

# Assistive Technology for Postsecondary Students with Learning Disabilities

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## Abstract

An increasing number of students with learning disabilities are attending postsecondary institutions. To meet the educational demands of these students, support service providers will likely rely on assistive technology. This article lists types of assistive technology appropriate for use with persons with learning disabilities at the postsecondary level and discusses ways in which assistive technology enhances learning. Additionally, an overview of legislation that has had an impact on assistive technology at the postsecondary level is presented. Issues involving assistive technology programs at the postsecondary level are discussed. Postsecondary assistive technology program components, device selection, and training guidelines also are outlined.

Assistive technology is defined by the Technology-Related Assistance Act of 1988 (P.L. 100-407) as any technology used to increase, maintain, or improve the functional capabilities of individuals with disabilities. Although assistive technology is recognized in the area of rehabilitation as a means to improve the quality of life for persons with physical disabilities, it has received little attention as a tool for helping individuals with learning disabilities (LD) to compensate for specific cognitive deficits. In the field of education, reports addressing the benefits of using assistive technology to compensate for specific learning disabilities have been generated primarily by professionals at the postsecondary level attempting to meet the needs of increasing numbers of students with learning disabilities attending college (Raskind, 1994).

As noted, an increasing number of students with learning disabilities are enrolling in and graduating from postsecondary institutions (Adelman & Vogel, 1992; Fairweather & Shaver, 1991; Henderson, 1992). In 1991, 8.8% of full-time college freshmen reported having some form of disability, compared with 2.6% in 1978. Of the types

of disabilities reported, learning disabilities were the fastest growing group, increasing from 15% to 25% of all students with disabilities over the 13-year period (Henderson, 1992). A number of researchers (Rothstein, 1993; Shaw, McGuire, & Brinckerhoff, 1994; Vogel, 1993) have pointed to factors that result in increased numbers of individuals with disabilities attending postsecondary institutions:

1. The passage of Section 504 "E" of the Rehabilitation Act of 1973 mandated accessibility to postsecondary education for students with disabilities and required postsecondary institutions to provide "auxiliary aids," such as taped texts, to students with disabilities.
2. P.L. 94-142 and P.L. 101-406 mandated special education programs and services for elementary and secondary students with disabilities; as a result, more of these students are completing high school and view attending college, with the assistance of support services, as the next logical and viable step.
3. As a result of being placed in least restrictive environments, many students with disabilities have taken

sufficient academic course work prerequisite to attending college.

4. Students with disabilities have become increasingly attractive to college admissions officers as a viable student market.
5. Advocacy groups and postsecondary guidebooks (e.g., Peterson's, Lovejoy's) have made these students aware of both their needs and their rights in regard to college options.
6. The increased availability of computers and other compensatory technology has resulted in greater student independence and access in the college setting.

As students with learning disabilities attend college in increasingly large numbers, the impact of assistive technology on their ability to successfully complete postsecondary education is being recognized (Raskind, 1994; Raskind & Scott, 1993). Educational support service providers, in meeting the demands of these students, will likely rely on assistive technology. What do educational service providers need to know in order to provide effective assistive technology services to students with learning disabilities

at the postsecondary level? The purposes of this article are to present types of assistive technologies appropriate for postsecondary students with learning disabilities, discuss ways in which assistive devices enhance learning, provide an overview of legislation affecting assistive technology at the postsecondary level, and present issues involving assistive technology at that level. Additionally, this article presents postsecondary assistive technology program components and provides guidelines on device selection and training.

### Devices and Their Effect on Learning Abilities

Difficulties experienced by postsecondary students with learning disabilities include reading, organization, memory, listening, math, and written language. The majority of reports involving students with learning disabilities using assistive technology have investigated written language difficulties (e.g., Collins, 1990; Cutler, 1990; Primus, 1990; Raskind, 1994). This is not surprising, as estimates of the number of adults with learning disabilities who exhibit written language disorders range from 80% to 90% (Blalock, 1981).

