nation at Risk*[16] a decade ago brought public awareness of the quality of American schools to a new high; nevertheless, colleges of education and their professors were neither leaders of the charge to reform, nor considered key elements in implementing change. Two major reports released in the late 1980s began to change this trend. The reports of the Carnegie Forum on Education and the Economy[17] and the

[13] The National Commission on Teaching and America's Future was created through funding from the Rockefeller Foundation and the Carnegie Corporation to establish "a national blueprint to determine how teachers in all communities can be supported and prepared to meet the needs of the 21st century classroom."

[14] John I. Goodlad, "The National Network for Educational Renewal," *Phi Delta Kappan*, April 1994, p. 632.

[15] Arthur E. Wise, Director, National Association for the Accreditation of Teacher Education, personal communication, Nov. 9, 1994.

[16] National Commission on Excellence in Education, *A Nation at Risk* (Washington, DC: U.S. Government Printing Office, 1983).

[17] Carnegie Forum on Education and the Economy, *A Nation Prepared: Teachers for the 21st Century* (Washington, DC: 1986).

Holmes Group[18] addressed improvements in the preparation of new teachers as a key link to educational reform. In addition, the American Association of Colleges for Teacher Education (AACTE) and the Association for Teacher Education made efforts to codify knowledge needed by new teachers.[19]

In its 1986 report, *A Nation Prepared: Teachers for the 21st Century*,[20] the Carnegie Forum's Task Force on Teaching as a Profession—made up of business and government leaders and union and school officials—called for sweeping changes in education policy. Among the eight recommendations, two were specific to the preparation of new teachers: 1) require a bachelors' degree in the arts and sciences as a prerequisite for the professional study of teaching; and 2) develop a new professional curriculum in graduate schools of education leading to a Master in Teaching degree, based on systematic knowledge of teaching, internships, and residencies in the school.[21]

Another influence for reform has been the Holmes Group,[22] a coalition of deans from the graduate schools of education at research universities that, in 1983, began a study of ways to reform teacher education and the teaching profession. Their 1986 report, *Tomorrow's Teachers*,[23] developed a common agenda that included eliminating the undergraduate education major, strengthening and revising both the undergraduate curriculum and graduate professional training of teachers, creating new professional examinations for entry into the profession, and connecting higher education institutions to schools, through the development of *professional development schools*. Professional development schools are places where both teachers and university faculty can systematically inquire into and take part in teaching practice to improve it.

The Holmes Group's agenda has not met with universal acceptance. Many educators have decried the exclusivity of the organization; other educators were concerned about the creation of one specific model of teacher preparation, especially one that required—as the Holmes Group's did—a four-year liberal arts major followed by a fifth year of graduate study in education. Another sticking point has focused on problems associated with the content, cohesiveness, and quality of instruction prospective teachers receive in the colleges of arts and sciences. Some have been concerned that the fifth-year model the Holmes Group advocates may not provide enough time for potential teachers to take all the requisite courses, observe teachers, participate in internships, and develop teaching skills in their subject matter specialties.

The group's most recent report[24] reiterates the value of professional development schools and emphasizes the need to make COEs accountable to their profession and to the public. In addition, the new report says Holmes plans to create alliances with other organizations, such as AACTE

[18] Holmes Group, *Tomorrow's Teachers: A Report of the Holmes Group* (East Lansing, MI: 1986).

[19] M.C. Reynolds (ed.), *Knowledge Base for the Beginning Teacher* (Elmsford, NY: Pergamon Press, 1989); W.R. Houston (ed.), *Handbook of Research on Teacher Education* (New York, NY: Macmillan, 1990).

[20] Carnegie, op. cit., footnote 17.

[21] Ibid., p. 3.

[22] Starting as an informal consortium of 17 education deans, the group took both name and mission from Henry Holmes, Dean of Harvard Graduate School of Education, who in 1927 suggested, "America has yet to be persuaded that the training of teachers is a highly significant part of the making of the nation." Lynn Olson, "An Overview of the Holmes Group," *Phi Delta Kappan*, April 1987, p. 691. Today the group includes deans of more than 80 education schools in research institutions.

[23] Holmes Group, op. cit., footnote 18.

[24] Holmes Group, *Tomorrow's Schools of Education* (East Lansing, MI: 1995).

and national teachers' unions, to support reform efforts in teacher preparation.[25]

Certification and Licensure of New Teachers

The education systems being challenged by current reforms are based on a legacy begun in the 19th century, when many states took over the functions of examining and credentialing new teachers. Typically, the state departments of education controlled public normal schools (and later teachers' colleges), and certification became a question of completing the course of instruction offered by these institutions. Today, state requirements for teachers are created by state legislatures. However, because public school teachers are employed by local boards of education (on the recommendation of the superintendent of a district), and these boards are made up of lay people, it might be said that the public is involved in employing teachers. Thus there is a divided responsibility—among the public sector, universities and colleges, and public schools—for what should be the basis of teaching.

In other professions—medicine, law, engineering, architecture—states have delegated the responsibility for licensing to autonomous standards boards composed of practitioners who establish the standards and processes of the profession for the nation. Teaching does not follow this model.[26] Instead, each state sets its own licensure or certification process for educators[27] and issues different types of certificates. In some cases, state departments of education determine qualifications to teach based on a requisite number of courses. State approval generally comes from reviewing specific teacher education programs on a program-by-program basis, resulting in hundreds of sets of standards for teacher preparation with varying levels of quality. "The generally minimal state-prescribed criteria remain subject to local and state political influences, economic conditions within the state, and historical conditions which make change difficult."[28]

In general, there is a *standard* teaching license or certificate. Each state sets its own standards that individuals must meet by completing an approved teacher education program and fulfilling state or district continuing professional development requirements. (Half the states require students to take a state or national test prior to admittance to a teacher education program. See table 5-1.) States issue both *provisional* and *permanent* credentials. A provisional certificate means a teacher is adequately prepared for initial employment but must meet some additional conditions of further coursework or experience (or both) before receiving a *permanent* certificate. There are also *emergency* teaching certificates, usually issued on a yearly basis, for those who are not yet qualified to teach but who are needed in areas of shortages. Emergency certificates are also used for candidates who lack formal qualifications but whom a district wants to hire for special skills or other reasons.

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[25] Ann Bradley, "Holmes Group Urges Overhaul of Ed. Schools," *Education Week*, vol. XIV, No. 19, Feb. 1, 1995, pp. 1, 8.

[26] Gail Huffman-Joley, "State Standards Boards Will Create a Stronger Profession," *Quality Teaching*, NCATE Newsletter, vol. 3, issue 1, fall 1993, p. 6.

[27] American Association of Colleges for Teacher Education, *Teacher Education Policy in the States: A 50-State Survey of Legislative and Administrative Action* (Washington, DC: spring 1994), p. vii. While the terms *license* and *certificate* are often used interchangeably, the Office of Technology Assessment uses the following terminology adopted by the American Association of Colleges of Teacher Education for its survey of teacher education policy: "A *license* is the official recognition by a state government agency that an individual has met state-mandated requirements and is therefore approved to practice as a duly licensed educator in that state. A *certificate* is a credential awarded by the profession in recognition of advanced skills or achievement. Some states use the term 'certificate' to describe what is more commonly referred to as a license. A *credential* refers to either a license or certificate."

[28] George M. Dennison, "National Standards in Teacher Preparation: A Commitment to Quality," *Chronicle of Higher Education*, Dec. 2, 1992, p. A-40.

Not all teachers today are prepared for their jobs. The National Commission on Teaching and America's Future suggests that, among the more than 200,000 teachers newly hired each year, one in four (50,000) are not fully prepared for their jobs. In the country's largest school district, New York City, more than half (57 percent) of the 4,500 teachers hired in 1992 were unlicensed. In fact, more than 15 percent of all schools and 23 percent of central city schools nationwide had vacancies in 1991 they could not fill with a qualified teacher.[29]

Alternative Certification

Alternative certification programs vary by state and are designed for nontraditional students taking accelerated preparation for teaching. Often, these programs are aimed at encouraging people with special skills or experience (such as retired military personnel) to go into teaching as a mid-career change. Many of those entering the profession through alternative preparation programs begin with emergency certification until they meet the full requirements of their teaching area.

After a period of expansion, the number of states offering alternative certification programs decreased from 43 in November 1993 to 36 in May 1994.[30] Some states have more than one alternative program for licensure; others have dropped alternative programs due to funding difficulties or lack of support from prospective students, school districts, or institutions of higher education. However, approximately 200 of the more than 500 colleges of education accredited by the National Council for Accreditation of Teacher Education still offer alternative certification programs.[31]

Some critics assert that alternative certification candidates lack sufficient pedagogical understanding, which is difficult to acquire after one begins teaching.[32] This is likely to become an even greater concern as standards for teacher education programs in general are raised.[33] Moreover, given the high attrition rate of beginning teachers in general, there is concern that those entering teaching without a strong base of pedagogical skills and experience may be particularly ill-prepared to handle troublesome settings.

Alternative certification does not automatically imply hiring outside the teaching profession, as some critics contend. It also provides a way to bring in qualified teachers from other states. For example, Oklahoma—in adopting the Master Teacher certification that has been developed by the National Board for Professional Teaching Standards—will waive its state certification for certified teachers from other states who pass the NBPTS certification assessments. NBPTS is developing advanced standards and assessments for teacher performance that encompass various components such as portfolios, certification center assessment activities, and essay examinations designed to demonstrate teacher knowledge and skill. Teachers who meet these standards will be designated as "Master Teachers."[34] In fact, this kind of flexibility for teachers who want to move

[29] Linda Darling-Hammond, "The Current Status of Teaching and Teacher Development in the United States," background paper for the National Commission on Teaching and America's Future, New York, NY, November 1994.

[30] AACTE, op. cit., footnote 27, p. v.

[31] Wise, op. cit., footnote 15.

[32] See, e.g., Jonathan Schorr, "Class Action," *Phi Delta Kappan*, vol. 75, No. 4, December 1993, pp. 315-318.

[33] James B. Stedman, Congressional Research Service Report for Congress, "Teachers: Issues for the 101st Congress," Feb. 23, 1990, p. 21.

[34] See, e.g., Arthur E. Wise, "Professionalization and Standards: A Unified System of Quality Assurance," *Education Week*, June 1, 1994; and "The Coming Revolution in Teacher Licensure: Redefining Teacher Preparation," *Action in Teacher Education*, vol. XVI, No. 2, summer 1994, pp. 1-13. See also, Lynda Richardson, "First 81 Teachers Qualify for National Certification," *New York Times*, Jan. 6, 1995, p. A-1.

TABLE 5-1: State Requirements for Entrance to Teacher Education Programs[a]

State	State or national tests[b]	Minimum grade point average	University/college of education entrance standards	Other state requirements[d]
Alabama	✓	✓	✓	✓
Alaska			✓	
Arizona			✓	
Arkansas	✓	✓		
California	✓		✓	
Colorado	✓			
Connecticut	✓			✓
Delaware			✓	
District of Columbia	✓			
Florida[e]	✓			✓
Georgia	✓	✓	✓	
Hawaii			✓	
Idaho	✓	✓	✓	
Illinois			✓	✓
Indiana		✓		
Iowa			✓	
Kansas[f]	✓	✓		
Kentucky	✓	✓		✓
Louisiana[g]	✓	✓		
Maine			✓	
Maryland			✓	
Massachusetts			✓	
Michigan				✓
Minnesota	✓[h]			
Mississippi	✓	✓		✓
Missouri	✓			
Montana				
Nebraska	✓	✓		✓
Nevada	✓			
New Hampshire			✓	
New Jersey		✓		✓
New Mexico			✓	
New York				
North Carolina	✓	✓		
North Dakota		✓	✓	✓
Ohio			✓	
Oklahoma	✓	✓		
Oregon	✓	✓	✓	✓
Pennsylvania			✓	
Rhode Island		✓	✓	✓

TABLE 5-1 (cont'd.): State Requirements for Entrance to Teacher Education Programs[a]

State	State or national tests[b]	Minimum grade point average	University/college of education entrance standards	Other state requirements[d]
South Carolina	✓	✓	✓	✓
South Dakota		✓		✓
Tennessee	✓	✓		✓
Texas	✓			✓
Utah			✓	
Vermont		✓	✓	✓
Virginia	✓	✓		
Washington	✓	✓		
West Virginia				
Wisconsin	✓	✓		
Wyoming			✓	

[a]American Association of Colleges of Teacher Education, Teacher Education Policy in the States, A 50-State Survey of Legislative and Administrative Actions (Washington, DC. AACTE, 1994)

[b]For example, National Teachers Exam, Pre-Professional Skills Test, PRAXIS, California Basic Skills Test.

[c]Standards set by individual Institutions of Higher Education (IHE)/Schools and Colleges of Education.

[d]For example, interviews, other demonstrations of basic skills competencies, course requirements.

