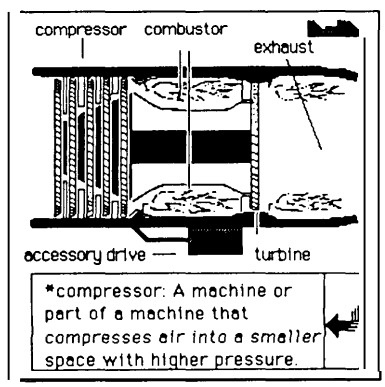
Technology Today: Practice vs. Promise 7

Advances in technology have "upped the ante" for adult literacy by redefining the skills people need to function successfully at work and in everyday life. At the same time, technology offers new tools with enormous potential for improving adult literacy-provided that learners and education programs can obtain and use them effectively.

Computer and video technologies, telecommunications, and consumer electronics all have features well-suited to adult education. Within each type of technology, an array of hardware, software, and learning materials is available. Hardware for literacy ranges from interstate satellite networks to pocket-sized language translators; from dazzling multimedia systems integrating words, pictures, sound, and touch, to the familiar telephone. Software ranges from basic drill programs that permit learners to practice a skill repeatedly, to sophisticated simulations that allow adults to interact with realistic reproductions of work or social situations.

As earlier chapters have suggested, technology has the potential to attract and motivate adults with limited literacy skills, give them greater privacy and control over their learning, adjust instruction to different paces and learning styles, transport education to new locations, reach more students at lower cost, train teachers, and improve program management and coordination. But is this potential being met? To answer that question, **this** chapter explores several questions:

- How much real access do literacy programs and learners currently have to hardware and software?
- How do literacy programs use technology now, and how could they use it more effectively?
- What are the barriers to broader access and more effective use of technology?



FINDINGS

- Computers are the most widely used technology in literacy programs, but even the use of this technology is limited. It is estimated that not more than 15 percent of literacy providers use computers regularly for instruction. Still rarer in literacy programs is the use of newer, computer-related technologies—digitized speech, videodisc players, and CD-ROM (compact disc-read only memory)-that offer promising multimedia applications.
- As literacy educators gain more experience, the uses of computers move far beyond traditional drill and practice. However, even experienced programs generally use technology as a supplement to traditional classroom-based instruction, rather than as a fundamental tool for learning.
- Video technology is surprisingly underused given its familiarity and availability. Lower end, inexpensive technologies-such as audio recorders, closed-caption decoders, and handheld electronic devices-are largely ignored.
- Available computer software does not adequately meet the demands of literacy programs. Courseware for video and other technologies is even more limited.
- A significant amount of hardware and software in businesses, homes, schools, colleges, and libraries is underutilized for literacy education.
- The promise of technologies to enable adults to learn anywhere, any time, is still largely unexplored. Technology is rarely used to reach learners outside of classrooms or to provide flexibility for learners.
- Significant barriers that inhibit widespread access and effective use of technologies include the cost and funding of technology, a highly fragmented marketplace, the lack of information about technology applications, and the institutional challenges faced by a diverse literacy field.

ACCESS TO TECHNOLOGIES FOR LITERACY

Recent advances have made technology more adaptable than ever before for adults with limited literacy skills. Computers with speech synthesizers can transform written text into spoken words, which is especially helpful to limited English proficient (LEP) adults and those with minimal reading skills. Touch screens, pointing devices, and icons have made computers less intimidating and easier to operate. Hand-held electronic devices make it possible for adults to learn on the bus, at home, on a coffee break, or in a waiting room. Distance learning technologies can extend opportunities for education and peer interaction to adults in remote locations. And the diversity of technologies means that something is available for almost every type of learning style or program need (see box 7-A).

In order to take advantage of these features, however, adult learners and literacy programs must have access to hardware and equipment and to software and other learning materials. Determining the extent to which literacy programs have access to technology is difficult because data are so limited, especially for some of the newer technologies. To supplement the limited existing research, the Office of Technology Assessment (OTA) initiated several studies and made staff visits to technology-using literacy sites.[1]

Access to Computer Hardware

Having access to hardware is the first, most obvious gateway to using technology. Literacy

[1] J.D. Eveland et al., Claremont Graduate School, "Case Studies of Technology Use in Adult Literacy Program," OTA contractor report, June 1992; Jay P. Sivin-Kachala and Ellen R. Bialo, Interactive Educational Systems Design, Inc., "Software for Adult Literacy: Scope, Suitability, Available Sources of Information and Implications for Federal Policy," OTA contractor report, June 1992; Christine Holland, SL Productions, "Observations: Technologies for Literacy in Mississippi and New York City," OTA contractor report and video footage, April 1992; and Education TURNKEY Systems, Inc. and Wujcik and Associates, "The Educational Software Marketplace and Adult Literacy Niches," OTA contractor report, April 1992. See appendix H for information on obtaining these reports.

Box 7-A—Technologies for Literacy

Computer-Based Technologies

- Computer and peripheral hardware (monitors, keyboards, printers, drives, mice, modems).
- Computer input devices (scanners, touch screens, pens, microphones).
- Local- or wide-area networks (computers and terminals linked over short or long distances), electronic mail, electronic bulletin boards.
- Multimedia systems that combine text, graphics, sound, animation, and video (computers connected with devices such as video monitors, laserdisc or videodisc players, CD-ROM players, speech synthesize, speech boards, audio speakers).

Some applications: Computer laboratories for instruction and self-tutoring; audio for help with pronunciation and vocabulary (especially useful with beginning readers and English as a second language students); presentation of information through multiple media (e.g., text, graphics, moving pictures, sound) to reach learners with different learning styles; information networks for teachers and administrators.

Telecommunications Technologies

- **Broadcast, radio cable, and satellite networks.**
- **Television sets, VCRs, video** players, camcorders, closed-caption decoders, and videocassettes.
- Telephone networks, telephones, touch tone, voice mail (see also local- or wide-area networks above).
- Facsimile (fax) machines.

Some ***applications:*** Two-way interactive distance learning, video conferencing for learners and teachers; television, videocassette, and radio courses to facilitate learning at home; informing public about literacy programs; sharing of courseware and effective practices; large installed base in order to reach many prospective learners who cannot or will not come to programs.

Consumer Electronic Devices

- **Portable electronic devices (calculator, language** translator, hand-held dictionary and encyclopedia digital books).
- Home videogame machines.
- Audio equipment (stereo, **compact disc player, tape player, cassettes, books on tape).**

Some *applications: Learning* "on the go" or at home, renting coursewareforVCRs or game machines, translating between English and another language, hearing correctpronunciation of unfamiliar words, reading books on tape or electronic books.

SOURCE: **Office of Technology Assessment,** 1993.

programs with computers are most often found in public schools, community colleges, and large corporations--institutions that have funds for hardware purchases, a prior commitment to learning technologies, and opportunities for buying in quantity at reduced prices. Although literacy programs benefit from being located in such institutions, it is rarely the literacy **program** alone that drives hardware acquisition.

Correctional facilities are another group of literacy providers likely to have access to computers. Federal prisons, for example, were early users of computer-based training in basic and vocational skills. Although comprehensive statistics are not available regarding technology access in correctional institutions, 35 of 65 Federal prisons use computers in their educational programs, as do the correctional systems in such States as

Texas, New York, Michigan, and Minnesota and such large cities as Los Angeles.*

Reliable estimates of access to computers among community-based organizations (CBOs) are particularly difficult to obtain, because these providers are so diverse. An OTA survey of 33 technology-using programs found that community-based literacy programs had fewer computers than programs in public schools, businesses, and community colleges.[3] Even so, many community-based and volunteer literacy programs do acquire hardware. A 1991 survey conducted by Literacy Volunteers of America (LVA) reported that 72 percent of LVA programs were using computers in some capacity (though not necessarily for instruction).[4] In addition, the Job Training Partnership Act (JTPA), which funds many CBOs, encourages computer-based instruction and allows Federal funds to be used for hardware and software (see chapter 5). Similarly, the Federal Job Corps program for severely disadvantaged youth has promoted the use of computers for education and training in its centers.[5]

Furthermore, most literacy programs with computers do not appear to have access to newer more powerful, computer-related technologies-such as scanners, speech boards, CD-ROM, videodisc players, modems, and touch screens-that make the technology more accessible and open up promising multimedia applications for adult learners. Typically, the 33 technology-using programs surveyed by OTA had stand-alone computers with color monitors and mouses. About one-half of the programs surveyed had some hardware with speech capabilities. Scanners, which allow teachers and students to customize software by copying photos, drawings, and text into their computer applications, appeared in only one-third of the sites. Videodisc players, CD-ROM, modems, and touch screens were even less available.[6] Access to newer technologies seems to depend on whether a "critical mass" of technology resources exists in a literacy education setting. Programs with relatively fewer computers (less than 15) also tend to have fewer of the more advanced technologies.[7]

Little is known about which factors create demand for instructional computers or how much technology planning precedes acquisition. Anecdotal evidence suggests that the motivation to purchase hardware comes from any of four sources: word-of-mouth success stories, the desire to attract students, the initiative of a technology crusader on staff, or an attempt to serve more learners when space, time, or personnel axe limited.[8] Very few literacy providers, especially those outside of community colleges or large school districts, appear to develop a comprehensive, long-range technology plan. Even workplace literacy programs operated by businesses sometimes fail to tap in-house technology expertise from other departments.[9]

Access to Other Hardware

Estimating the number of literacy programs with access to video and telecommunications

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[2] Education TURNKEY, Inc. and Wujcik and Associates, op. cit., footnote 1, pp. 34-35.

[3] Sivin-Kachala and Bialo, op. cit., footnote 1, p. 26.

[4] Literacy Volunteers of America, Inc., New York, NY, "Computer Use Survey, 1984- 1991," 1991. Forty percent of the LVA programs with computers reported using them for program management only.

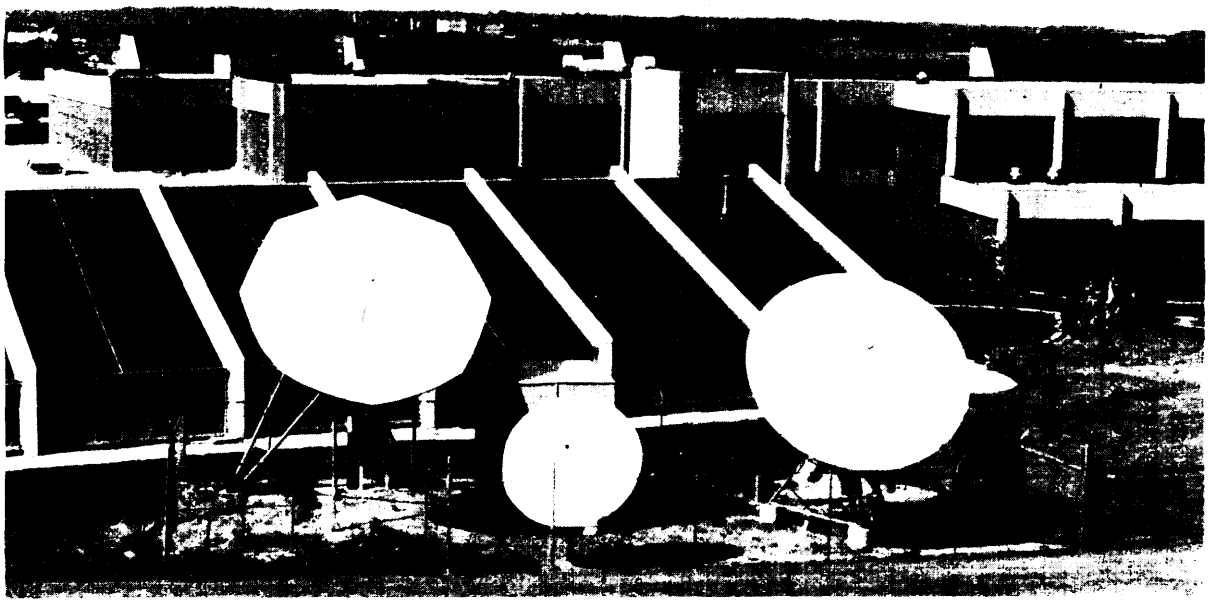
[5] Jo Ann Intili et al., *An Evaluation Feasibility Study of the Use of Various Technologies to Assist in the Instruction of JTPA Participants*, vol. 1 (Berkeley, CA: Micro Methods, June 30, 1989).

[6] Sivin-Kachala and Bialo, op. cit., footnote 1, pp. 28-29.

[7] Ibid., p. 29.

[8] Ibid., p. 66; Eveland et al., op. cit., footnote 1; Holland, op. cit., footnote 1; and Arnold H. Packer, *Retooling the American Workforce: The Role of Technology in Improving Adult Literacy During the 1990s* (Washington, DC: Southport Institute for Policy Analysis, 1988),

[9] Eveland et al., Op. Cit., footnote 1, pp. 133-159.