For students with learning disabilities, the technologies available include word processors with spell checking, proofreading, abbreviation expanders (programs that allow students to type abbreviations for frequently used words or phrases and press the space bar to produce the complete word or phrase), and outlining software programs. Also available are variable speech-control tape recorders, optical character recognition systems (reading machines), listening aids (systems that use a microphone and headset designed for students with auditory deficits), speech-synthesis/screen-review systems (voice output systems that read back text displayed on the computer screen), speech-recognition systems (systems that allow the user

to operate the computer by speaking to it), data managers (technologies that store personal information for students with organization and memory difficulties), and talking calculators.

These devices can enhance the individual's learning abilities by circumventing deficits. According to Garner and Campbell (1987), circumventing deficits is one of the two major purposes of assistive devices and is referred to as the *compensatory* approach. In this approach, an individual is helped to perform a specific task using assistive technology. For example, when a student acquires and listens to a taped version of the book that is to be read for English class in order to correctly answer comprehension questions about the material, his or her aim is to bypass a reading disability, not to learn to read. If, instead, the student wishes to improve his or her reading, the student might use a computer program to practice phonics skills. In this example, using assistive technology to learn to read exemplifies the second major purpose of assistive technology and is referred to as the *remedial* approach (Garner & Campbell, 1987). The purpose of this approach is to improve areas of deficiency. Of course, the two purposes may overlap. The compensatory strategy in which the student utilizes a taped book could possibly have remedial results if, while listening to the tape, the student follows along in the print version of the book, attempting to learn unfamiliar words.

Raskind (1994) suggested that although both remedial and compensatory approaches are beneficial for adults with learning disabilities, the compensatory approach "may offer the most expeditious means of addressing specific difficulties within particular contexts" (p. 159). Other researchers also support using compensatory approaches when providing services to adults with learning disabilities (e.g., Gray, 1981; Mangrum & Strichart, 1988; Vogel, 1987). The burnout that adults with LD experience as a result of years of remedial instruction that

yielded little benefit, and the appeal of immediate solutions to particular problems, lend support to using a compensatory approach when using assistive technology with these adults (Raskind, 1994).

Current support for assistive technology also arises from a growing understanding of its positive effects. Greater independence and relief from anxiety are benefits noted by Barton and Fuhrmann (1994) for students with learning disabilities who use tools to free them from the drudgery imposed by their disability: "Sometimes a simple handheld spelling checker relieves more anxiety than hours of therapy" (p. 91). Other writers have noted a heightened sense of self-esteem in students with disabilities who gain competency with technology (Raskind, 1994), a reduction of reliance on others and a move toward independence (Brown, 1989), and a regaining of a sense of control leading to vocational success (Reiff, Gerber, & Ginsberg, 1992).

The advantages of using assistive technology are numerous, as outlined above. However, the current literature regarding assistive technology focuses on the technology itself (hardware and software). There is no empirical research demonstrating the effectiveness of specific technologies in compensating for specific types of disabilities.

### Legislation Addressing Assistive Technology

Lawmakers recognize the need for assistive technology; this section provides an overview of federal assistive technology-related legislation that affects postsecondary students with disabilities.

#### Section 504

Legislation mandating access to adaptive computer technology systems and services includes Section 504 of the 1973 Rehabilitation Act. This law mandates accessibility to postsec-

dary education for "otherwise qualified" students with disabilities; however, Subpart E of the rules and regulations addressing postsecondary educational services was not in place until 1978. According to the Rehabilitation Act Regulations, postsecondary services are required to provide auxiliary aids, such as taped texts, to students with disabilities (Rothstein, 1993). These auxiliary aids are referred to in the educational literature as *ancillary equipment*, *adapted computer technology*, and *assistive technology*. Allowing students with disabilities to use such aids is considered making an academic adjustment or reasonable accommodation.