[e]Up to 10 percent of an IHE's admission may be to individuals who do not meet standards

[f]Standards are for regents restitutions only

[g]Up to 10 percent of an IHE's admission *may be to* individuals who do not meet standards, but candidates will have to meet standards for licensure

[h]State requires candidates to take the Pre-Professional Skills Test, but scores are not used for screening purposes. The low-scoring candidates are targeted for assistance.

[i]Minimum GPA requirement applies only to graduate program candidates, there is no minimum GPA requirement for undergraduate candidates

between states is one alternative measure NBPTS is encouraging nationwide.[35]

Technology and Certification

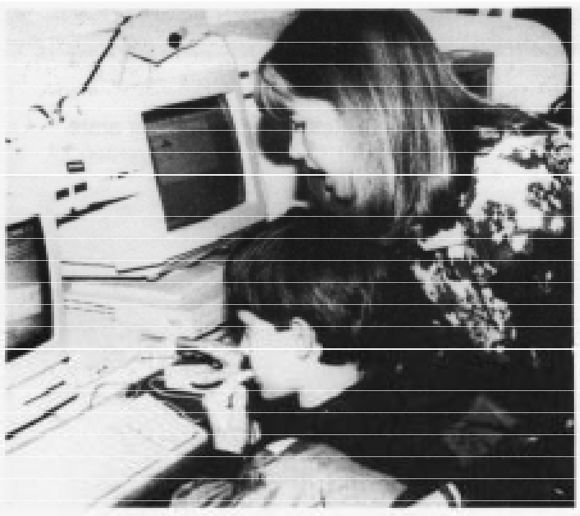
The importance of technology in teacher certification is gaining momentum. A recent survey under contract to the Office of Technology Assessment (OTA) found that at least 18 states require training in computers or technology for *all* teachers seeking certification.[36] Although that figure is far from a majority, it represents an increase over just a few years ago: in 1987 only 12 states had such a requirement for certification of all teachers.[37]

States take various approaches to technology certification requirements. For example, California requires a one-semester course, New Jersey and Texas require a three-credit course, and Kansas and Wyoming require a one-unit course. Washington state law specifies that all teachers must have general knowledge of instructional uses of the computer and other technological developments. In Michigan, recent legislation mandated that teachers have "a working knowledge of

[35] Joanna Richardson, "States Offer Incentives to Teachers Seeking National Board Certification," *Education Week, Sept. 7, 1994.*

[36] Ronald E. Anderson. "State Technology Activities Related to Teachers," OTA contractor report, November 1994.

[37] In addition to the 12 states that required computer-related courses for all teacher certification in 1987, six states had such requirements for teachers in certain subject areas (business, computer, or media education). 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 1988), p. 209.



RANKIN ELEMENTARY SCHOOL, TUPELO, MS

Technology is becoming more important for teacher certification. Eighteen states currently require training in computers or technology for all teachers seeking certification.

modern technology and use of computers" and that the university that graduates the teacher candidate "demonstrate [this knowledge] to the satisfaction of the school or district before an individual may engage in student teaching."[38] And since 1985, Idaho teachers have been required to "develop skills to use computer technology," including word processing, database management, and general instructional use. Idaho and Wisconsin, according to the survey, follow the preservice guidelines for technology training developed by the International Society for Technology in Education (ISTE) and approved by NCATE, the national professional accreditation body (see box 5-2).

Technology is also receiving heightened attention in some alternative certification programs. In Florida, an alternative preparation program connects institutions of higher education and local public or private schools with individuals from the military and business who have degrees in specific content areas needed by the schools. In this field-based preservice program, candidate practitioners work in classrooms as contracted fret-year teachers under the supervision of the teacher educators from the College of Education at the University of South Florida. A school-based team assists and evaluates the candidate's performance throughout the year. Technology proficiency is imperative in this model, since candidates are trained on and expected to use Florida's Information Resource Network (FIRN), a statewide teacher network, to communicate with each other and with the Alternative Teacher Preparation program office. Candidates use lesson plans distributed over FIRN and can take courses while off campus via distance learning.[39]

■ Accreditation of Colleges of Education

One of the major issues in the professionalization of teaching and teacher education is the accreditation of schools and colleges of education. Unlike those who practice law, medicine, social work, engineering, architecture, or other professions, teachers do not have to graduate from an institution accredited by the profession. In fact, today less than half the schools of education are professionally accredited.

There are two accrediting tracks for colleges of education: state standards boards and the National Council for Accreditation of Teacher Education. State standards boards have been created over the last 20 years, and now exist in 11 states.[40] Some are appointed by the governor, and a few report to the legislature. Some have complete responsibility for establishing standards and implementation procedures for licensure, while others have only

[38] See State of Michigan 87th Legislature, Enrolled House Bill No. 5121, sec. 1531b, Dec. 31, 1993.

[39] Molly Drake, University of south Florida, personal communication, December l994. The University, located in Tampa, currently serves seven Florida school districts with its Alternative Teacher Preparation program. See also, Eric Schmitt, "Peace Dividend: Troops Turn to Teaching:" New York Times, Nov. 30, 1994, pp. B-1, 12.

[40] Wise, op. cit., footnote 15.

BOX 5-2: Curriculum Guidelines for Accreditation of Educational Computing and Technology Programs

The Accreditation Committee of the International Society for Technology in Education (ISTE) in 1992 developed a set of "Curriculum Guidelines for the Accreditation of Educational Computing and Technology Programs, " which was approved by the National Council for the Accreditation of Teacher Education. The basic guidelines suggest that all teachers should be able to:

1. Demonstrate the ability to operate a computer system in order to successfully use software.
2. Evaluate and use computers and related technologies to support the instructional process.
3. Apply instructional principles, research, and appropriate assessment practices to the use of computers and related technologies.
4. Explore, evaluate, and use computer/technology-based materials, including applications, educational software, and documentation.
5. Demonstrate knowledge of uses of computers for problem solving, data collection, information management, communications, presentations, and decisionmaking.
6. Design and develop student learning activities that integrate computing and technology for a variety of student grouping strategies and for diverse student populations.
7. Evaluate, select, and integrate computer/technology-based instruction in the curriculum of one's subject area(s) and/or grade level.
8. Demonstrate knowledge of uses of multimedia, hypermedia, and telecommunications to support Instruction.
9. Demonstrate skill in using productivity tools for professional and personal use, including word processing, database, spreadsheet, and print/graphics utilities.
10. Demonstrate knowledge of equity, ethical, legal, and human issues of computing and technology as they relate to society and model appropriate behaviors.
11. Identify resources for staying current in applications of computing and related technologies in education.
12. Use computer-based technologies to access information to enhance personal and professional productivity.
13. Apply computers and related technologies to facilitate emerging roles of the learner and the educator.

SOURCE: Excerpt from goals established by the International Society for the Accreditation of Technology in Education, Accreditation Committee, Eugene, OR 1992.

partial responsibility.[41] Most are autonomous and determine the credentials, licenses, standards, assessments, and examinations for entry and advancement in the profession. In most cases, the boards also approve specific college or university teacher education programs.

NCATE was created about 40 years ago, and its mission today is to establish and help support a quality system for preparing future teachers throughout schools of education. The reorganization of NCATE in 1986, with its subsequent adoption of a set of standards for teacher education in

[41] AACTE, op.cit., footnote 27, p. vi.

1988, has been another key force in teacher education reform. Until this restructuring, the organization accredited individual teacher education programs, a task which duplicated in many ways the state's function.[42] This might explain why colleges of education have found requirements for state program approval and NCATE accreditation to be duplicative, although both are voluntary.

There are other concerns with duplication, as well. Institutions must sometimes undergo multiple reviews to satisfy different kinds of requirements, including university system requirements, subject-specific curriculum guidelines in the 17 associations recognized by NCATE, and guidelines for programs such as math and English developed by the National Association of State Directors of Teacher Education and Certification (NASDTEC).[43] To minimize this potential for overlap, NCATE so far has entered into partnerships with 33 states to cooperate in their review of institutions.[44] For example, Florida has agreed that its state teacher education institutions need only undergo a single review rather than three different reviews by the state board, the university, and NCATE.[45]

NCATE's role as the national professional accreditation body has not been without controversy. As one educator asserts, "NCATE demands high standards but has no mechanism to really assist institutions in making the changes needed."[46] Although many suggest that accreditation is important to assure the public that institutions have met high standards and provide a philosophical and intellectual foundation for teacher education, only 521—or 41 percent—of the 1,279 state-approved teacher education institutions have sought and received NCATE approval.[47] (As of September 1994, 41 additional institutions are candidates, awaiting an accreditation visit.[48]) Furthermore, the National Board for Professional Teaching Standards (NBPTS) does not require that candidates for its advanced professional certification ("Master Teachers") be graduates of accredited teacher preparation programs. However, NBPTS and NCATE are working together "to ensure that standards for accreditation and standards for advanced certification are compatible and congruent."[49]

In revising standards in 1988 to reduce duplication, clarify language, and emphasize areas of importance, NCATE also placed a new emphasis on technology. The NCATE standard "Pedagogical Studies for Initial Teacher Preparation" suggests that professional studies for all teachers include knowledge about and appropriate experiences with eight areas, one of which is educational computing, including the use of computer and related technologies in instruction, assessment, and professional productivity. Under the standards for quality of instruction for teacher education faculty, a new indicator was added stating that "instruc-

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[42] Ted Sanders, "A State Superintendent Looks at National Accreditation," *Phi Delta Kappan*, October 1993, pp. 165-170.

[43] See also the "1992 NASDTEC Outcome-Based Standards and Portfolio Assessment," a set of standards that serve as a resource for states considering, developing, or implementing outcome-based approaches for teacher education and certification.

[44] Jane Liebbrand, NCATE Director of Communications, personal communication, Sept. 23, 1994. See also, Karen Diegmueller, "NCATE Analysis of Education Schools To Help Forge Partnerships with States," *Education Week*, Mar. 24, 1993, p. 27.

[45] Wilmer S. Cody, "National Accreditation—An Effective Use of Resources," *Quality Teaching*, NCATE Newsletter, vol. 1, Issue 2, winter 1992, p. 1.

[46] Allen Glenn, Dean, College of Education, University of Washington, Seattle, personal communication, Jan. 6, 1995.

[47] Diegmueller, op. cit., footnote 44.

[48] Liebbrand, op. cit., footnote 44.

[49] Ibid.

tion reflects knowledge and use of various instructional strategies and technologies."[50] Qualifications for professional education faculty also must include "faculty modeling the integration of computers and technology in their fields of specialization." Finally, there is a standard to ensure that facilities, equipment and budgetary resources in the colleges of education are sufficient to fulfill its mission and offer quality programs. One indicator states that "facilities and equipment support education communication and instructional technology needs, including computers, and they are functional, and well maintained."[51] In addition, NCATE endorsed the curriculum guidelines for educational and computing technology programs developed by ISTE (see box 5-2).

Another organization acting as a catalyst to reform and improve the standards of teachers is the Council of Chief State School Officers (CCSSO). The CCSSO's task force on licensing standards, called the Interstate New Teachers Assessment and Support Consortium (INTASC), is working to develop common licensing standards for new teachers, from the perspective of the state departments of education. INTASC has worked with 22 states over the last three years to develop model standards that require teachers to demonstrate knowledge and skills; the new standards are intended to replace the current teacher preparation program approval system with a system based on achievement.[52] Both the CCSSO and NBPTS are also National Council for Accreditation of Teacher Education constituents, so the platform is being set for shared expectations for teacher education reform.

In addition, the National Association of State Directors of Teacher Education and Certification has published a set of model standards as resources for states considering outcome-based approaches to teacher education and certification. It is a first step in developing essential national standards for obtaining the initial professional teaching certificate and entering the teaching profession. In the future, NASDTEC plans to work with states to develop instruments, tasks, and materials for evaluating whether prospective teachers have the skills, attitudes, and knowledge for teaching. NASDTEC also plans to develop tools such as multimedia professional development systems and portfolio assessment models for demonstrating competence in teaching with technology.

Technology is also central to the NASDTEC outcomes, both as a separate subject area and integrated with content areas across the curriculum. For example, one standard states that "the beginning (high school) teacher during planning, delivery, and analysis activities correlates, integrates, and applies computer-supported learning, production, and management systems in classroom teaching," in order "to broaden student knowledge about technology, to deliver direct instruction to all students at different levels and paces, to use technology as a motivation for higher order learning, and to produce computer assisted solutions to real-world problems."[53]

K-12 Reforms, Colleges of Education, and Technology

Reform efforts that link colleges of education and K-12 schools are not commonplace, but such collaborations are vital if the current teacher workforce and future teachers are expected to be able to approach teaching and learning in an effective, cohesive manner. Typically, K-12 reform and col-

[50] The International Society for Technology in Education recommended NCATE's adoption of this standard. Margaret Kelly, California State University, San Marcos, personal communication, Sept. 13, 1994.

[51] National Council for the Accreditation of Teacher Education, "NCATE Standards" (Washington, DC: 1994).

[52] Arthur E. Wise, "Professionalization and Standards: A 'Unified System of Quality Assurance,'" *Education Week*, June 1, 1994, p. 48.