Kirkwood Community College

Despite a growing base of distance learning systems, few are being used to serve adults in literacy programs. Some schools, like Kirkwood Community College, are exploring the possibilities of reaching adult learners.

hardware is even more difficult than determining computer availability. While statistics exist about the presence of these technologies in different institutional settings, it is unclear to what extent video and telecommunications technologies are actually being used for adult literacy education. OTA studies indicate that very few literacy providers use video and telecommunications technologies, even when a parent institution, such as a public school, has access to hardware.

Community colleges, for instance, frequently use broadcast and cable television to offer college-level telecourses. Over one-half of the community colleges responding to a recent survey reported having a distance learning program,[10] but few use these for adult literacy education.

The private sector also appears to have access to video technologies that are used for general training activities. *Training* magazine reports that 92 percent of U.S. businesses with 100 or more employees use videotape materials for training purposes, 20 percent use interactive videodiscs, and 10 percent use videoconferencing, with higher percentages among larger businesses. This survey did not distinguish between training for basic skills/literacy and other types of corporate training, although 19 percent of the businesses reported providing some kind of remedial courses in reading, writing, basic mathematics, or English as a second language (ESL).[11]

A potential source of telecommunications hardware for literacy programs is the Federal Star Schools Program. The 10 telecommunications partnerships created by this program have provided over 3,000 elementary and secondary schools with satellite dishes and 1 project is

10 Ron Brey, *U.S. Postsecondary Distance Learning Programs in the 1990s: A Decade of Growth* (Washington, DC: American Association of Community and Junior Colleges, 1991), pp. 6-11.

11 ''~dUStryReWfi1992: 11th Annual Survey of Employer-Sponsored Training in America,'' *Training,* vol. *29, No.* 10, October 1992, pp. 31-59. When businesses were allowed to set the criterion for which courses qualify as ' 'remedial education,'' 40 percent reported offering such a course.

helping build a statewide fiber optic network in Iowa. Although the program is primarily a K-12 venture, several of the Star Schools projects are serving adults with limited literacy skills or adults who want to learn English.[12]

Personal electronic devices, such as language translators, hand-held dictionaries, and encyclopedias, are available in a limited number of literacy programs, although almost one-half million of these products are now in public schools and providers such as correctional institutions are beginning to acquire them. Several million individuals also own hand-held language devices.[13] To date these devices have had limited learning applications. Most were developed for a limited purpose, with preprogrammed contents on a microchip. Now that vendors are placing content on cartridges (e.g., whole books) sold separately with features like a built-in dictionary, these products are likely to become more serviceable for literacy in the future.

Availability y of Computer Courseware[14]

A second prerequisite to using technology is access to appropriate computer or video courseware or other technology-based learning materials. Although it is estimated that as many as 2,000 computer software products are marketed to the literacy community, relatively few are specifically designed for use in literacy programs.[15] Most of the marketed software products are "stand-alone," designed to run on an individual computer. Stand-alone products are generally quite affordable-most cost less than $100 per program-although a few exceed $1,000.[16]

Reading/language arts was the most commonly addressed subject among the 1,451 stand-alone software products identified by OTA, accounting for more than one-half of the products (see table 7-l). Mathematics was the next most popular subject, with about 22 percent of the products. Also common were so-called productivity tools, such as keyboarding, word processing, and spreadsheet software. Other subjects, such as social studies, science, job preparation, life skills, and problem solving, accounted for less than 10 percent each of the products. Most stand-alone software was targeted at adult basic education (ABE) programs, followed by ESL, and general equivalency diploma (GED) preparation.[17]

These stand-alone programs are only one type of courseware for literacy. Larger, more expensive integrated learning systems (ILSs) are also aimed at the adult literacy community. An ILS is a special type of computer network that typically includes a centralized ''server, linked to less-powerful terminals. It also includes instructional software covering one or more subject areas and

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12 Presentations by Brian Talbot, Pacific Northwest Star Schools P artnership, and Mabel Phifer, United States Educational Network, at the Federal Star Schools Project Directors Meeting, Washington, DC, Nov. 24, 1992.

13 Arthur Sisk, president, Franklin Learning Resources, The Educational Division of Franklin Electronic Publishers, Inc., personal communication Nov. 19, 1992.

14 Courseware is educational software or video programming packaged with supporting materials such as student manuals, teacher guides, and operating manuals.

15 The database of existing software marketed t. adult literacy was assembled by Sivin-Kachala and Bialo (op. cit., footnote 1, pp. 2-4) from the following sources: Marjorie DeWert and Beverly U, Student (eds.), *Apple Access: Adult Basic Skills Curriculum Software Guide (Cupertino, CA:* Apple Computer, Inc., 1991); Jeffrey H. Orloff (cd.), *Apple Access: Macintosh Educational Software Guide* (Cupertino, CA: Apple Computer, Inc., 1991); Tina Ruppelt (ed.), *Apple Adult Basic cation Resource Guide* (Cupertino, *CA: Apple* Computer, Inc., 1988); Barbara A.W. Wright (cd.), *Oregon/Washington Adult Basic Skills Technology Consortium Software Buyers Guide* (Seattle, WA: Oregon/Washington Adult Basic Skills Technology Consortium, 1991); Deborah Healey and Norman Johnson (eds.), *TESOL* CALL *Interest Section Software List 1991* (Alexandria, VA: Teachers of English to Speakers of Other Languages, 1991); and Education TuRNKEY Systems, Inc. (compiler), ''IBM Educational Systems Educational Software and Courseware,'' unpublished do cument, September 1991. Additional titles were provided by the sites responding to O'IA's survey.

16 Sivin-Kachala and Bialo, op. cit., footnote 1, p. 10.

17 Ibid., pp. I-3 to 1-11.

Table 7-l—Distribution of Available Literacy Software Products by Subject

Major subjects	Number	Percent	Major subjects	Number	Percent
Language arts	769	53.0%	**Language arts topics**		
Mathematics	313	21.6	Grammar and punctuation	234	30.5
General purpose	126	8.6	Spelling and vocabulary	231	30.2
Life skills	122	8.4	Reading comprehension	218	28.5
Social studies	111	7.6	Basic reading	206	26.9
Problem solving	65	4.5	Writing	107	14.0
Science	58	4.0	*Distribution of language arts products (total=769)*		
ESL/LEP specific	49	3.4			
Career guidance	39	2.7	**Mathematics topics**		
Computers and keyboard	31	2.1	Basic skills	225	71.9
Health	19	1.3	Applications	95	30.4
GED specific	17	1.2	Advanced	31	9.9
Employment	11	0.8	*Distribution of mathmatics products (total=313)*		

KEY: ESL=English as a second language; GED=general equivalency diploma; LEP=limited English proficient.

NOTE: A total of 1,451 stand-alone computer software products used in literacy programs were identified for this analysis. As some products covered more than one subject, the totals do not add up to 100 percent.

SOFTWARE TYPES:
General purpose: Open-ended software that is not subject-specific.
Career *guidance:* Helps students learn about different careers and match their interests to various fields of work.
Computers and keyboard: Includes learning how to use a computer (e.g., booting up, inserting disks, standard keys) and learning how people use computer-based technology.
Employment: Combines both preemploymenVwork maturity skills (e.g., good work habits and on-the-job etiquette) and vocation-specific skills.
Life skills: Includes skills necessary for success at everyday living (e.g., coping with stress, balancing a checkbook, reading a bus schedule),
Problem solving: Addresses general problem-solving skills with application across domains rather than subject-specific skills.

SOURCE: Jay P. Sivin-Kachala and Ellen Bialo, Interactive Educational Systems Design, Inc., "Software for Adult Literacy: Scope, Suitability, Available Sources of Information, and Implications for Federal Policy," OTA contractor report, June 1992.

a range of grade levels; computer-based activities and a curriculum framework correlated to a widely used test instrument; and a management system that sequences student activities, records student performance, and generates summary reports. The OTA survey identified nine ILS products that are marketed to adult literacy Programs.[18]

Despite this volume and variety, **OTA finds that available computer software is not adequately meeting the demands of literacy programs.** Literacy providers canvassed in site visits, surveys, workshops, and personal interviews agree that more appropriate applications are desired-applications that cater to adult interests and tie directly to the context of learners' lives.[19] Many of the existing software products were designed for children and young adults and may be inappropriate for adult learners. As one adult educator noted:

> Most of the software that is on the market has been written for "larger markets" and then sold to "submarkets" as being appropriate for their populations. This is an immediate turn off to teachers of adult literacy who are very concerned with the dignity of adult learners and want to use technology as a motivator. Sitting at a computer is an "adult activity" and should not be under-

18 Of the nine ILS products currently sold to adult literacy programs, six are correlated to the Test of Adult Basic Education (TABE) and five are correlated to the Comprehensive Adult Student Assessment System (CASAS). See ibid., pp. 12-14.

19 Stephen Reder, Northwest Regional Educational Laboratory, "On-Line Literacy Development: A Context for Technology in Adult Literacy Education," OTA contractor report, April 1992; Center for Literacy Studies, University of Tennessee, Knoxville, 'Life at the Margins: Profiles of Adults With Low Literacy Skills, " OTA contractor report, March 1992; and Joyce Hakansson, ''The Developer's Dilemma,'' OTA contractor report, October 1991.

mined by programs that are written for kindergarten to grade three.[20]

Many subjects and applications are not well-covered. Among them are writing; problem solving and critical thinking; adult-oriented courseware for GED preparation and ESL; career planning, preemployment skills, and workplace readiness; life skills; parenting skills; and reading and language arts for nonreaders and low-level readers, especially products that take advantage of human speech.[21]

Availability of Other Courseware and Programming

Video courseware and programming for adult literacy are extremely limited in quantity and scope. Other types of learning materials, such as courseware for consumer electronics, are rare.

Video courseware can include content on videotape, videodisc, or CD-ROM; live interactive distance learning courses; and television programming for broadcast, cable, and satellite transmission. They range in sophistication from the basic and inexpensive, such as "teacher and blackboard" public access television courses; to the slick and expensive, such as professional videotape productions involving location filming, professional actors, scriptwriters, teachers, and editors. The formats for video courseware vary from interviews, lectures, and discussions, to dramatizations, demonstrations, and storytelling.

A recent report surveying the current availability and use of broadcast-quality video programming identified five literacy series created for broadcast and cablecast. Kentucky Educational Television (KET) accounts for four of the five series and 99 percent of the use.[22] The fifth series, called *On Your Own,* is produced by WPSX-TV, a public television station in Pennsylvania in partnership with Prentice Hall. It consists of 33 5-to 15-minute segments designed for use by a teacher. Although the series is carried into 800,000 homes and learning centers throughout one-third of the State, it is not designed for free-standing home viewing.

The most widely used video courseware for adult literacy is KET's *GED on TV (see* box 7-B). This series is distributed to literacy programs in all 50 States, many of which use it to supplement classroom instruction. The three other KET products include *Another Page,* which is designed to teach reading skills at the 5th- through 7th-grade level; *Learn to Read,* a 30-segment series aimed at beginning readers; and *Math Basics,* a new series of 11 half-hour segments.

Over 750 training and education courseware titles exist for videodisc; however, only about 50 target basic skills.[23] Several other video titles relevant to adult literacy address issues such as parenting skills, health, consumer issues, job-readiness, and staff development.

An Untapped Base of Technology

OTA finds that a significant amount of technology in businesses, homes, schools, colleges, and libraries could be tapped for literacy and learning. Many companies have an impressive base of technology that is used for training. Large corporations also own videoconferencing and other telecommunications equipment, but it is used primarily for executive business meetings,

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[20] Inaam Mansoor, director, Arlington Education and Employment Program (Project REEP), Arlington, VA, personal communication, Apr. 22, 1992.

[21] Sivin-Kachala and Bialo, op. cit., footnote 1, pp. 61-62.

[22] Marian L. Schwarz, "Television and Adult Literacy: Potential for Access to Learning for an Unserved Population," report prepared for the Ford Foundation June 1992, p. 25.

[23] Richard Pollak, "Titles Available for Adult Training and Adult Literacy," unpublished data compiled from *Videodisc Compendium, 1993* (St. Paul, MN: Emerging Technology Consultants Inc., 1992).

Box 7-B-Broadcast Programming: The *GEL) on TV* Example

On Tuesday and Thursday evenings, while his children are doing homework, a 35-year-old father watches GED on TV. *Several months ago, while channel browsing, he stumbled upon a 2-minute video pretest on the local public television station. His self-score was high enough to qualify for the* GED on TV *program. Now, more than half-way through the series, he is stuck for the first time. He picks up the phone to call a tutor at the public television station's GED help line.*

In 1962, the Federal Appalachian Regional Commission (ARC) helped establish Kentucky Educational Television (KET) to produce and carry instructional programming to schools. With $100,000 from ARC, KET created a prototype for the first version of *GED on TV*, a series of programs to help viewers prepare for the general equivalency diploma (GED) examination. An additional $400,000 in State funds enabled KET to begin broadcasting *GED on TV* to Kentucky homes in 1975; since then the series has enrolled an average of 1,400 Kentuckians per year.[1] In 1986, KET revised *GED on TV* at a cost of $2 million, producing 43 half-hour segments and 3 workbooks. Today the series is also available in Spanish and is delivered in a variety of ways—broadcast, satellite downlink, videotape, and interactive videodisc.