### ***The Technology-Related Assistance for Individuals with Disabilities Act***

More recent legislation addressing assistive technology includes the Technology-Related Assistance for Individuals with Disabilities Act of 1988 (Tech Act; P.L. 100-407; reauthorized in 1994). "This law along with others, has directly influenced the availability and utilization of specially designed devices and accommodations meant to empower persons with disabilities" (Chandler, Czerlinsky, & Wehman, 1993, p. 117). An assistive technology device (ATD) is defined by P.L. 100-407 as "any item, piece of furniture, or system used to increase, maintain, or improve the functional capabilities of individuals with disabilities." An ATD can be low-tech (mechanical) or high-tech (electro-mechanical or computerized). Under the Tech Act, states are awarded grants to develop assistive devices and to provide training and technical assistance; 52 states and territories have currently received systems change grants under the law (Button & Wobschall, 1994). Information and referral services, equipment loan libraries, loan-financing programs, and protection and advocacy assistance are some services of state projects. Agencies involved with the Tech Act and professionals providing technology-

related services to postsecondary students with disabilities, particularly students with learning disabilities, need to ensure that the needs of these students are considered when planning assistive technology services.

### ***The Americans with Disabilities Act***

The Americans with Disabilities Act (ADA) does not specifically address assistive technology. It extends civil rights protection to postsecondary students with disabilities not previously protected by the Rehabilitation Act, and more fully protects students for whom coverage was limited. As Button and Wobschall (1994) stated, with the passage of ADA, "the message to our nation was clearly that the historical and often intentional segregation and exclusion of people with disabilities would no longer be tolerated" (p. 196). These authors concluded that technology services and devices will be critical in achieving the nondiscrimination provisions of ADA.

Wilson (1992) pointed out that even though the majority of colleges and universities say they are in compliance with Section 504 of the Rehabilitation Act, the publicity ADA is receiving may result in even better access to assistive technology for students with disabilities on campuses. If institutions are not in compliance with existing laws in terms of computer access (e.g., computerized card catalogs, physical access to facilities, computing networks), Wilson predicted that students will be more inclined to use the legal system to enforce rights. In describing differences between Section 504 and ADA, Jarrow (1993) stated, "ADA can be viewed as '504+' (p. 21). Some individuals who experience difficulty in learning, for instance, persons with environmental disabilities or chemical sensitivity, are not covered under Section 504 but may be under ADA to the extent that the disability limits a major life activity.

## **Postsecondary Issues Involving Assistive Technology**

This section discusses the issues of litigation, computerized testing, and access in relation to assistive technology at the postsecondary level.

### ***Litigation***

The responses by colleges and universities to Section 504 in regard to academic adjustments involving assistive technology for students with learning disabilities have not resulted in litigation. Two cases involving reasonable accommodation of exam format and what constitutes admissions discrimination were resolved by the courts; other litigation may have been initiated but was settled out of court (Rothstein, 1993).

A number of issues related to assistive technology could result in litigation. For example, difficulty could arise if colleges do not allow accommodations involving computers and word processors with spell checking programs for testing purposes. These arrangements might require monitoring of students to ensure that they do not access information stored in the computer's memory during testing, or that unapproved accommodations (e.g., grammar checkers) are not used. To deny this accommodation, the institution would have to prove that monitoring the computer exam would create an undue hardship.

Another source of difficulty may arise if faculty members refuse to allow accommodations requested for a student by the disabled student service office. This situation is more likely to lead to litigation when the institution has no grievance procedure in place. For example, if a student is not allowed to use a device recommended by the office of disabled student services, and no grievance procedure is in place, both the instructor and the institution may be liable (Rothstein, 1993).



## Computerized Testing

Colleges and universities are currently responding to issues involving assistive technology and computerized educational testing. Advances by major testing companies in computerized versions of standardized admissions tests (e.g., American College Test, Graduate Record Exam) have led to issues of equitable access in the testing environment for students with learning disabilities. It is not known if the ability to perform well on computerized standardized tests is impaired or enhanced for students with learning disabilities. Given the heterogeneous nature of the population, it is likely that some individuals with learning disabilities will benefit from computerized testing and others will not. Research to determine whether barriers are created by technology must be conducted in the near future to ensure that access is not *decreased* by the introduction of technology (Hockley, 1990).