[53] NASDTEC Standards Committee, "NASDTEC Outcome Based Standards" (draft), March 1993, p. 19.

MISSISSIPPI STATE UNIVERSITY

At Mississippi State University elementary teachers from around the state are trained to use multimedia computer equipment for a new 8th-grade course called Computer Discovery that helps students understand how computers are used in different careers.

leges of education reform are viewed as separate issues.[54] Indeed, "during the past 100 years or so of focusing on school reform, very little attention has been paid to the role of reforming teacher education."[55]

This situation is no different when it comes to technology education and implementation. **COE faculty rarely work with other agencies, such as school districts or state education agencies, on projects related to technology integration, according to data from the survey conducted for OTA.**[56] Likewise, many teacher education faculty are not aware of all the technology requirements for teacher certification in their states.

Often at the state and federal level there is little understanding of what this alignment between COEs and K-12 requires. Nevertheless, some collaborative partnerships among universities, schools, districts, regional education agencies, and state education agencies have shown great promise. For example, the University of Virginia teamed up with the Virginia state education agency to create Virginia's Public Education Network. California State University's telecommunications system spawned a collaborative, statewide K-12 staff development project, the California Technology Project, supporting free K-12 telecommunications and preservice teacher links.[57] Faculty at the University of Central Florida and the University of South Florida have been very active in technology training and development projects in collaboration with the Florida state education agency. And the Texas Education Agency's grant program supports technology-rich professional development schools (see box 5-3).

At the University of Washington, three reform efforts-the Center for Educational Renewal, the Institute for Educational Inquiry, and the National Network for Educational Renewal—are jointly creating an agenda for the simultaneous renewal of pre-kindergarten through grade 12 schools and the education of educators. Twenty-five universities and 100 school districts are linked by the National Network as part of this undertaking, and the Institute supports work at the educational settings involved in the network.

> The renewal of teacher education requires the availability of schools that are in the process of renewing. Schools that are renewing are as indispensable to good teacher education as teaching hospitals are to good medical education.[58]

54 John. I. Goodlad, *Teachers for Our Nation's Schools* (San Francisco, CA: Jossey-Bass, Inc., 1990).

55 Goodlad, op. cit., footnote 14.

56 Jerry Willis et al., "Information Technology in Teacher Education: Surveys of the Current Status," OTA contractor report, March 1994.

57 Kelly, op. cit., footnote 50.

58 Goodlad, op. cit., footnote 14.

Indeed, in the 19 institutions of higher education in the state of Washington, teacher education students are placed in schools the very first quarter of their teacher education programs. At the University of Washington, 60 hours of school-based experience is required to be considered for admission to the teacher education program.[59]

The professional development school movement[60] is a similar example of a K-12 and university collaboration. Institutions such as the University of Utah and the University of Houston have forged relationships with public schools to increase opportunities for teacher education students to observe and practice technology integration. Both Utah and Houston have discovered, however, that university faculty and K-12 teachers require considerable staff development and ongoing support to make the connections. Unless university policies (e.g., tenure, promotion, and merit salary increases) are changed to reward COE faculty for undertaking collaborative projects with K-12, there is little incentive for faculty to invest the substantial time and effort required for working closely with schools.

Increased COE collaboration with K-12 must be balanced against the additional drain on the limited technology and support resources available in colleges of education. As discussed in the section below, these COE technology resources are limited.

TECHNOLOGY IN TEACHER EDUCATION

Among the many demands on schools and colleges of education today, preparing teachers to use technology may seem like an additional burden. However, as noted above, states and professional organizations are increasingly recommending or requiring that all new teachers be competent in the uses of technology. **Moreover, emerging evidence suggests that technology can make several positive contributions to the overall preservice experience.**

For example, OTA case studies of four colleges of education where technology is an integral part of the preservice programs found technology being used in a number of ways to enhance the overall teacher preparation experience.[61] Technology can capture the reality of the classroom: a videotape of a teacher conducting an actual class can "anchor" preservice students to the complex and real-life interactions of students and teachers. Technology can facilitate access to and communication with additional resources, such as experts in the field or informational databases on CD-ROM available to teacher education students and faculty on the same network. Technology can also support and enhance traditional approaches to teacher-developed curriculum materials and instructional practices. While these kinds of programs demonstrate the possibilities, the underlying question remains: how well do most colleges of education prepare new teachers to use technology?

Preparing New Teachers To Use Technology

A Role for Colleges of Arts and Science

Teachers teach as they have been taught. Since most teacher education students receive much of their content instruction in the colleges of arts and sciences, it is important that effective teaching—including teaching with technology—is modeled in the other parts of the university preparation of prospective teachers. This is particularly important as states cut back the number of education courses a prospective teacher can

59 Glenn, op. cit., footnote 44.

60 See, e.g., Linda Darling-Hammond (ed.), *Professional Development Schools: Schools for Developing a Profession* (New York, NY: Teachers College Press, Columbia University, 1994); also, Joanna Richardson, "NCATE To Develop Standards for Training Schools," *Education Week*, vol. XIV, No. 19, Feb. 1, 1995, p. 3.

61 John R. Mergendoller et al., "Case Studies of Exemplary Approaches to Training Teachers to Use Technology," OTA contractor report, September 1994.

BOX 5-3: Redefining Preservice, Texas Style

Attending faculty meetings; participating in PTA meetings; going on field trips; observing and assisting in the library in the nurses clinic and counselor's office, and sitting in on parent conferences. No, it's not a day in a teacher's life. It's a semester in the life of preservice teacher candidates fulfilling an internship in Texas.

For example, at the Center for Professional Development and Technology (CPDT) at Stephen F. Austin University's School of Education, instead of three-and-a-half years of university coursework and a semester of student teaching, preservice teacher candidates must spend a semester as an intern-observing, learning, and taking university classes at a school site—prior to becoming student teachers. The teacher candidates are involved in all aspects of school activity They tutor individual students, teach in small groups, make bulletin boards, use computerized grade books, shadow mentor teachers in various assignments, and attend inservice training programs.

In a typical internship at a middle school, for example, teacher candidates spend an eight-hour day at the school two days a week, from the first bell in the morning until one in the afternoon, they are teacher interns working with a mentor teacher. Later in the day, they become university students again, taking methods courses taught by university faculty on-site at the middle school. During the rest of the week, the students return to the university to take regular classes, including a course using computers purchased with CPDT funds. The students get computer experience in their school sites, too, using technology (also funded with CPDT monies) in the mentor teachers' classrooms.

Often, this school-based experience is enough for students to decide whether or not they really want to become teachers. For the teachers in the school, the experience is also an education. As one teachers says, "The old student teachers would just take courses and come straight into the classroom, with no buffer zone. Now . . . we have student teachers who have seen what a school is about. " Teacher education faculty benefit, as well, since "the fact that university faculty are no longer teaching [only] on the university campus, and what they say will be validated in the classroom the next day, keeps everyone on their toes. "

In Texas, the time students spend in K-12 classrooms before they receive their teaching degrees is uniquely styled, in large part, because of efforts by the Texas Education Agency to reform teacher education. The Texas Education Agency (TEA) is a unit of the Texas state government, with extensive responsibilities for K-1 2 education and a serious commitment to technology use. The TEA oversees the certification of teachers and allocation of state funds to 1,050 local school districts with more than 6,000 schools. The TEA also supports 20 Regional Education Service Centers that provide direct services to the districts in their region (see chapter 4).

Since the 1970s, when personal computers became affordable, there has been interest at TEA in the use of technology in schools. The 1988 publication of TEA's "Long-Range Plan for Technology" makes a case for technology as one means of improving education in the state. Among the plan's initiatives that required action on the part of the state's legislature was a call for the Texas legislature to appropriate $50 per year per public school pupil for technology, with annual increases. The legislature actually appropriated $30 per year per pupil in 1992-93, and the figure has not been increased; however, it amounts to a commitment by the state of $113 million annually for technology.[1]

[1] The only significant restriction is the requirement that districts spend at least 75 percent of the money on "instruction, " as opposed to hardware TEA encourages districts to spend 30 percent of their technology allocations on staff development, but thus is a recommendation, not a requirement

BOX 5-3 (cont'd.): Redefining Preservice, Texas Style

This history of support for technology in schools has evolved into support for better use of technology in the preparation of new teachers It became clear that if K-12 students have technology access and experience, so, too, should the new teachers who are entering the classroom. The evolution to preservice support, however, has come about on a winding road. In 1987, the Texas legislature eliminated the undergraduate degree in educatihon and required that all students preparing to be teachers have a content major. The legislation also limited the number of courses a student could be required to take in education to 18 semester hours—12 credit hours of professional coursework and six credit hours for student teaching. Also in the 1980s, TEA developed (with legislative support) alternative certification programs, so college graduates who had no teacher education courses could become certified to teach while working as teachers.

By the end of the 1980s, it was obvious that both the 18-hour rule and alternative certification were not the optimal solutions. Alternative certification programs amounted to a sink-or-swim situation for the new teachers, and teacher education programs, while shorter, still emphasized lecture-based courses removed from the classrooms. Furthermore, there was concern that new teachers were not being prepared to use technology.

Ultimately, TEA developed an alternative to traditional university-based teacher education and alternative certification, and in 1991 legislation was passed authorizing funding for Centers for Professional Development and Technology. Approximately $34 million has been invested to support the restructuring of new teacher education programs through CPDTs. For the past three years, planning grants were awarded to teacher education programs in public and private colleges and universities to develop plans for reforming teacher education, CPDTs, like the one described in the above scenario, have an emphasis on integrating technology throughout the preservice curriculum and inservice staff development plan. This led to the creation of professional development schools—that is, sites within the K-12 setting that theoretically afford preservice students the best of both worlds, learning about teaching as teacher candidates and gaining important teaching experience in real school settings.

The responsibility for effectively Integrating technology into the new teacher education programs rests not with TEA but with the programs. So far, 17 collaborative have been funded for CPDTs, This number includes 50 percent of the educator preparation programs in Texas. Quantitative data indicate students going through a CPDT program score higher on the state-administered ExCept exam.[2] The support of the state education agency and the state's legislature for technology as a primary emphasis in teacher education reform provide a valuable example for other states to consider.

[2] The ExCept exam is required both in subject specialty and the general component prior to receiving certification to teach in Texas,

SOURCE John Mergendoller et al , "Exemplary Approaches to Training Teachers To Use Technology, " OTA contractor report, September 1994, pp. 9,1-930

Overall, teacher education Programs in the United States do not prepare graduates to use technologyas a teaching tool, and recent graduates of teacher education programs say they do not feel wall prepared to use teachnology in the classroom.

take, and as they move to abolish the undergraduate degree in education.

A recent survey at the University of Southern California indicates that-across all areas-"only a small percentage of college courses and classes use technology to enhance or supplement instruction."[62] According to the study, roughly one college course in six uses computer labs, and only one in 10 uses computer-based simulations and software. The survey also reports that research universities are more likely than other types of institutions of higher education to consider resources such as the Internet to be important for access to content that otherwise might not be available for classroom instruction.[63]

Technology Preparation in Colleges of Education

Even if the courses prospective teachers take in the general studies programs do not necessarily model technology use, it is appropriate that schools and colleges of education do so. However, anecdotal evidence, surveys conducted for OTA,[64] and a number of other sources[65] suggest that this is not so. **OTA finds that overall teacher education programs in the United States do not prepare graduates to use technology as a teaching tool.** For example, although the majority of colleges of education surveyed offer a course in information technology (educational computing, educational media, or instructional technology), only slightly more than half require that their students take such a course.[66]

For most types of technology,67 faculty who responded to the OTA contractor survey reported very low levels of use in the COE classroom, and recent graduates reported even lower levels of exposure to technology. In addition, the majority of teacher education faculty surveyed do not model technology use, do not use information technology to accomplish the objectives in the courses they teach, and do not teach students how to use technology for instructional purposes.

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62 *The Heller Report,* vol. 6, No. 3, January 1995, p. 1,7.

63 Ibid.

64 Much of this section comes from Jerry Willis et al., "Information Technology in Teacher Education: Surveys of the Current Status," OT contractor report, March 1994.

65 See, e.g., R.E. Schumaker and P.G. Hossain, "Computer Use in Education: Faculty Perception and Use of a Computer Learning Center," *Journal of Computer Based Instruction,* vol. 17, No. 3,1990, pp. 87-90; and J. Fratianni, R. Decker, and B. Koven-Baum "Technology: Are Future Teachers Being Prepared for the 21st Century?'' *Journal of Computing in Teacher Education,* vol. 6, No. 4, pp. 15-23.

66 Likewise, a separate study of teacher education programs in Michigfan found that 95 percent offered some type of training in information technology for teacher education students--but not necessarily a couse--and that 40 percent required information technology training of students in the teacher education programs. L. Carr, D. Novak, and C. Berger, "Integrating Technology into Preservice Education: Determining the Necessary Resources,'' Journal of Computing in Teacher Education, vol. 9, No. 1, pp. 20-24.