Community outreach for *GED on TV* takes many forms—from print campaigns to involvement of social service agencies. In Kentucky, the process, contracted by KET to Morehead State University, works as follows: before the series begins, KET conducts a promotion on television and in newspapers, giving out an 800 number. Callers are screened over the phone and mailed pretests and enrollment forms when appropriate. Those who pass the pretest are sent schedules and workbooks. They watch the programs at home and can use the 800 line for tutorial help. At the end of the course, KET sends a practice test to enrollees, scores it with feedback, and returns it to the student with a certificate that pays the $10 GED test fee. In 1990, 54 percent of Kentucky's enrollees took the GED examination and 74 percent of those passed it—comparing favorably with national pass rates overall that are reported to be about 70 percent.

GED on TV has been distributed nationally since 1982. It is currently licensed to Public Broadcasting Service stations in 36 States and learning centers in all 50 States, including over 600 military bases and all Federal and many State prisons. Schools, businesses, and libraries can license the programs to provide videotapes to their learners for $132 per half-hour.[2] Several educational cable services also carry the series. At present, over 150,000 persons are either formally enrolled in the home study course or have sent for the study guides. Since the beginning of the broadcasts in 1975, more that 2 million adults have been involved in the course in one of these two ways.

There is compelling evidence that *GED on TV* brings in students who do not respond to other literacy programs. For example, in a survey of Indiana's 2,763 enrolled students, 82 percent said they would not have attempted to get a GED if they could not study at home. Furthermore, "... of all the enrollees who responded from the six-county pilot area, 58.9 percent said that they were making their first contact with any adult education program when they called about studying at home."[3]

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1 KET-Kentucky Educational Television, "KET/GEt) on TV Use and Benefits, 197S-1989," unpublished data, May 1990.

2 Tape @~ do not include broadcast or tape duplication rights. KET-Kentucky Educational Television, *The KET Instructional Video Catalogue* (Lexington, KY: 1992.)

3 Summary of the Indiana Learn-at-Home Project, cited in Marion L. Schwarz, *Television and Adult Literacy: Potential for Access to Learning for an Unserved Population*, a report for the Ford Foundati● * June 1992, p. 30.

Continued *on next page*

file exchange, or electronic mail and less often for training.[24]

Colleges and universities also have a base of technology, plus wide experience using it for teaching and learning. According to a 1991 survey, 2-year public colleges have a total of 356,000 desktop computers, or a ratio of 1 for every 24 students. These computers are not

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24 James Posko, "AT&T Video Conferencing," *Procomm Enterprises Magazine,* April 1991; Jeff Charles, "There Is a Video in Your Future," *1992 Ten-Year Forecast* (Menlo Park, CA: Institute for the Future, 1992), pp. 159-164; and "IndustryReport 1992," op. cit., footnote 11, p. 46.

Box 7-B—Broadcast Programming: The *GED on TV* Example—Continued

Directors of programs in Kentucky, Indiana, Arkansas, and West Virginia suggest that several elements are important to success of the GED program. All the State directors agree that television advertising, particularly on commercial television, is critical. "There is general agreement that the greater the promotional effort, the greater the response."[4] Another important lesson is that both enrollment procedures and viewing opportunities need to be made as accessible and easy as possible. Videocassette recorders have become an important tool for increasing accessibility as learners can control the pace and schedule of their viewing—one outreach coordinator reports that everyone who has passed the test in her program had one.[5] The State directors also felt that support services (e.g., the 800 line) can make a difference, but are less crucial than advertising or accessibility.

New outreach activities are under way. The Public Television Outreach Alliance will promote the *GED on TV* series in a national effort. Targeted for fall of 1993, these efforts include: production of a 60-minute special to improve public awareness and motivation, a newspaper supplement that will reach 25 million readers, and an offer of 16 months of free use of the series by any public television station.

Cost Analysis

What does it cost to produce and deliver broadcast-quality instructional television and support services to adult learners? In the KET example, three elements are involved.

Production. The 1986 revision cost $2 million. If the programming has a life of 10 years, then Kentucky, which will serve an estimated 14,000 enrollees during those 10 years, will have spent $142.86 per student. However, if these costs are averaged out nationally—150,000 enrollees per year over 10 years—the cost drops to $1.33 per student. Furthermore, through licensing arrangements, KET expects to recoup its production costs.

Advertising and promotion. This is widely considered to be one of the most important investments in ensuring program success with an at-home audience. In 1990, this part of KET's budget was $60,000. Averaged out over the 1,100 Kentucky students who enrolled during that year, the cost was about $55 per student. However, there is some evidence that small increases in this budget can increase enrollment substantially, thereby driving down the other per capita costs. In 1987, when the Governor of Kentucky made *GED on TV* a special initiative, the advertising budget was $80,000 and the enrollment almost tripled to 3,000 (bringing advertising costs down to $27 per student).

Student support services. This budget was $166,000, paying for an administrator, a data manager, and 2 ½ full-time telephone instructors. Per capita costs for enrollees in 1990 was $151. However, the additional advertising dollars had been spent as they were in 1987 and 3,000 learners were brought in, the per capita costs for student support services would be reduced to $53 (assuming a constant level of student support services—an assumption that may not be realistic).

[4] Schwarz, op. cit., footnote 3, p. 31.

[5] Nellie Lawrence, outreach coordinator, KRMA-TV, Denver, CO, personal communication, Nov. 6, 1992.

evenly distributed within institutions, however, nor a& they used exclusively for student instruction,[25] let alone for adult literacy. In addition, the majority of community colleges use distance learning and video technologies for instruction.[26]

Public schools have more than 2.5 million computers. Because many elementary and secondary schools are not open in the evening and because some school computers are restricted to use by special programs (e.g., the Federal Chapter 1 program), adult education programs often do not have access to these resources. In addition, virtually all elementary and secondary schools have televisions, 98 percent have videocassette

[25] Kenneth C. Green and Skip Eastman, *Campus Computing 1991: The EDUCOM-USC Survey of Desktop Computing in HigherEducation* (Los Angeles, CA: Center for Scholarly Technology, University of Southern California, 1992), p. 12.

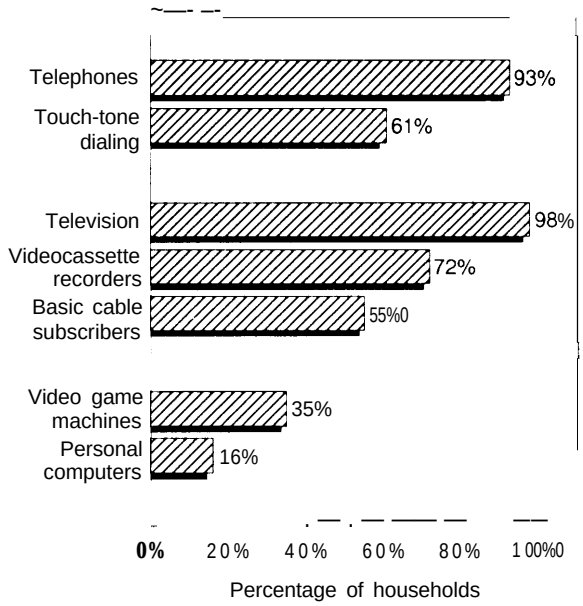
[26] Brey, op. cit., footnote 10, pp. 10-13, 67.

recorders (VCRs),[27] and61 percent have access to cable, although schools in the poorest communities are often the least likely to have cable.[28] A growing number of public schools have videodisc players, satellite dishes, and interactive distance learning systems.[29] Despite the fact that many adult learning programs are held in public schools, use of these school-based technologies for adult literacy instruction is rare,

Perhaps the greatest untapped resources for literacy are home technologies (see figure 7-l). Telephones and televisions are the most widely available. Ninety-three percent of households have telephones,[30] but over one-third of these are rotary or pulse phones, which limits their access to hotlines, voice mail, and audio text.[31] In 1990, 98 percent of households had at least one television, over 72 percent of households owned VCRs, and 55 percent subscribed to cable. Only 3 percent of households had a home satellite dish system, mostly in rural areas or small towns.[32]

Home computers are far from pervasive, especially among low-income and minority households, but the number is growing. In 1989, 17.3 percent of adults had a computer in their home, up from 9.1 percent in 1984. However only about 58 percent of adults who have access to a home computer report actually using it. Home computers were used most frequently by adults for word processing (62 percent of users), video games (44 percent) and household records (36 percent) .33

Figure 7-l—Technologies in the Home, 1990



NOTE: Total number of households is approximately 93 million,

SOURCES: Personal computer data from Robert Kominski, Computer Use *in the United States: 7989,* Special Studies Series, No. 171 (Washington, DC: U.S. Department of Commerce, Bureau *of* the Census, February 1991), p. 23; extrapolations to 1990 based on rates of change between 1964 and 1989. Video game data from Julia Marsh and Lawrence K. Vanston, *Interactive Multimedia end Telecommunications: Forecasts of Markets and Technologies* (Austin, TX: Technology Futures, Inc., 1992), p. 67. Telephone data from the U.S. Department of Commerce, *The NTIA Infrastructure Report,* NTIA Special Publication 91-26 (Washington, DC: October 1991). Touch-tone data from an AT&T survey **cited in Bob Bentz, "Reaching Rotary Dialers With Voice Recognition," *Infotext,* July 1991, pp. 64-65. All television data from Henry T. Ingle, "A Nation of Learners: The Demographics of Access to Vieo and Telecommunications Technology," *New Visions for Video: Use of Cable, Satellite, Broadcast, and Interactive* Systems *for Literacy and Learning,* Annenberg Washington Program (cd.) (Washington, DC: 1992).**

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27 Quality Education Data, Inc., *1992-1992 Catalog & Education Market Reference Guide (Denver,* CO:1992).

28 Steven *L.* Schongar, *Education and Technology, 1991 :A Survey of the K-12 Market* (Shelton, CT: Market Data Retrieval, and New York, NY: LINK Resources, 1991), p. 61.

29 Ibid., p. 54.

30 Alexander Belinfante, *Telephone Subscribership in the U.S.* (Washington, DC: Federal Communications Commission, September 1991) cited in U.S. Department of Commerce, *The NTIA Infrastructure Report,* NTIA *Special* Publication 91-26 (Washington, DC: October 1991), app. F.

31 1991 AT&T survey cited in Bob Bentz, "Reaching Rotary Dialers With Voice Recognition," *Infotext,* July 1991, pp. 64-65.

32 Henry T. Ingle, "A Nation of barriers: The Demographics of Access to Video and Telecommunications Technology," New *Visions for Video: Use of Cable, Satellite, Broadcast, and Interactive* Systems *for Literacy and Learning,* Annenberg Washington Program (cd.) (Washington, DC: 1992), p. 14.

33 Robert Kominski, *Computer Use in the United States: 1989,* Special Studies Series P-23, No. 171 (Washington, DC: U.S. Department of Commerce, Bureau of the Census, February 1991).

Game machines such as Nintendo or Sega are one of the fastest growing consumer technologies. As of 1990, at least 35 percent of households were estimated to have acquired home video game machines.[34] In the past, software for these machines has been strictly entertainment. Recently the attachment of compact discs to these technologies and the advent of more powerful microprocessors have facilitated the introduction of new kinds of video game machines. As new devices, e.g., compact disc-interactive (CD-I), are brought to market, the manufacturers are negotiating with educational developers to create products for their platforms. In some cases, educational titles are included with the purchase of hardware. This trend is expected to continue.[35]

USES OF TECHNOLOGY

Most literacy programs do not have access to technology. But what about those that do? How are they using it? Are the technologies bringing the expected advantages? Are they realizing their promise? Because systematic data are not available to answer these questions, OTA has taken some ''snapshots" of technology use in 33 programs,[36] 6 intensive case studies,[37] and many site visits.[38] (For a list of all the sites, see appendix G). Taken together these sources suggest some patterns and lessons regarding technology use.

General Findings About Technology Use

Preceding chapters of this report have already mentioned several potential advantages of technology. These are summarized in boxes 7-C and 7-D as a way of framing the discussion that follows about how programs are *actually* using technology, what they are learning about its strengths and drawbacks, and whether technology is fulfilling its potential.[39]

In its site visits and surveys, OTA found that for most programs "technology' means computers; other technologies are used only sporadically. In addition, the proportion of programs that use computers regularly for instruction is surprisingly small-probably not more than 15 percent of all literacy providers.[40] Research shows that when computers are first introduced into educational settings, they are used in ways that often mirror current instructional practices,[41] and literacy is no exception. Educators who are least experienced with technology tend to use computers more for drill, practice, and automated tutorials than for other types of activities,[42] reflecting the overall prevalence of drill and practice in literacy instruction.