## Access

As a result of the Rehabilitation Act and increased awareness of disability issues since the passage of ADA in 1990, services for students with learning disabilities have flourished. As services increase in the postsecondary setting, so too does the use of auxiliary aids, including assistive technology. Bursuck, Rose, Cowen, and Yahaya (1989), in their nationwide survey of postsecondary services for students with learning disabilities, reported that a majority of the schools they surveyed provided auxiliary aids, such as taped textbooks, tape recordings of lectures, calculators, and word processing programs. The same study concluded that small colleges and community colleges offer more personalized services, such as individualized tutoring and counseling, the use of Individualized Education Programs (IEPs), and progress monitoring of students with learning disabilities. It is unclear, however, whether access to assistive technology, and support in its use,

vary according to the size of the institution. Major universities may employ more faculty for technology instruction and allocate more funds for technological purchases than 2-year or community colleges. Or, the personalized services characteristic of smaller colleges may result in assistive technology's having a greater impact on these students' successful completion of postsecondary education. This is a viable area for future study in the use of assistive technology.

Whether the setting is a large state university or a 2-year community college, educators agree that once a functional level of competency in using an assistive device is gained, the student with disabilities should move into the mainstream setting (Brinckerhoff, 1993; Brown, 1989). For example, the student with dysgraphia (for whom writing is an agonizing task) could learn how to use a word processor to organize, compose, edit, and print thoughts using computer adaptations in the support services lab. This student could then use the writing lab available for all students in completing his or her regular class writing assignments. Hilton-Chalfen (1991b), in his tips for starting an assistive technology program said, "Go campus-wide from the beginning. Become part of the larger computing picture" (p. 43). By accommodating students with learning disabilities in this way, existing services are not duplicated, and accommodations become an integral part of the academic support network available to all students (Shaw et al., 1994).

## Barriers and Solutions

This section describes two historic barriers to assistive technology use. Also described are solutions to these barriers.

### Complexity

Early barriers to using assistive technologies are dissolving. Technology

is now simpler, less expensive, and more widely available on campuses. Computer adaptations once involved mechanical devices that took hours to install and learn to use (Brown, 1989). Now, many specialized programs are software-based. Users may access technical support by either calling the manufacturer using a toll-free number or on screen by utilizing a "help command" option (Raskind & Scott, 1993). Furthermore, programs that rely on graphical user interface (pull-down menus and icons) are now available for most types of computers. Some students find these programs easier to operate and the commands easier to remember.

### Availability

Assistive devices are present in virtually every postsecondary support services setting because federal legislation requires that postsecondary institutions receiving federal funds provide auxiliary aids to students with learning disabilities (e.g., Americans with Disabilities Act of 1990; Rehabilitation Act of 1973). In the 1994 Florida Career and Information Delivery System Report (Florida Bureau of Career Development, 1994), for instance, 90 of 91 community colleges and state universities surveyed indicated that they did provide learning aids for students with disabilities.

Additionally, innovative companies, recognizing the potential for a new market, have created technologies with new capabilities. Technologies that did not exist only a few years ago (e.g., reading systems that scan books, convert the text to speech, and simultaneously highlight the text and read it out loud) are now available as compensatory tools for students with dyslexia or other learning disabilities. Also, the expansion of existing services that provide taped books for students with print disabilities has resulted in increased availability of assistive technology for postsecondary students with learning disabilities. For

example, recent changes in policies and operating procedures by Recording for the Blind and the Library of Congress address the changing needs of students with learning disabilities and have resulted in more four-track tape recorders and taped texts being made available to students with learning disabilities (Wilkison, 1989).