67 See definition of *technology* as used in chapter 2 of this report.

When the OTA contractor survey asked recent graduates how well their teacher education program prepared them to use technology in their teaching, the majority responded that they did not feel they were prepared. As one respondent said, "Training is definitely needed in teacher education programs on things such as Hypercard, multimedia, CD-ROM, etc. The class I had showed us slides of what could be done, but we really gained no understanding and received no training in these areas."[68] **One conclusion to be drawn is that telling students about what is possible is not enough; they must see technology used by their instructors, observe uses of technological tools in classrooms, and practice teaching with technologies themselves if they are to use these tools effectively in their own teaching.** As a recent graduate stated, "most colleges and universities are using a broad base of computer technology; however, they are not giving student teachers enough background to use this in their own classrooms."[69]

In those COEs where technology is an integral part of teacher preparation programs, anecdotal evidence suggests that students will adopt the use of educational technology in instruction if they see faculty members modeling technology use.[70]

The low level of technology coverage in teacher education contrasts with the way that other professional preparation programs address relevant technologies. For example, few health care professionals complete their training and enter practice without an understanding of the technologies used in their specialty. Few business college graduates complete their degrees without experience using the computer-based tools of their business specialties. Of course, professions such as these often require graduate study, so students in those programs may have more extensive exposure to the school's resources, including technologies. Most teachers only need to complete an undergraduate program to teach, and the data reported here suggest that most new teachers graduate with limited experiences or understanding of the ways technologies can be used in their professional practice—the classroom.

Methods of Teaching With and About Technology

Coverage of technology in teacher education can be divided roughly into three types: 1) *discussion/demonstration*, 2) *technology practice*, and 3) *professional practice*. A faculty member conducting a science teaching methods course might, for example, *discuss* how computer-based simulations could be used in a high school science class. The instructor might even *demonstrate* a few simulations for the class using a large monitor or projection panel. This occasionally occurs in teacher education, but it is rare.

The next level of engagement with technology involves hands-on *technology practice*. In the science methods course, for example, the instructor might take the students to a teacher education computer lab and have them install science simulations into the computer and examine how they work.

At the third and most critical level of engagement, *professional practice*, students in the science methods class might see simulations being used in a high school chemistry or physics class. They might visit a classroom, view a classroom via a television connection, or watch it from a videodisc or videotape. At the level of professional practice, these students would also *practice teaching with technology*. In the methods course, they might create lesson plans that include technology and practice in teaching exercises. Later, in student teaching, they would observe teachers using technology and then teach with technology themselves.

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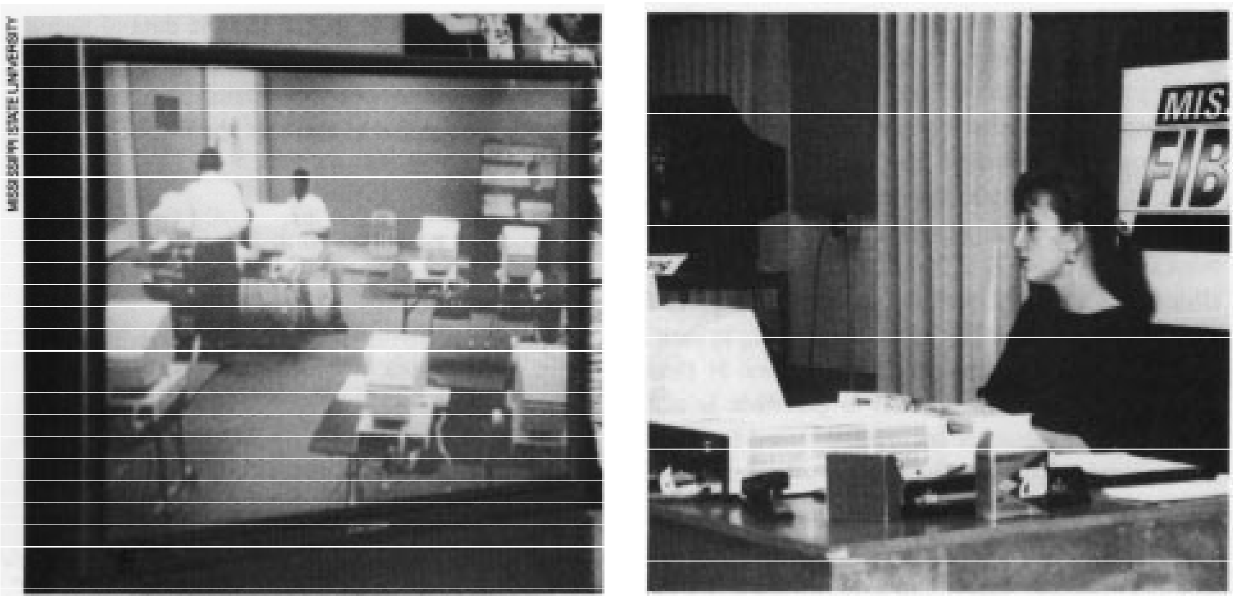
[68] Willis et al., op cit., footnote 64, p. 121.

[69] Ibid.

[70] Mergendoller et al., op. cit., footnote 61.



The opportunity for preservice teachers to practice teaching with technology is not common in colleges of education. However, Trina Dendy (right) conducted a distance-learning course for high school students as part ofher student teaching experience. Here, students in Corinth, Mississippi, receive the lesson (lefr), which she broadcast from West Point, miles away

In the contractor survey of recent graduates, 40 percent said education faculty used technology in the courses they completed; specifically, more than 60 percent said they had been *taught with* or *taught to use* some form of technology. However, an analysis of this is revealing: the areas that were most often reported as "taught about" were drill-and-practice applications and word processing. While half **of recent graduates surveyed reported being prepared to teach with drill and practice, tutorials, games, and writing and publishing centers, less than one in 10 felt they could use such formats as multimedia packages, electronic presentations, collaborations over networks, or problem-solving software. Rarely were** teacher education students asked to develop material or create lessons with technology.

When technology topics are included, they are more often discussed, read about or demonstrated than modeled, used, or incorporated into lessons created by students. When considering the integration of technology into specific content areas, the survey suggests that the majority of faculty did not require students to use technology, to develop materials, orccreate lessons using technology. Only the videocassette recorder was used by more than 20 percent of teacher education faculty, and only word processing was cited by more than 10 percent of faculty as a basis for creating lessons. Part of the reason technology is not used more by faculty, according to one survey respondent, may be that "until we train [COE] teachers and provide teachers with equipment, the teachers are not going to do much with students." [71]

Student Teaching and Technology

Technology does not appear to play a significant role in student teaching assignments. Even in preservice programs where technology is prev-

[71] Ibid.

alent and integrated in an exemplary way, one of the consistent problems identified in the survey and the OTA case studies was the lack of student teaching placements in technology-rich classrooms with teachers who know how to exploit the possibilities afforded by technology. Often, the preservice teachers knew more about technology use—in general, not specifically for education—than the practicing teachers supervising them.[72]

Barriers to Technology Use in Colleges of Education

Barriers to more integrated use of technology in COEs are similar to those in K-12 institutions. When asked to rank a list of 19 potential barriers, COE faculty gave the highest rankings to time, limited resources, faculty comfort level and attitudes, and little institutional encouragement for technology use. However, COE faculty do not generally see either complexity or reliability of equipment as major barriers to wider use of technology, and they see themselves as competent to use technology.[73]

Access to Resources

The data from the OTA survey suggest that a typical college of education is more likely to be a "have not" than a "have" when it comes to many types of educational technology. This is a serious barrier, since access to resources is an essential element of any effort to increase both teaching *with* and teaching *about* information technology.

Hardware and software resources are a problem in many programs. One suggestion—although only part of the solution—is a massive infusion of equipment through grants from computer companies (see box 5-4), the federal government, or states. However, funds for the acquisition of up-to-date hardware and software have been difficult for COEs to secure. As noted in chapter 6, federal support for technology in COEs has been limited.[74] The problem is also one of "pecking order" within a university. As one educator pointed out, "Colleges of education are often at the very bottom of their universities' priority lists for equipment funding, despite the fact that, in many instances, the college of education might generate the largest number of student credit hours (and therefore revenue) for the university."[75]

Information collected through the OTA case studies of four teacher preparation programs suggests that many colleges of education have so little equipment that any effort to increase technology presence in coursework would overwhelm existing resources. In addition, there is a tendency in education to think of technology as just another capital cost, to be amortized over 10 or 15 years. Given the rapid pace of technological innovations—and the reality that new software releases most likely will not run on machines more than four or five years old—this assumption is incorrect. Technology is not a one-time expense. As hardware and network installations become more technically complex, they need more attention and maintenance—costs that the COEs must consider and create long-term plans to handle.[76]

COEs, like K-12 schools, need to plan for how technology will be distributed and used before mandating its use. Trying to successfully implement hardware and software without a plan outlining the needs and functions to be addressed by that technology places the cart ahead of the horse. For example, buying 20 computers with built-in CD-ROM drives does little to define what will be done with them or how they could be deployed in a teacher education program. The machines could

[72] Mergendoller et al., op. cit., footnote 61.

[73] Willis et al., op. cit., footnote 64.

[74] In contrast, for example, teacher education programs in the United Kingdom were recently invited to write proposals for how they would use computer-controlled CD-ROM equipment; the proposals were evaluated by the government's education authority and most were funded.

[75] Paul Resta, "Preservice Education," *The Electronic School* (Alexandria, VA: NSBA, September 1993), p. A28.

[76] Mergendoller et al., op. cit., footnote 61.

BOX 5-4: Beyond the Box: Why Preservice Integration Requires Full Support

Working from a belief that improving technology use in K-12 education required improving the way new teachers learn to use technology, in 1989 IBM initiated the Teacher Preparation with Technology Grant Program. The program's primary goal was to help integrate technology into the curricula of teacher preparation programs nationwide, and secondarily, to introduce more K-12 teachers, present and future, to MS-DOS-based computer technology.

The effort was substantial: based on proposals submitted to IBM, a total of $30 million was donated (in hardware, software, cash, and training) to 144 teacher preparation institutions across the country. Each site received virtually the same equipment to establish a networked IBM lab.[1] An evaluation of the program reported that, over a three-year period (1990-93), approximately 52,000 preservice teachers have been trained on the equipment in the labs.[2]

One commonly voiced concern about such integration efforts in colleges of education is whether the necessary levels of technical and other support are sufficient to enable a critical mass of college of education faculty--+ specially those who are not currently technology advocates—to become technology users, The IBM evaluation study found that nearly two-thirds of the teacher preparation faculty involved in the projects were trained to use the equipment; however, less than half received this training as a result of the grant program.[3]

In their grant applications, most sites proposed using the equipment for training preservice and inservice teachers and developing curriculum materials for integrating technology in instruction; however, arrangements on how this was to be done was left to the grantees. Ultimately, the open-ended nature of the grants proved to be a problem for many sites. While they received a great deal of technology, the training and support given to sites was more technical "nuts and bolts" for getting the labs up and running rather than in training the teachers to effectively integrate technology in their classrooms. The evaluation reported, "sites felt that additional training for faculty was necessary" and suggested that supplemental funding should have been targeted for this training. During the grant award process, as one site pointed out, IBM could have "forced the colleges of education to provide . release time, or other perks as compensation for learning the technology. IBM had the clout to require this, they just didn't know it. "[4]

[1]Most sites received 10 to 15 IBM Model 25 or Model 30 workstations, a PS/2 Model 80 file server, two printers, networking hardware and software, IBM courseware, a $5,000 cash grant, training for two project staff in Atlanta, and technical support

[2]Gary G Bitter and Brandt W. Pryor, *The National Study of IBM's Teacher Preparation with Technology Grant Program,* Arizona State University, Technology Based Learning and Research (Tempe, AZ Arizona State University, 1994), p. 13

[3]Ibid , p. 11.

[4]Ibid,, p. 21,

be placed in a lab where teacher education students learn word processing. Or, three or four could be put in each of the college classrooms where methods courses (e.g., science, reading/ language arts, mathematics, art, social studies) are taught. However, if several of the science education faculty want to begin teaching students how to use videodisc-based packages that supplement or replace textbooks in some science classrooms, they might need fewer computers with CD-ROM capabilities and more videodisc players with bar code readers. Another alternative would be to put the computers in the classrooms of cooperating teachers in the schools—those who had been encouraged and supported based on a plan identifying their technology needs—as they supervise student teachers.

BOX 5-4 (cont'd.): Beyond the Box: Why Preservice Integration Requires Full Support

The IBM program evaluation found that about two-thirds of respondents noted positive changes in the teacher preparation faculty's attitudes toward the computer lab. For example, one site responded that, "The easy access to the network encouraged the faculty to try to integrate [the] technology into their classes and helped them see the value of a computer network in the learning and teaching process,"[5] A total of 367 courses—both required and electives—were developed or revised to incorporate the computer technology.[6]

Also, over half the sites reported that they included local schools as part of their projects, most often through involvement with inservice teachers, bringing children to the site lab, and through activities conducted as a part of the preservice program. Several sites maintain that much of their implementation success was due to the participation of and interaction with the local schools. As one site reported, "Participating in the schools gave [technology integration] a reality that was invaluable for the education faculty. The school's support of technology prods the university faculty and administration to do the same. "[7]

Although educators at the IBM sites appreciated the good intentions shown by IBM, many were frustrated by difficulties in integrating the technology into teacher preparation curricula, suggesting lessons for similar efforts. Some of the problems reported include technical or equipment difficulties, lack of training and technical support, lack of resources, outdated hardware (most were 286 machines), and marginal software. Some sites were able to resolve these problems, but many were not.