As programs become more experienced with technologies, they are more likely to use them as tools to assist all learning, and in ways that go well beyond drill and practice. Literacy providers with more technology experience use computers with word processors, spreadsheets, desktop pub-

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34 Julia A. Marsh and Lawrence K. Vanston, Interactive *Multimedia and Telecommunications:* Forecasts *of Markets* and *Technologies* (Austin, TX: Technology Futures, Inc., *1992),* pp. *66-67.*

35 John Lowry, chairman and CEO, Discis Knowledge Research, Inc., personal communication Dec. *2, 1992.*

36 Sivin-Kachala and Bialo, op. cit., footnote 1.

37 J.D. Eveland et al., op. cit., footnote 1.

38 For example, see Holland, op. cit., footnote 1.

39 For further discussion of the issues in box 7-D, see ch. 3, and of those in box 7-E, see ch. 6.

40 Development Associates, Inc., *National Evaluation of Adult Education Programs: Profiles of Service providers* (Washington, DC: U.S. Department of Education, 1992), p. 72; Education TURNKEY Systems, Inc. and Wujcik and Associates, op. cit., footnote 1; and Holland, op. cit., footnote 1.

41 Karen Sheingold and Martha Hadley, *Accomplished Teachers: Integrating Computers Into Classroom Practice (New* York, *NY:* Bank Street College of Education, September 1990).

42 Sivin-Kachala and Bialo, op. cit., footnote 1, p. 53.

***Many** adults use computers in the LA Times Learning Center.*

lishing, and databases-the same ways they are used in the ''real world. '[43] Students learn to use computers for practical things like writing letters or resumes, planning a budget, creating a business card or publishing a community newsletter. Educational games and simulations are also more common in sites with more computer experience.[44]

All of the technology-using programs surveyed by OTA also reported using computers for administrative purposes, such as general correspondence, registration and scheduling, recordkeeping, budgeting and payroll, student tracking, evaluation and planning, and mandated reports.[45]

The clearest finding from the case studies is that most programs are using computers principally as a supplement to a traditional program of classroom-based instruction. Two programs drawn from OTA's case studies illustrate this point.

The Metro Campus Adult Learning Center is located on the fourth floor of the Cuyahoga County Community College in Cleveland, Ohio. Students, who must have at least a 4th-grade reading level to enroll, attend either a basic skills course or GED classes. primary funding for the program is from JTPA: many of the students are single mothers who receive Aid to Families with Dependent Children (AFDC). The center has a computer laboratory with 31 Tandy computers, 26 of which have no hard drives. All are linked to one of two file servers that contain PLATO courseware.[46] The computer laboratory is open to students between 8:30 am and 4 pm. Classes are from 9 am to 1 pm every day. For 2 hours, students work in the computer laboratory, the

43 Holland, op. cit., footnote 1.

44 Sivin-Kachala and Bialo, op. cit., footnote 1, p. 53.

45 Ibid., p. 31.

46 PLATO-Programmed Logic for Automatic Teaching Operations—is an integrated learning system designed for adults reading at grade levels 4 through 12.

Box 7-C—Advantages of Technology for Adult Learners

Reaching Learners Outside of Classrooms

- With portable technology, adults can learn almost anywhere, any time, and can use small parcels of time more efficiently.
- Technology can carry instruction to nonschool settings—workplaces, homes, prisons, or the community.
- Adults can be served who would otherwise be left out, because of barriers such as inconvenient class scheduling, lack of childcare, or transportation.
- Learning at home can be more convenient and private for those who would feel stigmatized by attending a literacy program.

Using Learning Time Efficiently

- Learners can move at their own pace, have greater control over their own learning, and make better use of their learning time.
- Learners can handle some routine tasks more quickly through such processes as computer spell checking.
- Some learners advance more quickly with computers or interactive videodiscs than with conventional teaching methods.

Sustaining Motivation

- Novelty factor can be a "drawing card."
- Technology can be more engaging, can add interest to repetitive learning tasks.
- Importance of computers in society can enhance the status of literacy instruction.
- Privacy and confidentiality are added to the learning environment, reducing embarrassment adults often experience.
- Technology-based learning environments do not resemble those of past school failures.
- Intense, nonjudgmental drill and practice is available for those who need it.
- Instantaneous feedback and assessment are provided.

Individualizing Instruction

- Computers can serve as "personal tutors"—instruction and scheduling can be individualized without one-on-one staffing; suitable for open-entry, open-exit programs.
- Materials and presentation formats can be customized to suit different learning styles, interests, or workplace needs.
- Images and sound can help some adults learn better, especially those who cannot read text well.
- Computers with digitized and synthesized speech can help with pronunciation and vocabulary.
- Adults with learning disabilities and certain physical disabilities can be accommodated.

Providing Access to Information Tools

- Adults need to learn to use today's electronic tools for accessing information.
- Adults believe familiarity with computers will make them more employable.

SOURCE: Office of Technology Assessment, 1993.

other 2 hours they spend in a classroom that primarily uses traditional paper-and-pencil instructional methods. Student progress is tracked by the PLATO system and can be accessed readily by the teacher.

The Ripken Center is the first learning center established by the Baltimore City Literacy Corporation. Classes here are set up in 6-month segments, because most of its students generate enough funding from JTPA to cover that period. Current capacity is 85 students. Courses include ABE, pre-GED, life skills, counseling, and career orientation. Each student attends class for **3 hours a** day, **5** days a week. Each day a student spends half of the time (1 1/2 hours) doing classroom work; the other 1 1/2 hours are spent either in the

Box 7-D—Advantages of Technology for Literacy Programs

Recruiting and Retaining Learners

- Technology can be a magnet, attracting learners.
- More learners can be served and teachers used more productively.
- Programs can broaden their reach, serving those in remote locations.
- Teachers and counselors can maintain regular contact with learners.

Improving Curriculum

- Teachers can create individualized, engaging instructional materials related to the learner's needs and interests.
- Programs can share ''what works'' in terms of instructional materials and techniques.

Meeting Staff Development Challenges

- Teachers, volunteers, and administrators can be trained via video, distance learning, and self-study computer modules.
- Career ladders can be developed and information about vacancies can be posted nationwide.
- Staff can collaborate with their peers across town or cross country about problems, solutions, resources, and opportunities.

Enhancing Assessment and Evaluation

- Technology can track student progress continually, minimizing the need for ''high anxiety'' testing.
- Technology can provide diagnostic assistance for the teacher.
- Video and audiotape records, portfolio collections of writings, and other performance assessment measures can give more complete evidence of student progress.
- Program evaluation can be simplified by more systematic evaluation procedures and common data elements.

Streamlining Administration and Management

- Technology can more efficiently handle routine administrative tasks, freeing staff for instruction and providing comprehensive services to clients.
- Computer-based systems provide more efficient, accessible records on attendance, scheduling, personnel, budgeting, evaluation, and client tracking.

Augmenting Funding and Coordination

- Technology can serve as a magnet for fundraising and business contributions.
- Programs can pool resources and coordinate services, including social services, to serve learners better and avoid duplication of effort.
- Programs can share and access experts, databases, curriculum, public access software, government information, and national pools of literacy expertise.

SOURCE: Office of Technology Assessment, 1993.

computer laboratory (3 days a week for a total of *4 1/2 hours per week),* a life skills class (1 day), or a career preparation class (1 day). The Ripken Center has a laboratory with 14 IBM-compatible personal computers, one of which operates as a file server. These computers are setup to use the WICAT system;[47] teachers select appropriate components from WICAT to supplement classroom activities. Considerable diversity of lessons characterizes activities in the laboratory; in 1 site visit at least 10 different applications were being used among the 15 students in the room. Word processing software is also available and many students use it regularly.

47 The WICAT system is an integrated learning system.

Making computers a more fundamental part of the education experience requires accumulated skill and sustained effort. However, even programs with well-versed staff do not always have enough hardware to center instruction around technology.

Benefits and Limitations of Technologies for Literacy

OTA found that some of the anticipated benefits of technology are indeed being realized in the field-the good news. Case studies suggest caution, however, about overstating the advantages; technology has its limitations and can create new problems and challenges-the bad news.

The Good News

Learners like the tools. The overwhelming majority of people interviewed were highly enthusiastic about the benefits of computers in adult literacy. Almost everyone agreed that technology helps attract adult learners to the programs and keep them there. Mastering technology enhances self-esteem and increases motivation to learn. In addition, adults often view computers as a pathway to a vocational skill. Computer literacy programs designed to familiarize users with word processing, keyboarding, operating systems, and other applications are often more popular than classroom-oriented basic skills courses.

Information tools help teachers but do not replace them. There is no substitute for the dedicated and effective teacher. Contrary to the fears of some, there is no evidence from case studies that technology will usurp the critical relationship between teacher and learner. Rather, the tools can sharpen and focus the teacher-student interaction, and can spell the teacher during the more repetitive parts of the learning process; they can also ease some administrative tasks for the teacher. But ultimately it is the teacher who must guide the use of technology and shape its contribution to the overall learning context.

Information tools do meet some of the special learning needs of adults with low literacy skills. Creative use of information technology can support the open-entry, open-exit programs that many believe are essential for adult literacy instruction. The programs currently using computers describe many advantages: technology supports self-paced instruction, is nonjudgmental, adjusts to different skill levels, provides a "private' environment, and offers immediate feedback. Technology seems to help create a different type of educational experience, one that does not repeat the conditions of past failures.

The Bad News

Technology can be intimidating to some learners. Not everyone is equally enchanted by information technology. Any program that hopes to reach the full range of clients needs to provide learning opportunities that include a variety of methods. Those for whom technology does not work deserve as much consideration and alternative learning opportunities as those who are more comfortable with state-of-the-art tools. While technology draws many learners into programs, it may scare others away.

Tools require learner investment. Even the most "user friendly' software takes some time to learn. Most adults in literacy programs must invest time orienting themselves to the technology and learning how to use the tools before the tools can improve their learning. Additionally, since most learners have little or no access to information tools in their everyday lives, they may be unable to practice and gain familiarity during relatively brief computer laboratory times in programs.

Technical problems with hardware and software are common; special expertise is often needed to get technology working optimally. As programs come to depend more on systems made up of widely differing combinations of machines and software, they are more likely to need

specialized personnel to evaluate hardware and software, perform systems integration, troubleshoot, and switch equipment over to different applications. In most of the sites visited, there were one or more "gurus" who, by virtue of interest and capability (seldom formal training), had acquired the expertise and knowledge needed to keep the technology working for their less mechanically minded colleagues. These gurus are critical to the functioning of the programs-it is they who patch together the systems with baling wire and cellophane tape—not to mention with recycled disc drives and self-taught midnight programming.

Decisions about technology implementation-what to buy, how to use it, what works with different kinds of learners--often must be made by trial and error. In OTA's survey of technology users, word-of-mouth-especially from adult education colleagues and educational technology experts-was cited as the most important source of information on software. If a State or region has an agency that provides information on technology for adult literacy, most computer-using programs in the region will take advantage of its services. But technology users did not typically consult available resources such as reviews from online services or software guides, mostly because they did not know about these sources. In addition, most technology applications have not been formally evaluated. As a result almost no data on effectiveness is available to help guide technology implementation decisions (see the section on "Barriers" below).

Information technology requires new skills of teachers. Traditional methods of training teachers and volunteers for adult literacy are not generally oriented toward technology use. Many adult educators lack computing experience and, even when they can operate the equipment, cannot keep it running smoothly. Those uncomfortable with technology are unlikely to recommend it to their students; some fear it will replace them, or come between them and their students. Furthermore, effective teaching with technology requires new approaches that integrate technology with classroom work and make the most of technology's capabilities.

Integrated learning systems can be a mixed blessing. ILSs are designed to be all-inclusive, simplified arrangements for handling the complete teaching task. They are often especially valuable to smaller programs because they can reduce the need for specialized support personnel. The broad content coverage offered can provide materials for practicing what was covered in class as well as materials that can ''ffl in the gaps' in a program's curriculum. The automated management system takes care of placement, assessment, and diagnosis, and allows for self-paced, individualized instruction and testing.

However ILSs also have some disadvantages. Often they are difficult to customize for specific learner needs; some have materials designed for children that appear condescending to adults; some lack opportunities for learner control which can undermine motivation; and others are limited in their ''save and resume' capabilities which creates problems for students who only have a short amount of time to work on lessons. Most newer systems now targeting adult literacy are tackling these concerns in their design and software.

The Promise Unfulfilled

OTA finds that in many critical respects the technologies that are accessible to adult literacy programs are vastly underutilized and the potential of technology remains largely unfulfilled. Yet there are enough promising, effective, and exciting models of technology use to suggest that the potential is more than visionary and to encourage continued implementation.

Technology is rarely **used to reach learners outside of classrooms or to provide flexibility for learners.** Information technology for adult learning seems to have made little headway in delivering services to learners whenever and wherever they need it. Typically there is little use of ''distance learning" in the programs visited;

Motorola employees enrolled in Project SALSA learned at home on loaned computers and moderns.

most programs still require students to come to program sites within specified hours. Often there are good reasons for this-e. g., to provide social reinforcement or to develop employability skills such as punctuality. However, in most programs, learners experienced major difficulties in going to program facilities. Program administrators talked about difficulties in providing access to the technology whenever and wherever it was needed -they described situations in which equipment sat idle at some times and could not meet demand at others. There was little evidence of 'portable' technologies that learners could take home or to other learning sites.