### **Postsecondary Assistive Technology Program Components**

This section provides a review of the literature describing assistive technology program components in colleges and universities across the country. An increase in the number of program descriptions should lead to the delineation of best practices in providing assistive technology services at the postsecondary level.

Currently, only California has introduced a statewide system of specialized educational programming involving technology for students with disabilities in the postsecondary setting. In 1985, California established adapted computer technology centers in educational institutions across the state (Brown, 1989). These "High-Tech Centers for the Disabled" help students with disabilities, including individuals with learning disabilities, to successfully complete their postsecondary education. Specialized courses in the use of adapted technologies are taught by the technology specialists and instructional aides at the High-Tech centers. One adaptation students with learning disabilities learn to make uses technology to change the focus in the writing environment from a visual to an auditory one (Brown, 1989), which involves a combination of word processor, real time spell checker (which monitors spelling as words are being typed), screen-reading system, and speech synthesizer. It is reported that individuals whose oral language abilities exceed their written language abilities find this adaptation very helpful. Once the student becomes com-

fortable using the appropriate adaptation, he or she is encouraged to use campus-wide computer facilities, such as computer centers or writing labs.

This California model provides one tested framework for examination by other university systems interested in establishing programs that emphasize assistive technology for students with disabilities in the postsecondary setting. Additional centers with similar missions are emerging in other states (Hilton-Chalfen, 1991a). The University of Missouri-Columbia established the Adaptive Computing Technology Center in 1986. One objective of that center is to identify and evaluate assistive technology. The Educational Center for Disabled Students at the University of Nebraska-Lincoln evolved from a 3-year demonstration project into an integral part of the Services for Students with Disabilities Office. Academic and technical support are integrated with the provision of services to help students with disabilities successfully compete in the postsecondary environment. At the University of North Texas, the office of Disabled Student Services helps students with disabilities access computer center and media library services. Accessibility to computer hardware is emphasized. A graduate student funded through the Disabled Student Services trains students to use centrally located assistive technology.

### **Selection and Training Guidelines**

It is important for postsecondary service providers to be familiar with selection criteria and training concerning assistive technology. This section provides pertinent guidelines along with an overview of how secondary educators can prepare students with learning disabilities for using assistive technology at the postsecondary level.

#### ***Secondary Preparation***

Since the passage of Public Law 94-142, children with disabilities have

been assured access to education. Elementary and secondary schools are required to identify and serve students with disabilities; however, at the postsecondary level, according to Section 504 of the Rehabilitation Act of 1973, the responsibility for initiating provision of services and accommodations falls to the individual student. Educational preparation for assuming this role in the postsecondary setting should begin at the secondary level. During the middle school and high school years, students need to develop self-advocacy skills to prepare for this future role of initiator. Students also need to be confident of the strategies and accommodations that work for them so they will know what to request of service providers. Additionally, students need to be comfortable using computers, taped books, and calculators before entering college to benefit from those supports once there. Secondary educators, working as a multidisciplinary team, play an important role throughout the high school years in preparing students with learning disabilities for college by creating Individual Transition Plans that provide for the development of self-advocacy skills, compensatory techniques, and experience with appropriate technologies.

Some students with learning disabilities reach the postsecondary level without being exposed to assistive technology and its benefits. Additionally, some students with learning disabilities are not identified until they reach the postsecondary level. For these reasons, it is important that postsecondary service providers be familiar with selection criteria and training guidelines concerning assistive technology. Raskind and Scott (1993) pointed out the importance of choosing technologies relative to the individual, the functions to be performed, and the contexts in which the technologies will be used. Constraints limiting the use of technology across the contexts of home, school, workplace, and social settings may be physical (e.g., insufficient lighting, excessive

noise, a lack of space) or psychosocial (e.g., reactions of others to use of the device) and should be considered in selecting technology. Purchasing a screen-reading program with a speech synthesizer for use in the campus writing center where other students work, for example, would not be wise unless earphones were included and used.