The IBM grant program evaluation suggests that an infusion of technology into a program IS not sufficient to produce change. The open-ended nature of the grant program was a detriment to success for many of the sites. Sites were allowed near total discretion on how they integrated the grant into their teacher preparation programs; many sites were frustrated by a lack of guidance and support Recommendations made to IBM by the grantees suggest that more direction was needed. "[IBM should] have a clear set of expectations of what the grant recipients are to do" and' "have a reasonably well-developed game plan-don't do this in a vacuum. "

[5] Ibid., p, 47.

[6] The grant sites reported that 84 new courses were created and 283 existing courses were revised to incorporate the IBM technology.

[7] Bitter and Pryor, op. cit., footnote 2, p 7.

SOURCE. Gary G. Bitter and Brandt W. Pryor, The *National Study of IBM's Teacher Preparation with Technology Grant Program* (Tempe, AZ Arizona State University, 1994).

Faculty Comfort Level, Attitudes, and Training

Technology planning in the COE should involve a wide range of faculty from the college. One problem, however, is that many faculty do not have the knowledge needed to make informed decisions on technology issues, according to the aforementioned survey. Furthermore, professional development for faculty tends to emphasize the fundamentals of computing rather than the integration of technology into education. Like K- 12 educators, COE faculty need to understand ways technology can enhance instruction in their specialty areas.

A potential barrier to technology use in COES may be the attitudes of faculty. Although most teacher education faculty believe that technology is an important aspect of both K-12 education and teacher education, many seem to view technology as a separate type of content, rather than as something that should or could be integrated into a content area such as a math course or a social studies methods class.[77] **It is not surprising that faculty members agree technology is important while simultaneously presuming it is a "topic" that will be covered somewhere in the curricula other than in the courses they teach.**

OTA's data suggest most teacher education faculty concur that technology will play a critical role in the future of both education and teacher education. That generally positive attitude, however, does not translate into specific plans and actions the individual faculty member implements. There are several reasons for this dichotomy. While faculty say technology is important, many do not feel comfortable using technology in the COE classroom. That is true even though the majority of faculty (86 percent in the OTA survey) use a computer at home for many hours a week. Although they may have basic proficiency with word processing, disk operating systems, and spreadsheets, many are not as comfortable when it comes to integrating computer technology into instruction. In fact, most COE faculty in the OTA survey report some anxiety in using technology with their teaching applications, and almost all (90 percent) consider the knowledge level and confidence level of teacher educators to be barriers to wider use of information technology in teacher education. **Since the majority of teacher education faculty completed graduate programs and taught in schools where technology was not a major part of the educational environment, it is not surprising that they tend to have limited experience with technologies for instruction.**

Teacher educators responding to the OTA survey reported that they need help in integrating technology experiences into the courses they teach. A major effort to infuse technology into teacher education would include workshops, seminars, publications, and support materials developed specifically for various areas of teacher education.

Another attitudinal barrier among many teacher education faculty is a tendency to separate information technology from other components of the program such as subject matter content and professional practice skills. A methods instructor, for example, who is teaching cooperative learning strategies, may view information technology as a topic competing for time in his or her curriculum rather than as an integral part of effective cooperative learning strategies in the classroom. The tendency to isolate information technology, to put it in a separate "technology ghetto" in the teacher education curriculum, may be a major impediment to integration across the curriculum. The problem is comparable to teaching writing: are writing skills to be taught only by the English faculty, or is it something all instructors should take into consideration?

Another factor that influences faculty comfort level with technology is the perceived match between technological applications and the theoretical perspective of the faculty member. Some uses of technology in teacher education, such as drill-and-practice software, are based on a behavioral model, while others, such as interactive, multimedia models, are based on a cognitive or constructivist theory. Staff development and support efforts should take theoretical perspective into account and work with faculty within their preferred theoretical mode, unless an additional goal is to change underlying theory as well as encourage technology use. Researchers suggest both actions—increasing technology use and changing pedagogical theory—can happen hand-in-hand.[78]

Staff and Institutional Support

Faculty in colleges of education, like K-12 educators, feel they need more staff support for technology; however, unlike those in K-12 settings, they

[77] Willis et al., op. cit., footnote 64.

[78] Barbara Means (ed.), *Technology and Education Reform* (San Francisco, CA: Jossey-Bass Publishers, 1994).

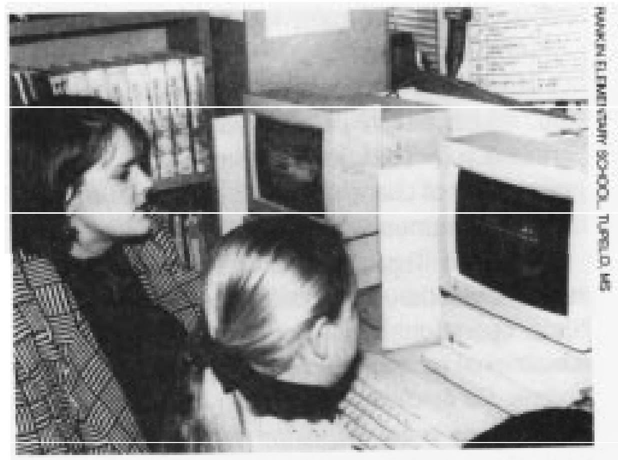
are more likely to have some technical support staff available in their institutions. Half the faculty responding to the OTA survey said their college had a full-time computer lab manager, and over one-third said a full-time technician was available. Unlike K-12 schools, additional support in COEs can be provided by graduate students who are comfortable with technology.

Another potentially important barrier to technology use in COEs is lack of institutional support for technology use by faculty. Although the incentive system in institutions of higher education is different than in K-12 schools, these rewards (e.g., tenure, merit pay, or promotions) do not encourage COE faculty to develop curricular innovations, software, or other information technology applications. As one respondent said,

> At a major university, rewards come only to those who do research and writing. No time is available to retool (learn the necessary skills) and restructure classes accordingly. It's an exciting time in the development of more advanced instructional technology. Released time for hands-on information immersion would be exciting.[79]

Only one-third of the faculty responding to the OTA survey said there were rewards for investing time in developing technology-based instructional materials or educational software instead of conducting more traditional research activities. About 40 percent of the faculty felt that the generally low level of interest demonstrated by colleges or institutional leadership was an important problem; only one in four did not see it as a barrier.

It seems that, in general, the use of computer-related technology as a teaching and learning medium is employed much less in teacher education than would be expected, given what is being taught about its value to education in technology-related teacher education courses. The opportunity for preservice teachers to experience models of computer-supported instruction before they try to manage it themselves is seldom available, suggesting the lack of synergy between computer education specialists and mainstream teacher education faculty.[80]



Finding enough student teaching placements with enthusiastic, expert technology-using teachers is a challenge for many colleges of education, but it is a key to preparing a generation of teachers who are fearless with technology

MODELS OF CHANGE: LESSONS FOR THE FIELD[81]

What the survey data do not tell are the stories of COES where changes have occurred and continue to take place, creating models for the field. There are colleges of education where technological tools are being implemented in ways that overcome some of the barriers of access, attitudes, training, and support discussed earlier in this chapter. These institutions, where technology support has been an intrinsic part of the vision of the teacher education program, share certain characteristics, including a required course that teaches students how to use technology, exposure to technology -rich K-12 classroom environments,

[79] Willis et al., op cit., footnote 64, p. 89.

[80] Betty Collis,"A Reflection on the Relationship Between Technology and Teacher Educatin: Synergy or Separate Entities?'' *Journal of Information Technology for Teacher Education,* vol. *3, No.* 1,1994, pp. 7-23.

[81] **The information in this section is excerpted, in large** part, from **Mergendoller** et al., op. **cit., footnote** 61.

and strategies that make technology transparent and intuitive to use.[82] In these institutions a number of factors come together: institutional leadership, which translates into funding support and permission for faculty to explore new areas; collegial support of changes; and close interaction with the K-12 community the COEs are meant to serve.

Even in colleges of education that might serve as implementation "models" for others—where basic operational knowledge of computer and educational technologies is acknowledged as important for students and faculty alike—this emphasis alone is not the vision driving the schools' technology training and support. Instead, what drives the use of technology is a vision of how educational technologies can solve instructional problems and provide curricular and administrative opportunities that could not be achieved as efficiently or powerfully otherwise. In such instances—including the four colleges of education highlighted below—technology is not embraced "because it's there," but because it is perceived to do important things better, more interestingly, or in entirely new ways.

University of Virginia, Curry School of Education

The elementary school computer lab is crowded with 4th-grade students and their "teachers"—preservice education students from the Curry School of Education at the University of Virginia (UVA). Pairs of eyes focus on computer screens as elementary and university students work together to explore the possibilities of the software program KidPix. *Movement is confined to wrists and fingers. Mouses click softly. Conversations are serious and focused. After struggling a while, a UVA student asks his 4th-grade partner if they should ask for help. "Yeah, it's time," comes the unenthusiastic reply. They lean over to the 4th-grader sitting next to them. "How can we save this under another name?" they ask. "We want to use it as a starting point for another drawing." The neighboring 4th-grader reaches over, takes possession of the mouse, and demonstrates how to solve the problem.*

At the University of Virginia's Curry School of Education, technology has been identified as one of the major strands within the teacher education program, and it is interwoven throughout the courses students complete as they work toward their degree. As part of this agenda, technology partnerships have been established with local schools to provide interesting and challenging field experiences for teacher education students, and simultaneously, to enrich the technological expertise of K-12 teachers. In addition, a statewide telecommunications system has been integrated with the teacher preparation course sequence and with the daily work of practicing teachers.

At its basic level, technology in the teacher education program at the Curry School involves three approaches to integration. First, the Curry School requires students to either take self-contained computer courses or demonstrate competencies in specific areas covered in those courses. Second, the college encourages the methods faculty to incorporate educational technologies into methods courses so students will have the opportunity to observe and practice teaching methods involving technology use. And finally, the school funds student teaching placements with teachers who use technology in their daily work.

There are, of course, challenges to these approaches. Computer courses do not address individual curriculum areas and can perpetuate the sense that technology is a separate topic, isolated from instruction. Expecting methods instructors to include technology in their courses raises questions of technological interest and expertise among those faculty. And finding enough student teaching placements where teachers are enthusiastic and frequent technology users is difficult.

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82 Mergendoller et al., op. cit., footnote 61.

The Curry School addresses these challenges through a schoolwide culture of technology use. This is reflected in several key factors, including support from the top by the dean, developing the technology expertise of faculty to serve as role models and provide support for their colleagues, creating technology-focused field experiences, and maintaining communications through a statewide telecommunications network.

The Dean's Role

The dean's support of educational technology infusion into the Curry School and the teacher education program is one of the reasons why Curry has developed a solid reputation for integrating technology and teacher education. When asked about the technology focus, given all of the ways one could support a teacher education program, the dean said he recognized "the power of technology to improve teaching."

> Technology could enable teachers to make a difference, and I felt we had to help those learning to be teachers to become competent technology users. I also saw, from a practical point of view, that you had to get ahead of the curve and stay ahead of the curve if you were going to distinguish yourself as an institution. This meant we had to make an early and substantial investment in technology if it was going to make a difference. Also, technology is very exciting! Teacher education is kind of a stodgy discipline, and I thought technology would liven it up. Finally, I thought that making technology available to Curry School students would raise the status of teacher education. Our students would be getting something Arts and Sciences students didn't. When we got our first IBM classroom installed, faculty from the engineering school across the street came over to admire it. They didn't have anything like it![83]

The dean's support of technology is more than rhetorical; technology integration is funded from the budget of the Curry School, and discretionary funds make possible small grants to individual faculty members or departments for technology purchases so that any faculty member who says he or she needs a computer gets one. Furthermore, the dean and other staff have been aggressive in competing for technology funds available to all of the schools within the university. The Curry School has received more than $2 million in funding from IBM, Apple, the National Science Foundation, and local telecommunications companies.

Developing Role Models for Faculty Technology Expertise

Using key faculty as role models for others is an important element in integrating technology across the college of education. At Curry, much of the initiative began with a faculty member[84] who was originally a member of the communications science program. His interest in and advocacy of computers and other educational technology have been critical in creating an educational climate that encourages Curry School teachers to experiment with educational technology and explore how technology can further their instructional and professional goals. His approach is one of patience, and his time frame long-term:

> You need to think in a five- to 15-year time frame. It takes that long. You have to work with one faculty member at a time. You keep coming around and find something they're really interested in. Everybody is not ready to swallow technology in exactly the same way at the same time. People are very reasonable; they will use technology if it makes sense to them.