Yet the potential remains. Individual experiments are being tried by a few; innovative ideas bloom where nourished.

- In a workplace literacy program at several of Motorola's plants in Arizona, students enrolled in a reading course were given computers and modems to take home. Throughout the 6-month course, they had access to a networked reading curriculum; families of the workers were encouraged to use the computers as well (see box 7-E).
- "Playing to Win" is a neighborhood technology center in the basement of a housing project in East Harlem, New York. The center, which serves about 500 people and has about 40 computers, is designed to give neighborhood residents access to computers and computer-based learning. The schedule at the center is filled with a mixture of classes from neighboring public schools, adult literacy programs, vocational groups, Head Start, and plenty of open laboratory time where any East Harlem resident can use the computers for a nominal sum. Trained counselors are on hand to help novices; learners can work on their own, or sign up for workshops and classes.[48]
- The Mississippi Mobile Learnin gLab, equipped with 12 computer workstations, travels to towns in northeast Mississippi and provides computer-assisted basic skills instruction. The laboratory offers basic computer literacy and word processing, job skill development, ABE, GED, and commercial motor vehicle drivers license review. The laboratory serves six counties and stays for about 8 weeks in each location. Each learner who comes has an individualized course designed for him or her.[49]
- At the Euclid Adult Learning Center, students can watch KET tapes during classroom times. They then complete related exercises in an accompanying workbook. To help students work at home, an 800 number is available that can be accessed from any touch-tone phone. A student can direct the phone system to a particular lesson and can review the lesson as many times as necessary by pressing "0."[50]

Networking-of both people and machines-is also limited. There is a striking absence of networking among sites and even within sites. At

48 see Steven Levy, "Access for All," *MacWorld,* August 1989, pp. 43-44.

49 Holland, op. cit., footnote 1.

50 Eveland et al., Op. cit., footnote 1.

Box 7-E—Project SALSA: Sending Computers Home With Learners

Many Motorola employees participate in basic skills classes (reading, writing, and mathematics) at the worksite. What if computers were also available at home? Would there be an increase in learning gains? Would employees' families benefit too? These questions formed the basis for Motorola's Project SALSA, a research project involving U.S. West Communications, Apple Computer, University Communications, Businessland, the University of Illinois, and Rio Salado Community College.

Fifty-three employees enrolled in a traditional reading course at Motorola's semiconductor facilities in Mesa and Tempe, Arizona, also received a computer and modem that connected them to the University of Illinois' NovaNET system. These workers, mostly female, single parents, had access to over 10,000 hours of educational software and received 14 hours of training in its use. A control group of 30 Motorola employees was enrolled in the same reading course, but not given computers. Teachers did not know who had the computers.

A formal evaluation at the end of 6 months compared the learning gains of those with computers at home to those in the control group. Although on average computer users made larger gains on a standardized reading test, the results were not statistically significant. However, some interesting lessons emerged.

First, the amount of time learners used the computers at home was quite low—users averaged only about 30 to 45 minutes a week. Learners varied widely in how much they used the equipment—some logged on only once or twice after the initial training, others used it quite a bit. Several factors seemed to affect use, the first being scheduling. The NovaNET hours were not optimal for most learners as the network was down from 7 to 9 pm and on weekends. In addition, many employees described having little time to use the computer and, even when they did, being too tired. This suggests that at-home systems will work best if they can be available whenever the learner has free time to use them. Individuals are likely to vary considerably in the extent to which they are able to study at home, feel comfortable using computers, or prefer face-to-face instruction.

A second problem was separation of the at-home coursework and classroom content. Because of the constraints of this experiment, teachers were not aware that some students had access to a computer and a software curriculum and, therefore, could not design classroom work to complement these educational resources. Students were pretty much "on their own" with regard to integrating computer materials into their coursework. As one student noted: "The reading class on NovaNET was not anything like the reading class at the plant." These results suggest that at-home work should be reinforced and integrated into what is being taught in class. Furthermore, teachers need to be trained in how to implement computers and software into their teaching.

Third, the need for technical support related to using the computers emerged as a central issue. If participants were confused during the training sessions, they became more frustrated when they took the computer home. Some eventually stopped trying to use the computer or NovaNET altogether. The evaluation suggested the importance of creating a team of instructors/trainers with responsibility for visiting employees, troubleshooting hardware, software, and communications problems, and creating user groups to share experiences over the system.

Despite the difficulties, anecdotal evidence suggested that family members benefited from the experiment. Of the 150 family members, 120 signed in and logged a total of 2,600 hours, sampling many software options. Some participants described family members working together with the computer—grandparents with parents and parents with children. Employees were excited and proud to participate in the project. The computer and NovaNET introduced learners to new subjects, technological capabilities, skills, and experiences. Participants appreciated the patient and private environment provided by the computer. Most participants liked having a computer in the home and appreciated the extra support. Many were reluctant to give up the computers at the end of the project and expressed an interest in purchasing a computer if Motorola offered to split the cost.

SOURCES: Linda Thor et al., ***SALSA (Southwest Advanced Learning System for Adults) Pilot Project Research Report*** (Phoenix, AZ: Rio Salado Community College, April 1991); Jim Frasier, manager of education research, Motorola University, personal communication, 1992; and Karen Mills, associate dean of instruction, Rio Salado Community College, personal communication, 1992.

the most basic level, there is far less use of computer networks than is possible or desirable. Although there are numerous examples of networked systems that combine electronic mail, bulletin boards, and other capabilities to create exciting learning environments for children,[51] these methods are not being employed in adult literacy programs. This is paralleled by a general isolation of personnel in one facility from those at other facilities even when programs fall under one central administrative system. Programs often seem to be functioning in an intellectual and operational vacuum.

Coordination of services with other agencies is frequently desired, but seldom achieved. Few programs use their technology to identify or access other social services available to adult learners, except for some welfare reform initiatives where such coordination is mandated. In short, the potential for information exchange is singularly untapped in agencies visited, despite their desire for it.

Several projects and States are experimenting with networking and data coordination:

- In Philadelphia ''Power Learning," a pilot project, implemented by the Mayor's Commission on Literacy, is linking together learners and teachers from eight community-based adult education projects. One-hundred learners, each enrolled in a program at one of the eight sites, have been loaned a computer and a modem to take home. The system allows electronic conferencing among teachers and learners, access to PLATO courseware, and word processing. Learners are using the computers in many ways, but writing is the predominant activity. Students are writing about themselves, talking to each other online, and sending messages to their teachers.[52]
- The Outreach and Technical Assistance Network (OTAN Online Communication System has been set up as part of California's strategic plan for adult education. This system provides electronic mail through which people working in adult education can contact others in California and throughout the Nation (see chapter 6, figure 6-2). In addition, it provides an electronic database full of resources and information for teachers and administrators.[53]

Video technology is surprisingly underused given its familiarity and availability. The virtual explosion of easily accessible and relatively inexpensive video technologies, in particular VCRs and videotapes, offers exciting new possibilities for using video as a learning and teaching tool. Yet video use in literacy programs is limited. Videos are used largely to provide information or stimulate group discussions in class. A few programs have videocameras or other video production equipment, which they use to tape special events or mock job interviews, but producing video or using video as a classroom resource is a rare activity.

Examples of innovations include:

- To help employees who want to improve their reading skills at home, one company is distributing a 5-1/2 hour beginning reader video series called I *Want to Read.*[54] As part of the service, this company conducts a promotional campaign with an 800 number, mails videos and support materials to interested employees, offers telephone counseling, and helps employees to find a community literacy program.
- Arlington Community Television has produced a video series called *Communicating Survival*

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51 See Reder, op. Cit., footnote 19.

52 Donna Cooper, executive director, Mayor's Commission on Literacy, Philadelphia, PA, personal communication, Mar. *26, 1993.*

53 John Fleischman and Gerald H. Kilbert, ''Adult Education Technology in the Golden State,'' *Adult Learning*, January/February 1993, pp. 15-16.

54 The series was produced by Anabel Newman of the University of Indiana.

that provides information critical to new immigrants, such as the useof911, emergency health care, the supermarket, and so forth. The tapes are produced in several languages and are being distributed for use by individuals, ESL classes, and refugee assistance groups.

- A collaboration between El Paso Community College and Levi Strauss is the first major project attempting to design and implement a video-based workplace literacy curriculum. A series of 60 ESL videos that focus on textile production and manufacturing techniques used in Strauss' 7 El Paso plants have been completed; the project is about to begin production of another 60 episodes to teach reading, writing, and mathematics skills within the workplace context. Using employee input and formative research, the video series is being designed for initial use with the predominantly Spanish-speaking workers in these plants.[55]
- The Children's Television Workshop has recently produced a children's literacy program called *Ghostwriter. The series* is targeted toward 2nd to 4th graders, particularly those who are ''. . . becoming reluctant readers and writers—who do not see the personal relevance of the printed word or are experiencing difficulty understanding and creating text. ' '[56] The program, which is being broadcast on many Public Broadcasting Service (PBS) stations during the 1992-93 television season, focuses on a multiethnic group of three boys and three girls who solve mysteries in their neighborhood by reading and writing. Viewers are encouraged to write and read through a host of print-based activities like letter writing and contests.[57] While not aimed at adults, the engaging format has attracted a number of parents seeking to enhance their literacy skills.
- The Annenberg/Corporation for Public Broadcasting (CPB) project is soliciting proposals for funding to develop an adult television course that teaches ESL. The course will include a series of at least 20 broadcast-quality television programs (30 minutes in length) with integrated print and audio materials. The first phase (year 1) will fund one planning and formative research effort ($100,000). Annenberg/CPB expects to provide $1.5 million for production and distribution (to be matched by an additional $1.5 million in outside funds). The programs will have wide distribution through broadcast and cable, in community-based ESL programs, in community college ESL programs, and through public libraries, corporations, and other community organizations .58
- Vermont Interactive Television is a statewide telecommunications system that allows people all over the State ready access to education and training resources. Currently nine sites are connected via two-way interactive television. Learners go to the site nearest their home and attend classes that may be taught by teachers in another part of the State. Learners can use the system to work on their GED. All classes are preserved on videotape for learners who may miss a class or want to review material.[59]

Simpler, inexpensive technologies-such as audio recorders, closed-caption decoders, and **hand-held electronic devices-are largely ignored.** Although many literacy educators described the virtues of audio for learners who lack reading skills, audiotape recorders were seldom being used. Few literacy programs seemed aware

55 All three of the above examples are drawn from Schwarz, Op. Cit., footnote 22.

56 Children's Television Workshop, "Literacy Project Snapshot," unpublished manuscript, Nov. 19, 1990, p. 2.

57 Children's Television Workshop, *Ghostwriter Activity Guide (New* York, NY: 1992).

58 Annenberg/CPB Project, ' 'English as a Second Language Solicitation Guidelines,' unpublished document, 1993.

59 ''Adult Basic Education: Expanding Horizons Over VIT,'' *Online: The Newsletter of Vermont Interactive Television*, vol. 2, No. 1, August 1991.

of other, less well-known devices such as closed-caption decoders or hand-held dictionaries and translators (see box 7-F).

There are some experiments that indicate these technologies have much to offer:

- The Mott Haven Library Center for Reading and Writing in New York City (see chapter 4), which serves mostly adults who read below grade-4 level, has an extensive collection of books on tape that are very popular with these learners. The collection is large because a pool of volunteers reads and records books; the collection can easily and inexpensively be updated to keep up with the interests and requests of the learners.
- The Institute for Communication Disorders offers a special literacy program for learning disabled adults with O to 3rd-grade reading ability at the International Center for the Disabled in New York City. The teacher, a learning disabilities specialist, reports that calculators and the Franklin Speaking Spelling Ace are extremely helpful to her students. Cassette tape recorders, which students use to listen to books on tape and to make audio notes, are at the top of the teacher's list as useful technology.
- The Arlington Education and Employment Program (REEP) in Arlington, Virginia, and the National Captioning Institute (NCI) have proposed a project to use closed captioning in ESL classes. After REEP has identified videos relevant to their ESL curriculum, NCI will provide captions (available at two different paces) and will provide training to teachers using the captioned videos. Anecdotal reports suggest that many non-native speakers of English find captioning helpful; NCI reports that 50 percent of individuals who purchased decoders in 1990 did so in order to learn English.[60]

The availability of relevant and versatile software is limited. Providers repeatedly mentioned the need for software that addresses the specific needs of adults with low literacy skills. They ask for content that is meaningful to adults, not just a refashioning of something originally made for children. There is a great need for high-quality programming that can be easily customized by instructors to meet the special needs of local client populations.

Interesting possibilities are being explored as programs acquire technology and software that enable them to create their own products.