It is also important to consider future needs when purchasing technology. When possible, select technology designed for use by the general public, rather than technology designed specifically for individuals with disabilities. This standard technology is usually less expensive and in many instances will better prepare the student for the workplace (Raskind & Scott, 1993). Also, consider the compatibility between new software or hardware and that already owned or being used. Some manufacturers allow buyers a trial period in which to evaluate new technology. If the technology meets the needs of the individual in bypassing the deficit, has the ability to perform necessary functions, and is appropriate for use across settings, it should improve the functional capabilities of the individual with disabilities.

### **Training**

Once the appropriate technology has been selected, instruction in its use should include general strategies effective in teaching all students with learning disabilities. Effective training strategies include the following (Brown, 1989; Raskind & Scott, 1993).

1. Using a multisensory approach to training, in which students are provided with visual instruction (including videotapes and diagrams), oral instruction, and written instruction. Related to this strategy is the notion of using technology to teach technology. Having students watch videotapes demonstrating how a device is used can be an effective training strategy that simultaneously teaches the use of other types of technology. Train-

ers should be cautioned, however, not to overload students with too much technology at one time.

2. Providing repetition by giving students numerous opportunities to practice what they have learned.

3. Modeling, whereby students watch others using the device and then attempt to do the same.

4. Having frequent concept reviews, that is, competency checks conducted frequently during each training session, in which students demonstrate what they know. Also, each training session should begin with a review of the previous day's session. This allows the trainer to assess whether the student retained previous information and is ready for additional information; if not, previously presented information must be retaught.

5. Providing meaningful instruction. Allow students to generate their own words for technical terms, based on what is meaningful to them. Assist students in developing mnemonics to foster information retention. This strategy includes the use of acronyms, visualization, and rhyme to help students remember functions or steps in operating a device.

6. Using concise, clear language in describing features and operations of the technology and presenting only the amount of information needed to complete the task at hand.

7. Instilling motivation. To be motivated to learn to use technology the student must accept that a disability exists and have an immediate need that can be met by the technology. The instruction should be meaningful. Develop the concept of need and the value of incorporating student experiences in their suggestions for training.

### **Conclusions**

Assistive technology is a tool for making the learning environment more accessible and for enhancing individual productivity. Assistive technology that enables individuals with learning disabilities to compensate for

reading, organization, memory, or math deficits are available and are increasingly more affordable. The use of assistive technology in postsecondary settings may enable students with learning disabilities to express themselves at levels commensurate with their intelligence. Federal legislation has been enacted regarding assistive technology use at the postsecondary level, and the advantages of assistive technology have been reported; however, the effectiveness of specific devices has not been empirically documented. Some barriers to the use of assistive technology are dissolving; however, educational service providers at the postsecondary level must be prepared to continue addressing issues related to assistive technology, such as making reasonable accommodations; providing grievance procedures to mediate conflicts among faculty members, students with disabilities, and assistive technology service providers; and ensuring equitable access in the testing environment for students with learning disabilities.

Students who have been identified as having a learning disability at the secondary level should come into the postsecondary setting fully aware of the strategies, accommodations, and devices that work for them. In addition to instructional accommodations, transition plans, written and implemented at the secondary level, should assist students with the development of self-advocacy skills, so that students can initiate services needed at the postsecondary level.

Some students with learning disabilities are identified after arrival at the postsecondary level. In addition to being knowledgeable about various types of devices, postsecondary service providers need to be familiar with issues related to device selection and to training guidelines.

Successful selection and use of assistive technology at the postsecondary level has implications for assistive technology use after college. It is acknowledged by those in the field that learning disabilities continue throughout



the lifespan (Patton & Polloway, 1992). This implies that the need for assistive technology does not end with the fulfillment of the individual's educational aspirations, but persists in his or her employment, social, and leisure endeavors.