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[83] James Cooper was Dean of the Curry School of Education, University of Virginia, at the time of the OTA case study; he resigned from this position to return to teaching at the end of the 1993-94 school year. Information taken from personal communication, Feb. 3, 1994, Charlottesville, VA. Mergendoller et al., op. cit., footnote 61.

[84] Glen L. Bull, Professor of Instructional Technology, Curry School of Education, University of Virginia.

> You have to remember that technology has layers. There's the technological, and that is what everybody focuses on. But there's also the social and the institutional. Here you have to go one person at a time. You can't just have one or two stars and leave everybody else behind. The minute you define supporting the stars as your mission, you are lost. It's a nibbling away process. The key is not to try to convince the faculty but to let them hold their views. Make sure you include everybody—support both Mac and DOS platforms.[85]

Currently about 20 percent of Curry School faculty use some form of instructional technology as a research focus, another 20 percent use it extensively in their teaching to access and display information, and the remaining 60 percent limit their technology use to word processing and other personal productivity uses. One faculty member has been given time to work with the less technologically proficient faculty on the instructional uses of technology. A conference room with four networked computers (Macintosh and MS-DOS) has been set aside to provide for "walk-in" faculty consulting and development. Although graduate students have provided similar services in the past, this is the first time a faculty member has been assigned this role. While the arrangement is now a pilot program, if successful, it may become part of the Curry School's faculty development and support structure.

There is also an Educational Technology Committee, with one representative from each department in the Curry School. Now in its 10th year, the committee meets twice a month in meetings open to all faculty who wish to attend. The committee is responsible for identifying the overall technological direction to be taken by the Curry School, but it also serves as a technical and emotional support group. One member explained, "When I need to know something, when I need to know where to go, I find out here."

Technology Field Experiences

Over the last several years, the Curry School has embarked on a number of pilot projects to enable its students to use technology in their field experiences with K-12 teachers and students. For example, in the spring of 1993, an after-school computer club was created to pair third-year teacher education students with a socioeconomically and ethnically diverse group of 4th-grade pupils at a local elementary school. The club—which meets once a week in a computer lab at the school—enables the elementary students and supervising lab teachers to gain computer skills and build self-confidence, while the Curry School students acquire the practical experience working one-on-one with students. When the club meetings conclude, the Curry students return to the classroom and write reports to "their" students' classroom teacher, make notes in a journal about the tutoring experience, and plan activities for the following week's meeting.

Another pilot project is the Technology Infusion Program, pairing Curry School students with practicing teachers. The Curry students take a fifth-year course in instructional computing, surveying a range of instructional concepts. During the first half of the semester—after learning about a technology concept or software program—students try out "mini-projects" in a practicing teacher's classroom. The focus of the class then shifts from learning a skill to practicing it. Later, Curry students work on a more elaborate project with the teacher. Currently, to ensure success in the Technology Infusion Program, the number of participating Curry School students is limited to 20 a year.[86] Part of the reason for this is that the Curry

[85] Glen L. Bull, personal communication, Feb. 4, 1994, as cited in Mergendoller et al., op. cit., footnote 61.

[86] Although the overall enrollment at Curry is approximately 1,300 students, the majority of these are pursuing advanced degrees. The teacher education program is a five-year program, with approximately 100 students each year entering the program in their sophomore year.

staff are aware that small-scale success generates a momentum for expansion, and expansion can often overwhelm resources allocated to a project. As one professor says, "We're guinea pigs—or, better yet, canaries going down the mine. You have to go in very small steps . . . build on what has gone before."[87]

Virginia's PEN

The Virginia Public Education Network (Virginia's PEN) directly serves Curry School students. Virginia's PEN is a distributed network that began in the mid-1980s as Teacher-Link, a network connecting the teachers supervising Curry School student teachers, and the student teachers themselves with the Curry School faculty.[88] It also provided participating public schools with access to the Internet. Today, the network is the literal and figurative backbone to educational telecommunications in Virginia. As of 1994, Virginia's PEN connected 2,000 public schools in 137 districts to the Internet, providing a seamless telecomputing network that links (via a toll-free number) all Virginia schools from kindergarten through graduate school.

While Virginia's PEN duplicates some communications and conferencing services often provided by commercial networks, such as America Online, it also provides services designed specifically for K-12 teachers. The services are organized by "pavilions," and each pavilion has its own moderated conference, projects, and listings of instructional and staff development resources by subject area. Students communicate with each other, Curry School faculty and staff, and K-12 teachers to discuss projects and problems, and present solutions. The result is an extended Jeffersonian academic village[89] online, connecting Curry students, K-12 teachers, and Curry faculty.

Lessons Learned[90]

A number of important lessons can be culled from the experiences at the Curry School:

- **Rather than mandating the use of educational technology, look for pockets of opportunity and exploit them.** The culture of technology use is built on a social foundation. Helping individuals to work more effectively by introducing them to appropriate technology will secure their general support of technology use and establish a critical mass of users. The expectations of this critical mass will encourage the growth of a technology-using culture within the school.
- **Preparing preservice teachers and their professors to use technology takes a long time.** It is essential to maintain a realistic time frame of at least three to five years.
- **When introducing a technological innovation, go slow.** Too slow is preferable to too fast. New technology is inherently "buggy"; plan an implementation schedule that allows enough time to work out problems.
- **Focus on the current experience and needs of the individual technology user.** Preservice teachers and faculty vary in their technological expertise and anxiety. Necessary training time will vary. Adequate time must be provided to support the technophobic as well as the "techies."
- **Educational technology infusion needs to be an interdepartmental endeavor.** By involv-

[87] Bull, op. cit., footnote 85.

[88] Funding was provided by the Curry School, IBM Academic Information Systems, and the Centel telephone company. At the time it was created, the network was known as Teacher-Link and, in addition to communications for teachers, it gave participating public schools access to the Internet. By the end of the decade, the Virginia Department of Education agreed to institutionalize it statewide.

[89] Thomas Jefferson, President of the United States, founder of the U.S. Patent Office and supporter of innovation, also founded and designed the University of Virginia to extend his own vision of an "academical village."

[90] These and the lessons learned in subsequent sections are based on the analysis of the OTA contractors' observations and extensive discussions with the faculty at the various schools.

ing faculty from all program areas, and making decisions about technology purchases an interdepartmental undertaking, turf wars over technology can be minimized.

- **Technology replacement and upgrade costs should be included as a regular line item in the operating budget.** While special grants can increase hardware and software, consistent long-term support is needed.

University of Wyoming, College of Education

Wyoming has developed an impressive, well-articulated plan to enhance the technological capabilities of present and future teachers and the K-12 students they serve. In the late 1980s, the public schools and the university developed a new model for teacher education in which each sector would play a role in educating students and teachers about technology. The university's college of education would infuse technology experiences throughout a redesigned teacher preparation program. The districts would provide placements for aspiring teachers where they could receive hands-on experience and also be exposed to some classrooms that were not so "computer-rich."

The support for Wyoming's program stems from the bottom-up manner in which the mandate for technology was developed. School reform was the vehicle for creating a plan that is designed to meet the overall needs of education throughout the state. Computer skills, specifically, were seen as integral to children becoming productive citizens. There is a strong commitment to improve the technological skills of teachers, both preservice and inservice, that is shared by individual school districts, the state department of education, and the University of Wyoming.

The College of Education at the University of Wyoming is a pioneer in the use of several information technologies that have promise for extending the reach of a university and for interconnecting school districts in useful ways. These technologies include interactive compressed video, audio teleconferencing, and electronic mail on the Internet.

The University of Wyoming is the only four-year teacher education institution in Wyoming—a huge state with its population distributed in small towns and rural pockets at great distances from one another. As a result, outreach has always been a priority for the university, and the college of education in particular. Many inservice courses are offered through extension, and there is a large item in the school's budget to cover the cost of car and air transportation for faculty who teach these courses. But extension teaching in a sparsely populated northern state is difficult for a number of reasons. The distance problem is not only one of transporting faculty to a distant site, but of having sufficient students in any one location to justify offering a course. In a given semester, there may be only a few teachers or administrators in any one town who need a particular course. In addition, for five months of the year there are unpredictable and often severe snowstorms that make travel treacherous and make it difficult to bring any group together on a regular basis. Because of the challenges created by distance, technology has become a necessity, not an extra.

Linking Schools to the University with ICV

In 1990, when the governor announced the availability of monies from an education trust fund and invited proposals, several educational groups joined forces and responded. The university's School of Extended Studies, the College of Education, the state Department of Education, and a number of public school districts were all interested in two-way interactive video communication. The state Telecommunication Office proposed the creation of a telephone network capable of supporting interactive compressed video (ICV) by using the excess capacity of the existing state Data Network Backbone. ICV is a form of television transmission that requires less sophisticated equipment than typical broadcast television. Unlike one-way broadcast television, ICV supports groups at two or more sites interacting with one another. This technology would make it possible to overcome the long distances that separated the districts from the university and from one another. It would facilitate both inservice training of existing teachers and mentoring of preservice teachers in their district placements.

Student teaching placements are part of Wyoming's "Phase Program," begun in 1992, in which teacher education students pass through three phases of increasingly intense clinical involvement in schools around the state. For students who choose a career in teaching early in their undergraduate career, four out of eight semesters that comprise their undergraduate degree program include placements in K-12 schools. Each phase has clearly stated expectations for the technological proficiencies students must exhibit at the end of the phase. By the end of the program, each student should meet the college's new requirements for technological competencies.

Together, the public schools and the university developed a new model for teacher education in which each plays a role in educating students and teachers about technology. The districts provide placements for aspiring teachers where they can receive hands-on experience with some of the best model programs and also be exposed to the realities of the less computer-rich classrooms. The placements are in model schools, called Centers for Teaching and Learning (CTLs). A CTL is a school whose teachers and administrators have engaged in a lengthy process of renewal, examining its mission and redefining its curriculum and instructional approaches in ways that recognize this mission. Each CTL has identified master teachers to serve as mentors for university students assigned to the district. In addition, each district has identified Clinical Teachers, partially paid by the university, who supervise college students when they are present in the district.

This model would not be possible without technology. The interactive compressed video system is used to maintain a regular connection between the university and the district. Two or three times a month, the university and district hold electronic meetings where students give progress reports on their experiences and respond to teaching-learning issues posed by their university professors. District clinical teachers set the context and facilitate student reporting.

Another use of ICV is to support school renewal efforts around the state. Under project VEIN (Video Education Interactive Network), school-university teams develop seminars and courses to support various aspects of school restructuring and curriculum improvement. Although still new, ICV is being used experimentally in a variety of applications. For example, faculty in the college of education's counselor education program have set up a monthly "town meeting" where counselors in outlying districts can go online to share ideas about different issues. A difficult issue for Wyoming at present is trying to expand the ICV network, since costs for installing the interactive compressed video remain high.

The Role of a Laboratory School Within a College of Education

Laboratory schools—common in the past—are actual schools connected with colleges of education, where prospective teachers can gain much of their teaching experience. However, many COEs closed their lab schools in the 1950s and 1960s, in part, because the students in lab schools were traditionally the children of university faculty, and many were concerned that teacher candidates would not be exposed to a range of students in the lab schools.

Since then, many COEs have developed instead Professional Development Schools (PDS)—a public school outside the university but serving many of the same functions as previous lab schools. Wyoming has both these institutions: a series of Professional Development Schools that play an important role in educating future teachers about appropriate roles for technology, and a lab school located in the same building as the college of education. The lab school's proximity to the university and its technological advances combine to give it primacy among the professional development schools in Wyoming. There may be other schools in Wyoming equally advanced technologically, but they are at a great distance from the campus at Laramie. The Phase Plan is good for immersing education students in real schools; the ICV technology is promising for interconnecting

CTLs and the college of education; but the physical proximity of the PDS—coupled with the fact that the school's students can share resources with the college—makes it an unusually rich resource for learning about technology. Almost daily an education student might be sitting next to a middle school student who is using computers in interesting ways. When it comes to learning about technology—a rapidly changing field—Wyoming has found its laboratory school to be a valuable resource.

Lessons Learned

At the University of Wyoming College of Education, a number of lessons are directly related to the fact that Wyoming is in a unique geographic setting where vast distances and severe weather patterns often dictate schedules. There are general lessons to be shared, however:

- **Changes at the college of education that are embedded in public school reform will more likely have a long-standing impact on the way teachers are prepared.** Long-term change has a better chance of surviving if it is nurtured at the bottom and supported from the top, rather than being mandated from the top.
- **Informal learning communities can be created that involve technology at all levels and each level can assist the others to do their best.** In some cases, the K-12 students themselves learn the technology and help their teachers find ways to use it. Teacher education students placed in these settings learn that all expertise does not reside in the teacher, a valuable lesson.
- **A lab school within a college of education or a professional development school nearby may be an extremely valuable—and convenient—resource for teacher education students.** It can be a particularly useful testbed for new uses of technology.