- Design tools, such as software shells, make it increasingly easy to create courseware that reinforces basic skills through materials specific to the workplace (see box 7-G).
- The Correctional Educational Division (CED) of the Los Angeles County jail system (see chapter 4, box 4-F) has supported the onsite development of computer software and video programming that more closely meets the needs of their inmate population. For example, they have developed computer reading materials for the 3rd- and 4th-grade reading levels that make use of idioms frequently heard by inmates in the jails. CED also has impressive video production facilities; one of their main purposes is to produce short videos, requested by teachers, to illustrate concepts or skills that teachers find themselves demonstrating repeatedly (e.g., the safe use of hand tools).
- Chemeketa Community College in Salem, Oregon, has recently created software for teachers called *Textbook Toolbox. This software allows* teachers with no programming experience to create electronic textbooks using

60 These &- come from decoder warranty registrations. C. Eric Kirkland, National Captioning Institute, Inc., personal communication, August 1992.

Box 7-F-Closed Captioning

Captioning is a way of displaying a "script" on the television screen, much like subtitles in foreign language films. Originally developed for the hearing impaired, applications of captioning technology may prove to be an important resource for literacy. The first captioning system was pioneered in 1971. By the late 1970s, it was possible to embed the text into the Vertical Blanking Interval of the video signal. The development of "closed" captions made the text visible only on those sets equipped with a special decoder. Until recently, viewers were required to buy and install this decoder (about $160 to $200), if they wanted to view captions. However, as a result of Federal legislation, all television sets with screen sizes 13 inches or larger, whether manufactured or imported for use in the United States after June 30, 1993, will have captioning capability built directly into the television receiver.[1]

This legislation accelerated the development of hardware circuitry and put captioned programming within reach of large numbers of people who can benefit, including an estimated 24 million Americans who are hearing impaired, 38 percent of older adults with some hearing loss, children and adults learning to read, and those who are not proficient in English. The cost of captioning technology was lowered by aggregating demand. High-volume production of the chip and installation during manufacturing will reduce the unit cost of decoders to under $5. Since about 20 percent of households purchase a new television each year, well over 40 million households are expected to have a caption-capable television by 1996.

By enlarging the audience with access to captioning, the legislation sought to provide marketplace incentives to pay for more captioned programming. The production of captions for programming, which is quite expensive, started with Federal dollars but, in recent years, has been supported by a mix of government, television network, and advertiser funding.[2] All prime-time network broadcasts are captioned, as are many sporting events, newscasts, and public affairs programs. The library of captioned movies on videotape is expanding as well, with over 3,000 titles available in 1992. However, basic cable networks, such as CNN, and pay cable networks, such as HBO, offer limited access to captioned programming.

Greater access to closed captioning has spurred a renewed interest in its potential educational uses. Studies of the effects of closed captioning on adult learners, adults and children with learning disabilities, and limited English proficient adults and children indicate that captioning may benefit these populations.[3] For example, there is limited evidence that closed captioning motivates these learners to read and helps improve their reading skills. Further research and experimentation are needed to exploit the potential of captioning as an educational tool. Some of the major questions are: 1) Can captioning, particularly as a part of incidental television viewing, improve reading and writing skills? Under what circumstances? For what kinds of learners (i.e., limited English proficient or nonreaders)? 2) How should captions be designed? 3) What are cost-effective ways to produce and distribute captions widely? A few studies on these questions and pilot projects are under way.[4]

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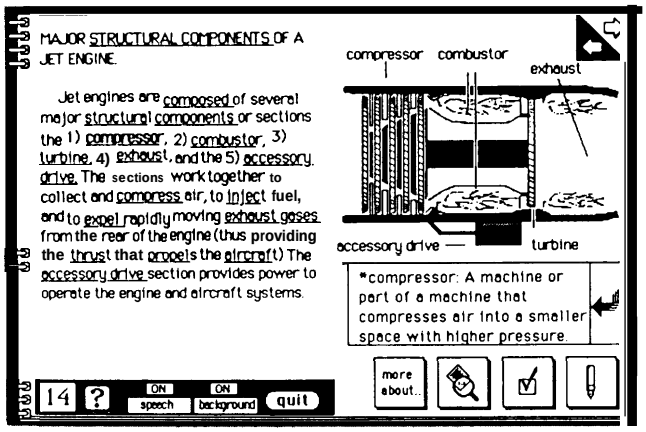
1 Public Law 101-431, The Television Decoder Circuitry Act of 1990.

2 According to the National Captioning Institute (NCI), the Federal Government covers about 2s percent of the production costs for captioning. NCI estimates the cost of an hour of captioning at about $500 to $1,800 and up to 20 person-hours, depending on the application. Morgan Bramlet, manager of public relations, National Captioning - - communication, Feb. 12,1993.

3 See Rita M. Bean and Robert M. Wilson, "Using Closed Captioned Television to Teach Reading to Adults," *Reading Research and Instruction*, VOL 28, No. 4,1989, pp. 27-37; E. Askov et al., Pennsylvania State University, Institute for the Study of Adult Literacy, "Adult Literacy, computer Technology and the Hearing Impaired," unpublished manuscript, 1989; Susan B. Neuman and Patricia Koskinen, "Captioned Television as 'Comprehensible Input': Effects of Incidental Word Learning From context for Language Minority Students," *Reading Research Quarterly*, vol. 27, No. 1, 1992. pp. 94-106; and Robert M. Wilson et d., "Using Closed Captioned Television to Enhance Reading Skills of Learning Disabled Students," *Yearbook of the National Reading Conference*, vol. *35*, 1986, pp. *61-65.*

4 The Media Access Research and Development Office at the WGBH Caption Center, funded by the Corporatio n for Public Broadcasting and the U.S. Department of Education, conducts research on human * and design issues related to captions for adults and children and delivery of simultaneous Spanish translati"on. Larry Goldberg, Executive Director, WGBH Caption Center, "Closed Captioned Programming: Changing Development in the Television Landscape," presentation St the Annenberg Washington Program, Oct. 17,1991.

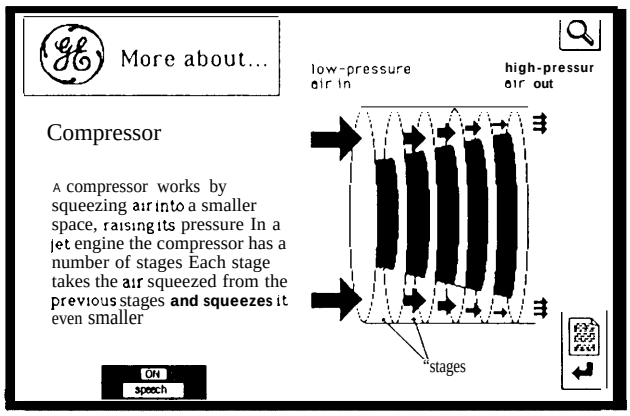
Box 7-G—Basic Skills Instruction Embedded in Job Training Materials



One of the difficulties experienced by some companies in upgrading the skills of their employees is the complexity of job-related technical documents and training manuals required for learning new systems. The technical vocabulary and complex concepts require high-level reading skills that may be beyond the capabilities of many employees.

The General Electric (GE) aircraft engine factory in Rutland, Vermont, faced this problem when GE sought to upgrade the production system. GE wanted to change operating procedures from line work, with its single repetitive tasks, to a team approach, in which groups of employees would be responsible for a cluster of tasks. When a training program was instituted, many employees were unable to understand the training materials. Rather than "dummy down" the manuals, GE took a different approach. Under a Federal workplace literacy grant with the Vermont Department of Education, GE converted the written manuals to software and used them as basic texts for their workplace literacy efforts.

The complex manuals are made more understandable to workers through the addition of speech and graphics using a hypertext/hypermedia system that offers links to supplemental information that help the user read and understand the text (see figure above). The user can "click" on a word or concept that is not understood and hear it read aloud and may request its definition in written format. A feature called "more about" gives more detail on complex concepts; e.g., if the employee wants to find out more about a "compressor," he or she clicks on the more about button, which brings up a graphic representation of a compressor and a description of how it works (see figure below). This "closeup" feature provides the context known by a good reader, but necessary for more limited readers to comprehend the material. In choosing the closeup option, alternative wording of a passage can be provided, removing some of the nonessential information that can be confusing; other techniques include explicit numbering of sequential steps, highlighting causal relationships in the text, and graphic representations or animations of descriptive passages. Checkup questions help students monitor their comprehension as they go along.



Adult education teachers like using the software in their classes because it teaches basic skills in a meaningful context, using the manuals the employees must understand for success on the job. Employers see it as a way to "sneak" basic skills training into job training, making it more palatable for both management and workers. Because the materials are so tied to the workplace changes, all employees benefit: some are "brushing up" on rusty skills, while those whose literacy skills may be very limited are not stigmatized by their participation.

SOURCE: Based on Michael Hillinger, Lexicon Systems, Sharon, VT, personal communication, August 1992. See also Michael L. Hillinger, "Computer Speech and Responsive Text," *Reading and Writing: An Interdisciplinary Journal*, vol. 4, No. 2, 1992, pp. 219-229.

notes, sounds, graphics, movies, and dictionary features.[61]

BARRIERS TO USE OF TECHNOLOGY

Why are literacy programs not taking greater advantage of technology? OTA identified several barriers that inhibit widespread access and effective use of technologies. They include funding, market, informational, and institutional problems. Many of these barriers are interrelated: e.g., funding barriers contribute to market barriers and vice versa.

Funding Barriers

Hardware and software cost money. Even technology that is reasonably priced by the standards of public schools, small businesses, or middle-income consumers may be out of range for literacy programs, since most cannot buy in quantity and thus take advantage of reduced prices. As discussed in chapters 4 and 6, most literacy programs operate on very tight budgets (average spending of $217 per student[62]), using funding from multiple and sometimes unreliable sources. Most literacy providers, especially small community-based organizations, cannot afford technology.

The median annual technology budget of the technology-using programs in OTA's survey (those with less than 15 computers) was $500.[63] Compare this with the average cost of $1,000 to $1,500 for a computer with color monitor, keyboard, and mouse. The startup price of an ILS generally ranges from $18,000 to $65,000, including equipment, the management and instructional software, setup, and initial training. Annual support and software updates for ILSs cost from $1,500 to $6,000.

Newer technologies such as computer-based multimedia systems and interactive videodisc systems are even less affordable (see box 7-H). Among the most expensive technologies are two-way interactive telecommunications systems. Initial capital costs are high, and continuing outlays, such as subscriber fees, can also be expensive, making distance learning prohibitive for most programs.

The cost of technology is also an obstacle for the millions of adults who could benefit from literacy-related technology in the home or at work. As noted above, televisions, VCRs, telephones, computers, and game machines are commonplace features in many homes and workplaces. But adults with limited literacy skills are among the least affluent consumer groups. Many cannot afford technological devices, even at mass market prices. They are also less likely to come in contact with technologies on the job.[64]

Although telephone service is often thought of as universal, only 93 percent of households actually have telephones (fewer than have televisions). Furthermore there are disparities related to ethnicity-while 95 percent of white households have phones, only 84 percent of African-American and 83 percent of Latino households do so.[65] Those households with annual incomes of less than $15,000 also have lower rates of phone service.[66] A 1991 survey of cable and VCR penetration also shows a strong relationship to

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61 Lucy Tribble MacDonald, Chemeketa Community College, Salem, OR, presentation at Literacy Volunteers of America National Conference, Denver, CO, November 1992.

62 This amount is for fiscal year 1990 programs funded by the Adult Education Act and includes Federal and State/local contribution. See ch. 4, table 4-1.

63 Sivin-Kachala and Bialo, op. cit., footnote 1, p. 24.

64 Center for Literacy Studies, Op. Cit., footnote 19.

65 Belinfante, op. cit., footnote 30.

66 Ibid.

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Box 7-H—Multimedia, Hypermedia, and Adult Learning

Multimedia is the integrated use of sound, text, graphics, animation, still images, and motion video. Multimedia applications use a variety of hardware configurations, typically a computer linked to an interactive videodisc, CD-ROM player, television, and/or videocassette recorder. More recent technology configurations bundle the hardware together so that all images—text, graphics, animation, and full-motion video—can be displayed simultaneously on multiple windows on a single, desktop monitor.

Multimedia and hypermedia are often used interchangeably, but they are not identical. Multimedia refers to hardware that makes it possible to present multiple types of media, or to the applications (software) running on multimedia hardware platforms. One of the more powerful of these applications is hypermedia, a process that links software images in an associative, rather than linear fashion. Like hypertext software, used for many years to allow a user to link text by following an associative line of inquiry, hypermedia software makes it possible to take this concept further, creating associative links across media forms (e.g., text to video, or sound to graphics and animation). Hypermedia authoring tools are becoming easier to use, allowing teachers and learners to create their own lessons. Three illustrations follow:

1. Books on CD-ROM can be used with a computer. As the "pages" appear on the computer screen, the user can hear the book read aloud in English or in a different language. The user can interrupt to request a definition or clarify a concept. Supplementary material can feature video, graphics, or animation as well as sound and text.[1]
2. An interactive videodisc application simulates a jury trial. The learner joins the jury and views short video segments. The vignettes dramatize the courtroom procedure and show other members of the jury discussing the trial and making inferences. After each segment, multiple-choice questions are displayed on the monitor.
3. A CD-ROM presents the history of Native American tribes who lived in Mendocino County, California. The tribes are presented through photographs from the turn of the century, pictures of artifacts, sound recordings, and oral histories. Students can use segments from the CD and integrate them with their own videos and interviews with members of the tribes today to create a multimedia report.