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#### REFERENCES

- Adelman, P. B., & Vogel, S. A. (1992). Issues in program evaluation. In S. A. Vogel & P. B. Adelman (Eds.), *Success for college students with learning disabilities* (pp. 323-343). New York: Springer-Verlag.
- Barton, R. S., & Fuhrmann, B. S. (1994). Counseling and psychotherapy for adults with learning disabilities. In P. J. Gerber & H. B. Reiff (Eds.), *Learning disabilities in adulthood: Persisting problems and evolving issues* (pp. 82-92). Stoneham, MA: Andover Medical.
- Blalock, J. (1981). Persistent problems and concerns of young adults with learning disabilities. In W. Cruickshank & A. Silvers (Eds.), *Bridges to tomorrow: The best of ACLD* (Vol. 2, pp. 31-45). Syracuse, NY: Syracuse University Press.
- Brinckerhoff, L. C. (1993). Establishing support services with minimal resources for college students with learning disabilities. In M. L. Farrell (Ed.), *Support services for students with learning disabilities in higher education: A compendium of readings* (Vol. 3, pp. 54-63). Columbus, OH: Association on Higher Education and Disability.
- Brown, C. (1989). *Computer access in higher education for students with disabilities: A practical guide to the selection and use of adapted computer technology* (2nd ed.). Washington, DC: Fund for the Improvement of Postsecondary Education, U.S. Department of Education.
- Bursuck, W. D., Rose, E., Cowen, S., & Yahaya, M. A. (1989). Nationwide survey of postsecondary education services for students with learning disabilities. *Exceptional Children*, 56, 236-245.
- Button, C., & Wobschall, R. (1994). The Americans with Disabilities Act and assistive technology. *Journal of Vocational Rehabilitation*, 4, 196-201.
- Chandler, S., Czerlinsky, T., & Wehman, P. (1993). Provisions of assistive technology: Bridging the gap of accessibility. In P. Wehman (Ed.), *The ADA mandate for social change* (pp. 117-134). Baltimore: Brookes.
- Collins, T. (1990). The impact of micro-computer word processing on the performance of learning disabled students in a required first year writing course. *Computers and Composition*, 8, 49-68.
- Cutler, E. (1990). Evaluating spell checkers, thesauruses, dictionaries, and grammar editors for the community college student with learning disabilities. In H. J. Murphy (Ed.), *Proceedings of the Fifth Annual Conference on Technology and Persons with Disabilities* (pp. 163-175).
- Fairweather, J. S., & Shaver, D. M. (1991). Making the transition to postsecondary education and training. *Exceptional Children*, 34, 264-270.
- Florida Bureau of Career Development. (1994). *Career and information delivery system report*. Tallahassee, FL: Author.
- Garner, J., & Campbell, P. (1987). Technology for persons with severe disabilities: Practical and ethical considerations. *The Journal of Special Education*, 21, 24-32.
- Gray, R. A. (1981). Services for the adult LD: A working paper. *Journal of Learning Disabilities*, 4, 426-431.
- Henderson, C. (1992). College freshmen with disabilities: A statistical profile. Washington, DC: American Council on Education, HEATH Resource Center (ERIC Document Reproduction No. ED 354 792)
- Hilton-Chalfen, D. (1991a). *Computers and students with disabilities: New challenges for higher education*. (Available from Educational Uses of Information Technology, 1112 16th St. NW, Suite 600, Washington, DC 20036)
- Hilton-Chalfen, D. (1991b). Starting an assistive technology program. In H. J. Murphy (Ed.), *The impact of exemplary technology-support programs on students with disabilities* (pp. 42-59). Washington, DC: National Council on Disability. (ERIC Document Reproduction Service No. ED 361 950)
- Hockley, D. (1990). Planning adaptive computing services in post-secondary education: An integrated approach. In *Proceedings of Beyond Ramps: A disabilities services conference for higher education* (pp. 25-33). St. Paul, MN: (ERIC Document Reproduction Service No. ED 322 693)
- Jarrow, J. E. (1993). A quick refresher course. In M. L. Farrell (Ed.), *Support services for students with learning disabilities in higher education: A compendium of readings* (Vol. 3, pp. 54-63). Columbus, OH: Association on Higher Education and Disability.
- Mangrum, C. T., & Strichart, S. S. (1988). *College and the learning disabled student*. Philadelphia: Grune & Stratton.
- Patton, J. R., & Polloway, E. A. (1992). Learning disabilities: The challenge of adulthood. *Journal of Learning Disabilities*, 25, 410-416.
- P.L. 100-407, The Technology-Related Assistance for Individuals with Disabilities Act, 1988.
- Primus, C. (1990). *Computer assistance model for learning disabled* (Grant # GOO 8630152-88). Washington, DC: Office of Special Education and Rehabilitation Services, U.S. Department of Education.
- Raskind, M. H. (1994). Assistive technology for adults with learning disabilities: A rationale for use. In P. J. Gerber & H. B. Reiff (Eds.), *Learning disabilities in adulthood: Persisting problems and evolving issues* (pp. 152-162). Stoneham, MA: Andover Medical.
- Raskind, M. H., & Scott, N. (1993). Technology for postsecondary students with learning disabilities. In S. A. Vogel & P. B. Adelman (Eds.), *Success for college students with learning disabilities* (pp. 240-280). New York: Springer-Verlag.
- Reiff, H. B., Gerber, P. J., & Ginsberg, R. (1992). Learning to achieve: Suggestions from adults with learning disabilities. In M. L. Farrell (Ed.), *Support services for students with learning disabilities in higher education: A compendium of readings* (Vol. 3, pp. 135-144). Columbus, OH: Association on Higher Education and Disability.
- Rothstein, L. F. (1993). Legal issues. In S. A. Vogel & P. B. Adelman (Eds.), *Success for college students with learning disabilities* (pp. 21-35). New York: Springer-Verlag.