University of Northern Iowa, College of Education

At the University of Northern Iowa (UNI), a professional development/laboratory school has also proved a unique asset, modeling technology use and utilizing remote video to bring classroom exposure to teacher education students. As in Wyoming, the lab school at UNI is to teaching what a research hospital is to a medical school. A recently installed fiberoptic network connects the lab school to the college of education, so faculty can "ship" classroom video to methods classes. This is part of a pilot project that allows video from any of the 48 classrooms at the lab school to be sent to classrooms in the college of education. Using a portable control unit that can be wheeled into classrooms, the model also relies on two professional-quality video cameras and several microphones in a classroom for transmission. (The transmission is also videotaped so it can be used later for anyone who misses it, or for reflection on teaching practices.) The lab school has its own technology committee that encourages diffusion of technology throughout the school.

Two video classrooms at UNI are also used for distance education courses. For example, if classroom teachers want to take additional classes so they can be certified to teach students with disabilities, the course is offered in the video classrooms with a UNI professor as part of the Iowa Communications Network (ICN). ICN is used by both education and state agencies.

Technology and Student Teaching

The entire state of Iowa has a population of around three million. The number of UNI students who do classroom observations and student teaching is far greater than the university's local area (with a population of about 100,000) can handle. With over 700 students to place in student teaching each year—and because many schools in Iowa are not culturally diverse—UNI places students throughout the state, and in other states and countries. There is, for example, a full-time UNI faculty member in San Antonio, Texas, where (in the spring of 1994) 28 UNI students did their student teaching in the diverse, multicultural local schools. Other UNI students have done student teaching in Nebraska, Kansas, Oklahoma, and Egypt.

To deal with hundreds of student teachers spread across the state and nation, UNI has organized students into clusters, 10 of which are in Iowa. The clusters are made up of all the student teachers in a region along with a UNI faculty member assigned to that region to support the students, the collaborating teachers, and other professionals, including the 85 members of the UNI Teaching Associates Cadre (a group of master teachers in Iowa schools who participate in collaborative projects including revising and improving student teaching experiences). UNI also funds a clinical supervisor for each of the centers in the state. This is a half-time position for a local school district employee, who works with the UNI faculty member assigned to the region, to supervise student teachers.

With such a diverse and dispersed group participating in student teaching, communication and coordination are major problems. To deal with these problems, a UNI group created a teleconferencing system that allows students, faculty, and cooperating teachers who have access to a personal computer and modem to exchange electronic mail and participate in a wide range of electronic conferences. The system has been in place for almost 10 years and staff and students have both felt the benefits. Conferencing on "caucus" may take the form of public discussion of items which anyone on the conference may read, or private messages. Participants with diverse perspectives are able to contribute freely and at their own convenience to continuous discussions related to teacher education. Students, faculty, practitioners, and administrators—though separated by hundreds of miles—have an avenue for mutual problem solving and the exchange of ideas.

Prior to the electronic conferencing system, the 10 faculty coordinators met face-to-face on campus once a month to discuss matters relating to teacher preparation. Now they are in almost daily contact through the network. This has had multiple effects. First, it has increased the sense of connectedness for the faculty coordinators—both among themselves and with campus colleagues. Second, it has improved the productivity of the monthly face-to-face meetings. With the regular contact in between meetings, more work can be accomplished so that face-to-face meetings concentrate on matters that can best be handled in that medium. Further, the work of the group is enriched by the addition of the clinical supervisors and the cadre members. The network helps forge relationships between the academic and the practitioner, a connection vitally important for a college of education.

The dean and a faculty member describe benefits of the electronic mail/conferencing system for student teachers:

> The student teaching experience is an intense and crucial, formative experience. It is a time when all the preparatory training and experience is brought to bear in an actual classroom experience of significant duration. In a conventional student teaching situation, the student teachers have access to the cooperating teacher in whose classroom this experience is taking place, the supervising faculty member from the university, and their peers in weekly face-to-face seminars.
>
> The addition of the computer conferencing networks to this experience accomplishes several important things. First, it expands the resource base for the student teacher. In addition to the available resources mentioned above, the student can now have access to faculty coordinators, clinical supervisors, and peers across the state. Furthermore, the students may now have access to resource people back on campus including professors in the content areas or methods areas, or library and media staff. We have had student discussions taking place on the system with library resource people who were following the online discussions. On occasion, the resource people would enter the discussion, noting that there was material available in the UNI library for a problem the student seemed to be having. The student would acknowledge that the material would be helpful and the material was mailed immediately on loan. Similar offers of counsel from supervisors and peers represent significant enhancement of resources during this critical period.
>
> Second, the student has an alternative and supplementary communication medium. Given peoples' schedules and relative comfort levels with face-to-face communication, this network

represents another way to connect with those who can be of help during the student teaching experience.[91]

Outreach is a large part of UNI's daily operations, and the teleconferencing system is also used for outreach activities in which school administrators around the state present problems or pose questions for input from UNI faculty and other administrators.

Lessons Learned

A number of lessons have been learned from the process at UNI:

- **Institutional support and recognition from the university leadership are important.** At UNI the central administration demonstrates in many ways that teacher education is an honorable and valued part of the university's academic mission. The often unspoken but understood opinion of an institution's leadership about teacher education can facilitate—or hinder—reform efforts. Institutional support can be nurtured and encouraged, especially with leadership from a dean who supports technology.
- **Major changes do not always require grants or additional funds.** Neither the university nor the college of education are well endowed. Most of what UNI has accomplished has been done by reallocating existing funds. Over a period of seven years, UNI made many internal adjustments in personnel, budget allocations, and priorities to boost technology-related initiatives.
- **Grassroots leadership across the college is critical, too.** Which technologies are supported and how they are used was decided by college of education faculty, department heads, and program coordinators. The dean was a supporter, but the faculty took ownership of the technologies in use.
- **New faculty can be a significant factor in supporting technology.** Over the next decade the majority of faculty in many colleges of education will change through retirements or resignations. As search committees are formed, hiring faculty who use technology in the courses they teach can be an effective way of increasing the percentage of faculty who integrate technology into teaching.
- **Identify people with the talent and interest to succeed in technology reforms.** Do not spread resources thinly, across people or across areas of technology concentration; UNI, for example, has chosen to emphasize telecommunications, rather than cover all technologies.
- **K-12 teachers can be a significant source of leadership.** Much of what UNI teacher education students see and learn about technology in education comes from the innovative uses in the lab school. Also, since about 90 percent of the lab school faculty use technology in their classrooms, they are another source of influence on traditional teacher education faculty.
- **Do not push technology.** UNI's approach to technology diffusion targets problem areas—such as communicating with scattered student teachers—and suggests ways technology can improve the quality of instruction.

Vanderbilt University, Peabody College

Teacher education students at Peabody College use technology extensively as an integral part of their professional preparation. Peabody's approach to teacher education attempts to duplicate the richness and complexities of a K-12 school setting using a blend of video and computers, primarily through video case studies of teachers in real classrooms. This approach brings to preservice teachers a clinical experience previously not possible.

[91] Mike Waggoner and Thomas Switzer (1991), as quoted by Mergendoller et al., op. cit., footnote 61, p. 27.

A number of factors make Peabody's approach feasible. A relatively small number of enrolled students—about 20 percent—are preparing to become classroom teachers, so the student-to-teacher ratio is low. Also, an onsite research and development center, the Learning Technology Center, has for a decade investigated complex teaching and learning issues in K-12 education, so the college has been influenced by the center's findings over the years. In addition, teaching is highly valued by Vanderbilt's leadership, with the chancellor an outspoken advocate for the profession—as well as for technology.

Building Technology on a Constructivist Learning Base[92]

Cognitive science is a highly respected specialty at Vanderbilt. There are faculty groups pursuing this in both the College of Arts and Science and Peabody College. The long-standing interest in the science of human learning has shaped much of Peabody's technological contributions. It seems quite natural that themes of learning, teaching, and technology permeate Peabody College. The dean of Peabody summarized the college's perspective in this way:

> Our goal has been to find ways that advanced technologies can capitalize on what cognitive science has learned about knowledge and its acquisition, and the social process of learning, to design environments that assist teachers and students in the transaction of the learning process. This contrasts with the beliefs of some who have assumed wrongly that learning is a singular activity and that technologies will transform education by totally replacing teachers.[93]

For the last decade, Peabody College has been developing innovative uses of technology to enhance learning. With deep roots in cognitive science and an interest in constructivist learning principles, researchers at Peabody's Learning Technology Center developed a series of technological experiments to test a new approach to learning. In the early 1980s, they were studying that bane of 5th-grade math—the story problem. Sensing that the problem for most students lay not in their math skills but in the abstract quality of the story problem itself, they sought to "anchor" the problem in a rich story context. They caught the attention of many educators when they put on videodisc portions of the popular Hollywood movie *Raiders of the Lost Ark* and made the disc into an experimental anchor for problem-solving instruction. Viewers were asked to solve problems such as estimating the breadth of a pit-trap and the height of a tomb door using only the information that Indiana Jones, who stood next to the pit and the door, was 6 feet tall.

Later, sensing the limitations for school-based instruction of a made-for-entertainment video, they began developing a special purpose adventure video that would support mathematics instruction in the middle grades. Titled the *Adventures of Jasper Woodbury*, it contained (eventually) a number of real-world, compelling problems that required problem-solving skills and math to solve.

Other projects emerged built on the same anchored instruction philosophy. In time, various faculty recognized the potential of the anchored instruction approach for teaching college students how to teach math. These insights fit nicely with the growing recognition in the 1980s of the importance of case-based instruction to provide opportunities for novice teachers to confront the complexities of instructional decisionmaking. When, in the late 1980s, funding opportunities for new teacher education materials became available from several federal agencies (the National Science Foundation, the Fund for the Improvement of Post-Secondary Education, and the U.S. Department of Education), a cadre of Peabody educa-

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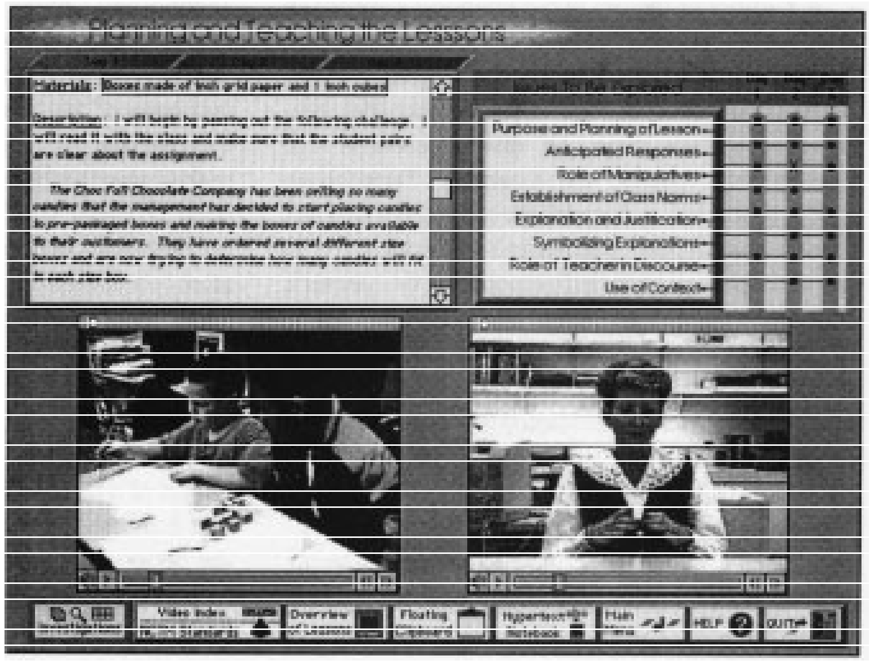
[92] Constructivist learning refers to a view of learning in which students construct their own knowledge based on exploration, evaluation, and revision of ideas, drawing on prior knowledge and understanding.

[93] James Pellegrino, as cited in Mergendoller et al., op. cit., footnote 61, p. 53.

At Peabody College, Vanderbilt University, "video cases" are used by teacher education students to view teachers in action in the local schools. A videodisc controlled by Hypercard software allows the teacher education students to watch any number of video segments in any order. It is also possible for the students to stop the video at key points and enter their own comments in en electronic notebook, which is collected and reviewed by the college instructor.



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tors applied for monies to extend the anchored instruction approach to the training of future teachers. Several of their products are centered on technology.

Peabody Integrated Media Approach

The Peabody Integrated Media Approach (PIMA) extends the anchored instruction model by using videotaped cases of real teaching, which are then **brought** to the college classroom for viewing and discussion as a way to build the clinical skills of potential teachers. Although it is no substitute for actual experience managing a classroom of children, PIMA is a valued contribution to the education students' understanding of teaching practice and also indirectly builds their computer skills. A basic assumption of Peabody's approach is that teachers cannot be told how to practice professionally; in other words, readings and lectures alone do not provide the full scope of what they will face in the classroom.