Multimedia and hypermedia can incorporate a mix of learning techniques in one piece of courseware. Many adult learners, unable to use text for information, have developed alternative skills for understanding, organizing, and remembering information that draw on imagery, sound, and spatial memory.[2] Multimedia materials can incorporate these skills as a basis for learning, rather than relying on text alone. Hypermedia is also a powerful tool, because it puts adults in control of the learning path, allowing them to make information links based on personal choice and logic. Hypermedia makes it easy to "browse" through information, encouraging learners' intellectual curiosity.[3]

Each generation of computers includes more multimedia capability; new courseware releases increasingly use video, sound, and graphics. Though highly promising, there are also challenges. Multimedia courseware applications are more expensive and complex; it may be difficult for literacy programs to select appropriate courseware. Teachers will need training in order to take the fullest advantage of the power of multimedia. Most vexing is that little or no compatibility exists from vendor to vendor and from one generation of equipment to the next. With the proliferation of formats now vying for commercial acceptance (e.g., CD-ROM, CDI, DVI), many educational users will wait to make large-scale commitments to multimedia.

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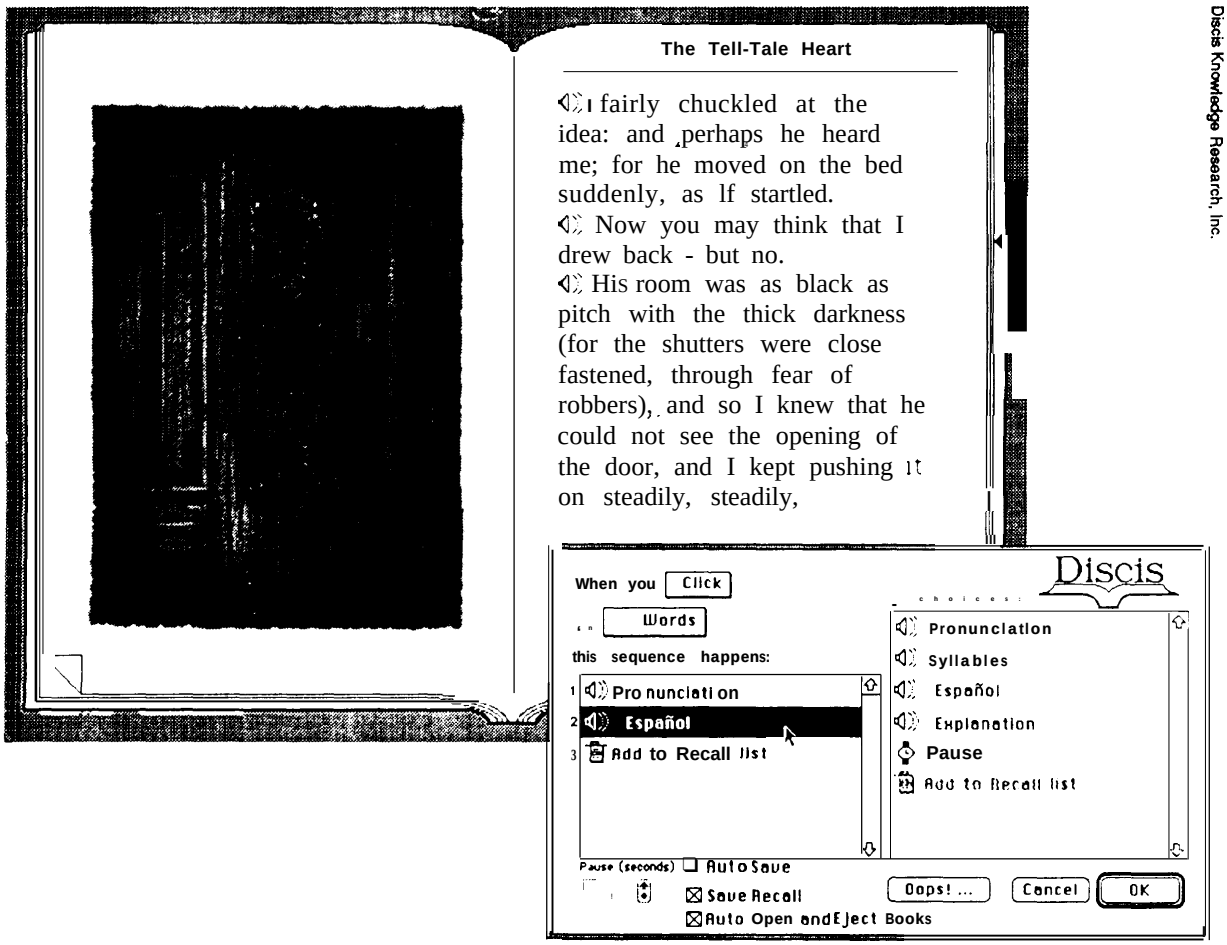
[1] Recent examples include *The Tell-Tale Heart*, by Discis Books, and *Who Built America?* a multimedia social studies textbook developed by the Voyager Co. in cooperation with the American Social History Project in New York City. Voyager also created the *Expanded Book Tool Kit*, a tool for converting existing texts to multimedia electronic books.

[2] See J. Gretes and T. Songer, "Validation of the Learning Style Survey: An Interactive Videodisc Instrument," *Educational and Psychological Measurement*, vol. 49, No. 1, spring 1989, pp. 235-241.

[3] Wayne Nelson and David Palumbo, "Learning, Instruction, and Hypermedia," *Journal of Educational Multimedia and Hypermedia*, vol. 1, No. 3, 1992; Antonietta Lanza and Teresa Roselli, "Effects of the Hypertextual Approach Versus the Stuctured Approach on Students' Achievement," *Journal of Computer-Based Instruction*, vol. 18, No. 2, spring 1991, pp. 48-50.



This software version of the Tell-Tale Heart allows the reader to choose either a Spanish or English reading of the text, the tempo of the reading, and words to be defined,

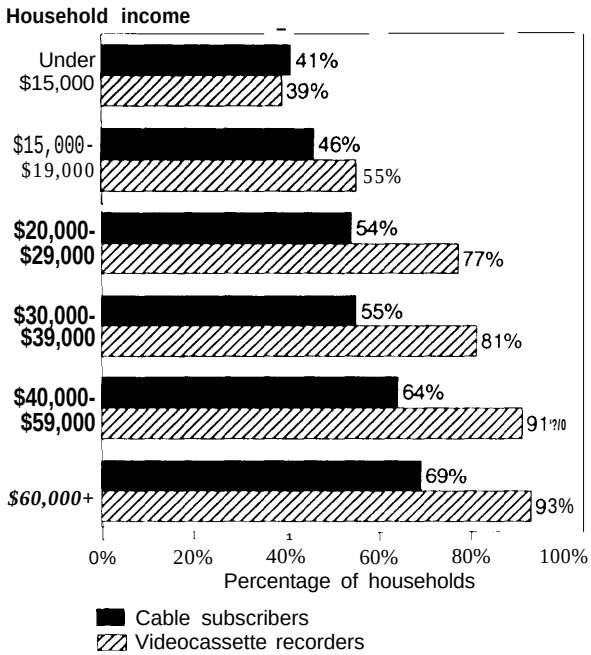
income (see figure ***7-2); 41*** percent of households in the lowest income bracket (under $15,000) have cable and 39 percent have VCRs, compared with 69 and 93 percent respectively for those in the highest income bracket ($60,000 or more).[67]

Computer ownership is related to income, education, and ethnicity. While 15 percent of all households had a computer in 1989, only 6 percent of households with incomes under $20,000 had them compared with 39 percent of households with incomes of $50,000 or more. Computers are found in the homes of 18 percent of white adults, but only in 8 percent of African-American and 8 percent of Latino adults.[68] Both access to and use of home computers are related to the educational level of adults. For example, only 4.6 percent of those with less than a high school degree have a home computer, compared with 33.7 percent of those with a college degree. Furthermore, 25.6 percent of those without a high

[67] A.C. Nielsen Co., National (50-State) Sample of 4,000 Households (Nielsen Peoplemeter Service), as reported in Boston Consulting Group, "Public Television: Developing a Ready-to-Learn Service," report prepared for the Public Broadcasting Service, January 1993. Data collected by Nielsen in 1991.

[68] Kominski, op. cit., footnote 33.

Figure 7-2-Households With Videocassette Recorders and Cable Subscriptions, by Income, 1991



NOTE: The average for all households in 1991 is 57 percent cable subscribers and 73 percent with VCRs.

SOURCE: A.C. Nielsen Co., National (50-State) Sample of 4,000 Households (Nielsen Peoplemeter Service), as reported in Boston Consulting Group, "Public Television: Developing a Ready-to-barn Service," report prepared forthe Public Broadcasting Service, January 1993. Data collected by Nielsen in 1991.

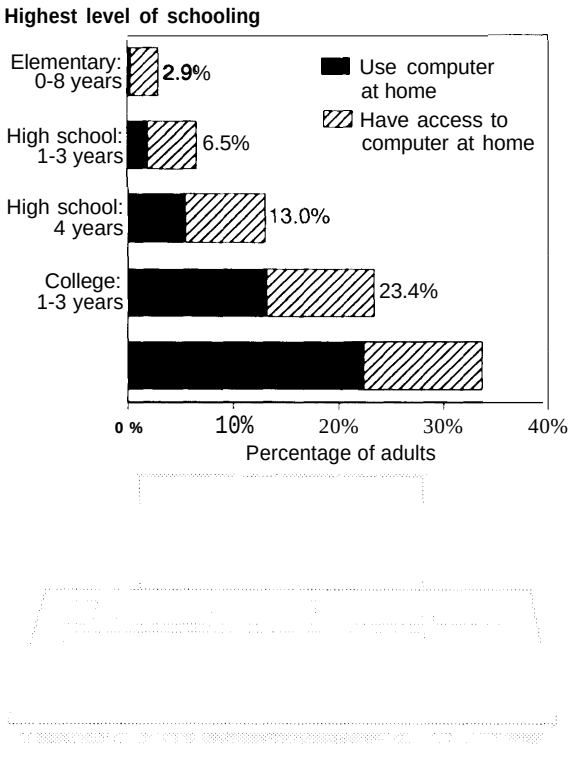
school degree report using their computers, compared with 71.2 percent of those with college degrees (see figure 7-3).

Market Barriers

The **costs** to research, develop, market, distribute, and support technology aimed at the specialized needs of adult learners can be very high. To develop a courseware package, the needs of learners must be researched, educational experts must be consulted, and courseware must be tested in the field. In some cases, focus groups are convened and formal assessments conducted. Although some technical aspects of the development process have become cheaper in recent years, consumers have also come to expect better presentation quality (i.e., the use of graphics and sound) and educational value (i.e., the incorporation of critical thinking skills and contexts relevant to the learners). These features increase the cost of development.

Without some reasonable hope of a return, companies are unlikely to invest the startup costs for specialized technology aimed at limited, fragile submarkets. Such is the case with the literacy market-by any measure small, fragmented, underfinanced, and Underdeveloped.[69]

Figure 7-3-Adults With Home Computers, by Level of Schooling



NOTE: Figure includes persons 18 years and older in 1989.

SOURCE: Robert Kominski, *Computer Use in the United States: 1989*, Current Population Reports, Special Series P-23, No. 171 (Washington, DC: U.S. Department of Commerce, Bureau of the Census, February 1991).

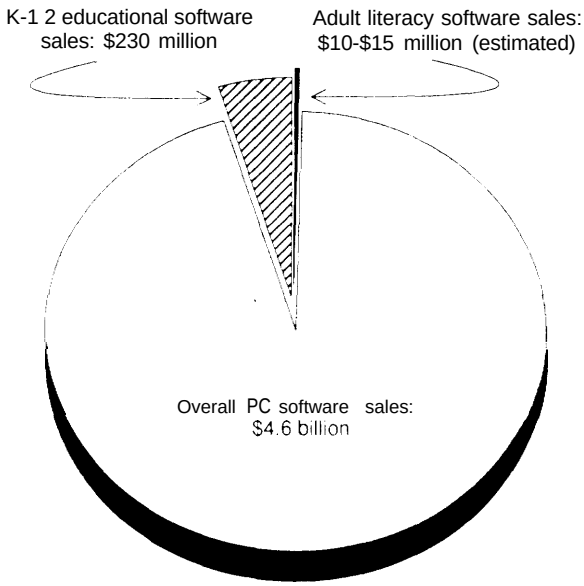
[69] Education TURNKEY Systems, Inc. and Wujcik and Associates, op. cit., footnote 1.