Whether in reading and language arts or math education class, teacher education students at Peabody do more than just watch a teacher in action; they use video footage of classroom teachers-which has been converted to videodisc and is controlled by computer—to analyze and discuss teaching styles or strategies and comment on the teacher's performance. In the math education class, for example, students use Hypercard to control the videodisc presentation, so they can jump forward to a different part of the video or review a segment already seen. Students can stop the video at key points, enter comments in an electronic notebook, and print out their comments. The notebooks are collected electronically at the end of the class for the instructor to read.

Virtual Professional Development

For more than eight years, Peabody faculty have been developing a variety of electronic supports for teacher education, including electronic lecture outlines with "buttons" accessing bibliographic references, video illustrations or other information the instructor might want to use during a class discussion, video-based cases for analysis, instructional resources for preservice teachers (sample lesson plans, activities materials, etc.), miscellaneous class assignments, and so on. These materials are organized in a virtual environment called the PPDS—Peabody Professional Development School (see figure 5-1).

PPDS is a hypermedia map of a school that links students to these different resources by calling for them in the appropriate place. For example, the resources are organized into "rooms" and are accessed through icons, such as furniture or objects in the rooms. Students "entering" the PPDS sign in at the virtual office by logging onto the system. The PPDS offers a variety of activities; for example, the Demonstration Classroom is a "place" where preservice teachers can watch assigned elementary school math and science lessons or check the filing cabinet for more resources, written lesson plans, or additional information about the math involved.

Each time students use the PPDS they not only access useful materials, but also become more familiar with the technology. More recently, education students have been creating and entering materials into the PPDS resource files; previously only Peabody faculty contributed materials. All the data have been organized, indexed, and entered into the school's integrated media database, and it is now available for future teacher education students. This type of activity provides opportunities for teacher-education students not only to become more facile with technology, but to develop a sense that technology can be an integral part of the teaching/learning process.

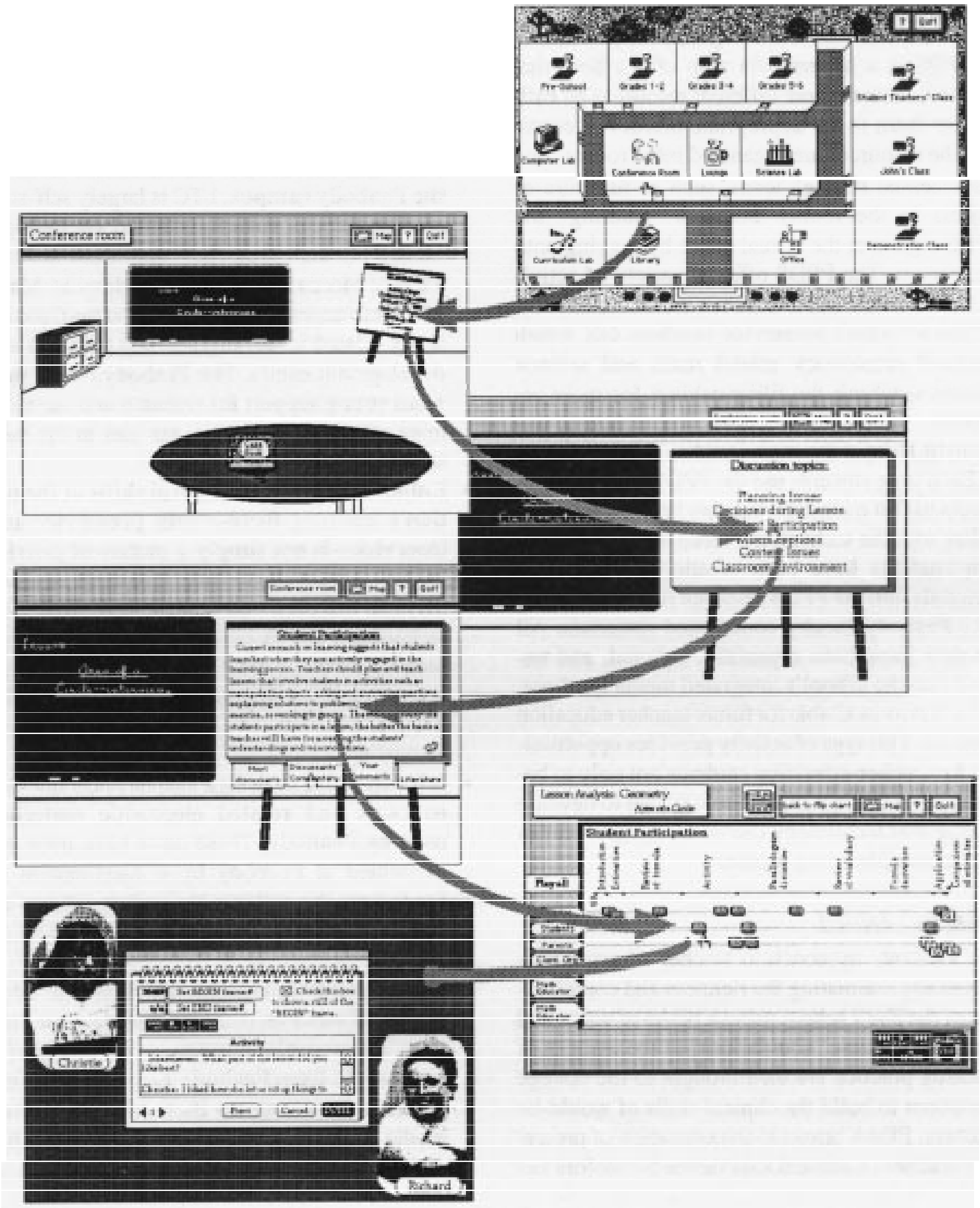
Lessons Learned

The Peabody approach to teacher education involves approximating the richness and complexities of the K-12 school using a blend of video and computers. These "simulations" of the realities of teaching practice are then brought to the college classroom to build the clinical skills of would-be teachers. PIMA brings to the education of preservice teachers a clinical experience heretofore not possible. While not a substitute for actual experience managing a classroom of children, PIMA makes a valuable contribution to students' understanding of teaching practice while indirectly building their computer skills. There are a number of factors that make Peabody unique:

- **The Learning Technology Center is clearly a catalyst that shapes fundamental ideas on the Peabody campus.** LTC is largely self-supporting through funds generated by multiple funded research projects,[94] and it has become a sort of Mecca for educators worldwide. Many of the advances at the education school are directly related to advances at this research and development center. The Peabody model provides strong support for research and development efforts in education, not just in the hard sciences.
- **Enhancing the technological skills of the nation's teaching force—both preservice and inservice—is not simply a matter of providing them with classes and workshops** where they can learn the well-accepted approaches to technology use in classrooms. The developments at Peabody are a result of the technology research and development efforts of the faculty itself, and the faculty's access to a rich array of resources.
- **It is expensive to design and develop the video cases and related electronic materials used by Peabody.** These costs have been underwritten at Peabody by a combination of funds from the college, Vanderbilt University, business and industry, and various federal sources.
- **It is not clear how easily teacher-education faculty at other institutions could adopt Peabody's electronic resources "off the shelf" and benefit from Peabody's considerable experience in setting up their own integrated media approach to teacher education.** But these resources (the video cases and related

[94] Several federal programs have contributed to the Learning Technology Center's research, including the National Science Foundation and the U.S. Department of Education's Fund for Improvement of Post-Secondary Education.

FIGURE 5-1: Peabody College's Virtual Professional Development School



To organize all the resources available to teacher education students, Peabody has created a virtual environment called the Peabody Professional Development School. PPDS is a Hypermedia map of a school; each room represents different resources. By clicking on the icon-for example, the conference room in this illustration-students have access to "conference' resources, such as a flip chart. By continuously clicking on the appropriate icons, students can browse and navigate their way through PPDS to access materials that will help them achieve instructional goals.

SOURCE: Peabody College at Vanderbilt University.

"contents" of the Peabody Professional Development "School") have characteristics that are different from both college textbooks and printed case studies used in business-school education programs.

- **The clinical approach to teaching entailed in PIMA requires a lot more time and involvement from college instructors than the traditional lecture/discussion formats that characterize much of college teaching.** To induce faculty at other institutions to adopt PIMA may require additional incentives.
- **Implementation of PIMA requires an expensive infrastructure**—both a technological infrastructure (computer laboratories) and the staff to keep it working.

CONCLUSIONS

These examples are promising, but they represent a limited scope of the potential for improving technology use within teacher education and, more importantly, improving teacher education overall with technology. As discussed earlier in the chapter, there is no central source for collecting data, sharing experience, or evaluating the effectiveness of teacher education in general, and certainly not for technology in teacher education in particular. Although advances such as telecommunications networks offer resources, without a road map there is no guarantee that the "information superhighway" will be used by teacher educators, K-12 educators, or their students, or that it will open up new worlds for them. But several conclusions can be drawn about the current status and possible future directions of teacher preparation.

Reform of teacher education should accompany any significant reform in K-12 education. However, this is a challenging task, given the general status of colleges of education in the university hierarchy, the exclusion of colleges of education from much funding at the state and federal levels, and the overall lack of priority given COEs in terms of funding or support for reform efforts. Enhanced resources for COEs that coincide with each national push for K-12 reform may increase the likelihood of real changes at both levels.

Furthermore, if technology is to break out of the isolated role it plays today and become an integral part of the teacher education curriculum, several things must happen. **An integrated curriculum infused with information technology requires that teacher education faculty and cooperating K-12 teachers model effective instructional technology use.** This interaction between K-12 schools and teacher education programs is an important, generally overlooked variable. It requires considerable training and support for current K-12 educators and for teacher education faculty in all segments of the teacher preparation program. Like K-12 educators, teacher education faculty need to see how information technology supports and facilitates instruction in their content or professional area.

Teacher education faculty need help integrating technology into the courses they teach. Since the majority of teacher education faculty completed graduate programs and taught in schools where technology was not a major part of the educational environment, it is not surprising that they tend to have limited experience with technologies for instruction. But simply telling teacher education students about what is possible is not enough; they must see technology used by their instructors, observe uses of technological tools in classrooms, and practice teaching with technologies themselves if they are to use these tools effectively in their own teaching once they graduate.

Colleges of education have much to learn from one another, and technology can be a catalyst to make the necessary connections. Teacher education programs need to provide considerable support, create and disseminate traditional and electronic resource materials, and revise incentives within teacher education to encourage teaching that integrates technology in instruction. A comprehensive strategy necessitates different instructional approaches in teacher education, such as video cases of teachers using technology in their classrooms, teaching lessons and activities for education students involving the use of technology, and supervising development and teaching of technology-supported lessons in cooperating schools. These approaches are not easily accomplished—all are expensive and require changes in the skills, perspectives, and attitudes of teacher education faculty and administration—but they are needed nonetheless.

College of education administrators are key players in any effort to improve preparation programs. Almost all of the universities considered exemplary in this area have deans and department chairs who see technology preparation as critical. Conferences, workshops, and publications for education leaders would make COE administrators and non-technology oriented faculty aware of needs and alternatives. Technology "gurus" in COEs should be encouraged to publish articles, make presentations, and offer workshops tailored to the needs of the nonspecialist, to extend their expertise to their less technology-oriented colleagues.

Limited technology resources are an issue for colleges of education. A reading instructor who decides to change textbooks for an introductory reading methods course does not necessarily set about to write his or her own textbook; he or she has a choice of at least a hundred texts already in print. If that same instructor decides to use Hypercard stacks or video cases of effective integration of technology in reading instruction, there are very few choices. The instructors may indeed be faced with the prospect of writing their own stack or creating their own video, and the COE needs to be prepared to support such innovation.

A few grant programs have targeted the creation of technology-supported materials for teacher education, but more support is needed. For example, the major video material for teacher education developed at Vanderbilt University and other institutions has been funded by federal, state, and corporate grants.

In addition, a national clearinghouse or distribution center for such materials is needed. A nonprofit clearinghouse that reviews submissions and accepts them for distribution, duplicates disks, or designs and produces supporting documentation and manuals would be a significant contribution to reducing the barriers to greater use of technology in teacher education. Many developers of such materials are not as concerned with making a profit, as they are on seeing their materials distributed to other teacher educators. Resources such as the Internet offer possibilities for broad dissemination of such materials.

Recognition of the importance of technology in teacher certification is gaining momentum. States take various and often mismatched approaches to certification and technology requirements. But guidelines do exist—such as those developed by the International Society for Technology in Education—and perhaps more need to be developed to help states figure out what teachers need to know about how to use technology effectively.

Colleges of education, states, and K-12 schools need to work together to develop a set of shared expectations for joint reform efforts, with a close eye to the role of technology in the reform. COE faculty rarely work with other agencies—such as school districts or state education agencies—on projects related to technology integration, in part, because K-12 reform and COE reform are typically considered separate issues. In fact, the two are directly related. New teachers leave COEs and enter classrooms where they inevitably face a multitude of challenges. Perhaps, as one educator suggests, the first step in terms of technology knowledge ought to be to "make the teachers fearless" in their attitude about technology.[95]

[95] Lee Ehman, Professor of Education, Indiana University, Bloomington, personal communication, June 27, 1994.