The universe of literacy programs--or potential ‘‘customers’ ‘—is small compared with other educational or corporate markets. In addition, as explained above, funding limitations prevent many literacy programs from purchasing hardware, which further shrinks the potential customer base. Although individual learners theoretically comprise a much larger market, they are least likely to be able to afford technology .70

Definitive data are not available on total sales of literacy-related technologies, but statistics on sales of computer software corroborate the notion that in the large pond of the technology market, the adult literacy market is a small fish indeed. The entire personal software industry had annual sales of about $4.6 billion in 1990. In that same year, elementary and secondary schools spent about $230 million for educational courseware.[71] By comparison, OTA estimates that the adult literacy market had annual software sales in 1990 of roughly $10 to $15 million (see figure 7-4).[72]

Without a large and visible base of potential customers or a healthy record of past sales to attract them, even software companies with considerable expertise in "crossover marketing" may shy away from the literacy market. Developers outside the education field seem particularly uninterested. Consequently, most of the active competitors in the !iteracy market are those with a stake in larger education and training markets, such as K-12 schools or corporate training, Some of these vendors simply sell their existing educational products to literacy clients. Others successfully revise products originally designed for the K-12 education market. Only a few companies market high-quality products designed especially for adult literacy (see box 7-I).

Figure 7-4-The Personal Computer Software Market, 1990



NOTE: Does not include software purchased or licensed as part of an Integrated learning system.

SOURCE: Office of Technology Assessment, 1993, based on data from Education TURNKEY Systems, Inc. and Wujcik Associates, “The Educational Software Marketplace and Adult Literacy Niches,” OTA contractor report, June 1992.

The literacy software market is in an early stage of development. There are currently few people with both expertise in adult literacy and know-how in technology to develop applications for the literacy market. In addition, slow economic growth and a lack of other factors make it unlikely that technology “seeding” will occur for adult literacy.[73] However, some firms have been able locate funding to cover the high costs of developing literacy software, including multimedia with

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70 OTA/Annenberg Workshop, “New Visions for Video Use of Cable, Satellite, Broadcast, and Interactive Systems for Literacy and Learning, ’ Jan. 27, 1992.

71 Figures for educational courseware are for the 1989-90 school year and do not include software purchased or licensed as part of an integrated learning system. Education TURNKEY Systems, Inc. and Wujcik and Associates, op. cit., footnote 1, pp. 12-13.

72 Estimates based on OTA conversations with vendors and programs.

73 Seeding is grants of computers by hardware companies to stimulate future sales. It also stimulates the development of courseware and peripherals. Seeding has occurred in the K-12 and higher education markets.

Box 7-I—Franklin Electronic Learning Resources

It takes a worker three bus changes and 2 hours to go from her city apartment to her suburban house cleaning job every day. Her husband, an unemployed construction worker, takes their disabled teenager to the local public health clinic every 2 weeks for physical therapy. On each visit the pair waits at least 1 hour before seeing the therapist. This family spends much of their commute and wait time in bored frustration.

Portable, electronic learning aids could provide an interesting resource for thousands of individuals with similar stories. With hand-held electronic units, waiting time at bus stops, in clinics, and many other places could be spent practicing vocabulary, mathematics, English, or grammar skills. For those trying to learn to read or to speak English, these devices can serve as personal "tutors," translating and pronouncing unfamiliar words encountered in everyday life.

One vendor of portable electronic devices, Franklin Electronic Learning Resources, is creating a niche in the literacy market. Its products include English and bilingual dictionaries, a thesaurus, a spelling tutor, and an encyclopedia. On average these units weigh about 4 ounces, display up to six lines of text, and often include a speaker. The Spanish Master, for example, enables a user to type in an unfamiliar English word, hear it pronounced, and see a written Spanish translation. It also provides spelling and grammar assistance and word games. For someone with limited English proficiency, the tool could be an invaluable resource in everyday life—used, for example, to translate labels on products in the grocery store, to help ask a salesperson a question, or to understand signs and directions.

Although most of its sales to date have been in the consumer electronics market (6 million devices), the company anticipates future sales of these devices in community colleges, prisons, libraries, and community-based literacy sites. Anecdotal evidence from the literacy field has been very encouraging. Users like portable devices because they are easy to use, affordable, and flexible. Franklin staff believe that adults with limited literacy skills are not ashamed to be seen in public using hand-held devices because they feel part of the high-tech age. Once learners in literacy programs are exposed to hand-held learning devices, the company feels, an increased market will develop among personal users.

Why does this company see a market for personal literacy tools, while other vendors with similar products have not? The company views adult education as a logical extension of its long involvement with the K-12 education market and the leadership at Franklin has taken a personal interest in adult literacy. Reference materials and language translation have broad appeal without the need for much customization. In addition, the company has redefined itself from hardware vendor to electronic publisher. As a publisher, Franklin believes that it can effectively serve several niches cost-effectively. For example, the company's latest product, *The Digital Book System* (see photograph), includes a library of digital books that range from health to Spanish/English translation to religion.

As the technology becomes more powerful, cheaper, and smaller, Franklin's president envisions new ways it can serve adult literacy. For example, an adult learner newly enrolled in a literacy program could use a personal learning tool in the following ways:

> After orientation to a Franklin portable electronic unit, the student takes a pretest. . . . [A] plan of activities is downloaded into the unit, and the student is asked to work through the activities [at the literacy site]. . . . Now comes the neat part! Instead of going away to come back for 3 hours tomorrow night, the student once again has a set of activities downloaded into the portable unit. . . . He can work through the set of activities as needed at home, on the bus, at work during lunch breaks and even during television commercials! . . . At long last, the instructional package travels with the student instead of demanding that the student come to the instruction.[1]

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1 Arthur J. Sisk, president, Franklin Learning Resources, The Educational Division of Franklin Electronic Publishers, Inc., personal communication, Oct. 28,1992.

opportunities for customization (see box 7-J). Virtually all of the technology firms included in OTA industry case studies raised the necessary funding internally or through partnerships with other groups.

Information Barriers

OTA finds that **there is inadequate information available to both consumers and producers of adult literacy technologies.** From the consumer end, most literacy educators, even those with some technology expertise, are not aware of the range of technology options available. The problem exists at all levels but is most obvious among novice technology users, who do not fully understand the capabilities of technology and who rarely or never consult software reviews.[74] Literacy program administrators often have little training in or experience with technology, hence do not know what to look for or how it could benefit programs.

From the vendor end, there is a shortage of specific market information on potential or existing literacy customers and their needs. Particularly lacking is more comprehensive data on the current uses of educational technology by literacy programs and home consumers; their current and anticipated expenditures for hardware, courseware, and other instructional materials; and effective product design features for hard-to-reach literacy populations.[75]

Technology vendors in OTA's case studies adopted various strategies to cope with this lack of information, including hiring consultants and market research firms to conduct limited studies or develop ''best estimate' projections; conducting their own design research during prototype testing, rather than relying on existing research; hiring experienced developers and marketers who had their own information sources in the literacy field; and refining existing products based on feedback from their customer base.[76]

Franklin Electronic Publishers, Inc.

Digital books on many different topics can be plugged into this small hand-held device, making it possible to read and learn anywhere, anytime.

Both literacy programs and technology developers could benefit from more information on the effectiveness of different types of technologies in improving literacy skills. This is especially true for specific subgroups of learners such as adults with the very lowest reading skills, with limited English proficiency, or with learning disabilities. Similarly, there is little hard data available on the effectiveness of some newer technologies for adult literacy, such as interactive distance learning. Some literacy providers are reluctant to adopt technology-based approaches because they have doubts about their effectiveness, especially when weighed against their cost. More evidence of effectiveness might help persuade adult educators to buy hardware and convince technology vendors to invest in developing better software.

Institutional Barriers

Some of the common institutional challenges faced by literacy programs constrain their use of technology and work against the development of

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74 Sivin-Kachala and Bialo, op. cit., footnote 1, p. 68.

75 Education TURNKEY, Inc. and Wujcik Associates, op. cit., footnote I.

76 Ibid.

Box 7-J—Developing Innovative Software: The Example of Interactive Knowledge, Inc.[1]

In the last decade, startup companies have contributed to the development of computer software for K-12 education and corporate training. For some companies, public funding played a significant role. There are signs that software development in the adult literacy submarket could follow a similar pattern.

Interactive Knowledge, Inc. (IK), a firm that designs, develops, and distributes multimedia courseware for adult education, is one example. The company evolved from a 6-year research effort that began in 1985 at Central Piedmont Community College (CPCC) in Charlotte, North Carolina. At that time, CPCC hired Tim Songer and Chuck Barger, two media and instructional designers with experience in adult education, to create adult reading comprehension courseware. With grants from the U.S. Department of Education and the North Carolina Department of Community Colleges, CPCC staff developed two programs: *The READY Course*, 50 hours of reading comprehension instruction on topics of interest to adults (e.g., using credit cards and medical concerns) for those reading between the 5th- and 9th-grade levels and *The New Reader Bookstore*, a CD-ROM-based curriculum with over 120 hours of audio-based instruction to help adult nonreaders develop decoding skills. In conducting product-development research, the designers learned that effective courseware: 1) incorporates high-quality digital audio, 2) gives the learner control and choice throughout each lesson, and 3) integrates instructional content into real-life contexts.

In 1991, Songer and Barger, along with a third *Ready* employee, Sam Hess, left CPCC and founded Interactive Knowledge. They negotiated the exclusive rights to package and market the two reading programs and pay royalties to CPCC on the sales. Since that time, the company has prepared several other multimedia products aimed at adult, family, and workplace needs. The company markets its courseware to a variety of adult education providers including public schools, community colleges, community-based organizations, correctional facilities, libraries, and businesses.

In the process of creating these "off-the-shelf" products, IK has also developed software shells that can be easily customized for a particular industrial or educational client. The shell makes it possible to combine reading, mathematics, and critical thinking instruction with content from any business or subject area. Producing IK's custom products cost about $3,000 to $4,000 per hour of instruction compared with typical costs for custom courseware of $15,000 to $18,000 per hour.

The firm's use of multimedia to develop an innovative product line would not have been possible without the $800,000 in Federal, State, and private grants. Notes Songer: "This business would not exist without the research and development funds available to us at the college . . . We were able to start the business with many important contacts in place and an established reputation for developing effective adult literacy solutions."

IK is unusual because its founders began to design multimedia for adult literacy at a time when there was almost no installed base of videodisc players and CD-ROM drives among providers. The future of IK is still uncertain. The lack of funding and technology know-how among adult educators and learners creates serious market impediments, and small technology firms often have limited resources and business experience. In the little-explored literacy submarket, companies like IK have many questions to answer: Does the company have the products that educators and learners want? Are the prices realistic? How can a small company identify and inform potential customers about products? How can they identify customers who have multimedia capacity? How will State economies affect the funds available to literacy programs for hardware upgrades? For small innovative firms like IK, designing for an emerging technology that is not yet installed in literacy programs, viability rests on many players in an unpredictable marketplace.

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[1] *Basal* on Tim Songer, president, Interactive Knowledge, Inc., Charlotte, NC, personal communication, Oct. 28, 1992. See also Tim Songer, "why Multimedia Works: Perspective on Literacy Courseware," *Literacy Practitioner*, a Publication of Literacy volunteers of America—New York State, Inc., VOL 1, No. 1, December 1992.

a viable literacy market. The diverse and sometimes fragmented nature of the literacy field is one such barrier. Different types of literacy programs, such as ABE, GED preparation, ESL, correctional education, workplace skills enhancement, and family literacy, require different kinds of instructional content. The apparent need for customized products for each submarket, however small or seemingly unprofitable, increases development and customer support costs and may dissuade developers from entering the market. In addition, the diversity of service providers means that there is no identifiable, formal market relationship, no clear purchasing pattern, and no single organizational structure; this makes it difficult for companies to obtain market-relevant information and complicates marketing and distribution.[77] The fragmentation of funding sources presents still another barrier, especially when some Federal grant-in-aid programs limit expenditures for hardware and equipment (see chapter 5).

Another institutional barrier cited by technology developers is the lack of common performance objectives for literacy programs. Industry respondents believed that commonly accepted standards and objectives could reduce customization costs and over time bring down prices.

The shortage of experienced professional staff for adult literacy, who could help develop software and programming, is also perceived as a barrier, particularly among firms that have decided not to enter the adult literacy market. Virtually all of the case study firms in the literacy marketplace had a core team with directly related experience, which the firm could supplement through consultants and reassignment of staff from other divisions within the company.

CONCLUSIONS

The use of technology to address the problem of adult literacy is limited but growing. Technology has the potential both to improve the existing system of literacy education and to reach people in new ways. Although some literacy providers are experienced users of technology, the potential of technology for programs has barely been exploited. Of equal import but even less explored is the potential of technology to help individual learners and give them access to information and learnin g tools. The promise of technology needs to be realized. There are encouraging signs that investment and interest in technologies for literacy are increasing. Rapid technology development is occurring simultaneously with a growing recognition of the importance of lifelong learning. These factors have created an opportune time to stimulate the private sector, aggregate the market, and encourage innovative uses of technology.

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77 Ibid., pp. 34-35,