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- Gay, G. (1986). Interaction of learner control and prior understanding in computer-assisted video instruction. *Journal of Educational Psychology, 78*, 225-227.
- Hasselbring, T. S., Goin, L. I., & Wissick, C. A. (1989). Making knowledge meaningful: Applications of hypermedia. *Journal of Special Education Technology, 10*, 61-72.
- Hooper, S., & Hannafin, M. J. (1988). Cooperative CBI: The effects of heterogeneous versus homogeneous grouping on the learning of progressively complex concepts. *Journal of Educational Computing Research, 4*, 413-424.
- Hunter, M. (1982). *Mastery teaching*. El Segundo, CA: Tip.
- Huntley, M. (1991). The danger of style. *ISTE Update, 3*(8), 2-3.
- Hurricane Hugo [computer software]. (1990). Atlanta, GA: Turner Educational Services.
- Kinzie, M. B., Sullivan, H. J., & Berdel, R. L. (1988). Learner control and achievement in science computer-assisted instruction. *Journal of Educational Psychology, 80*, 299-303.
- Locatis, C., Letourneau, G., & Banvard, R. (1990). Hypermedia and instruction. *Educational Technology Research and Development, 37*(4), 65-77.
- MacGlobe [computer software]. (1992). Novato, CA: Broderbund.
- Malouf, D. B., Jamison, P. J., Kercher, M. H., & Carlucci, C. M. (1991). Computer software aids effective instruction. *Teaching Exceptional Children, 23*(2), 56-57.
- Mastering Fractions [computer software]. (1985). Washington, DC: Systems Impact.
- McLellan, H. (1992). Hyper stories: Some guidelines for instructional designers. *Journal of Research on Computing in Education, 25*, 28-49.
- McLellan, H. (1993). Hypertextual tales: Story models for hypertext design. *Journal of Educational Multimedia and Hypermedia, 2*, 239-260.
- McNeil, B. J., & Nelson, K. R. (1991). Meta-analysis of interactive video instruction: A 10 year review of achievement effects. *Journal of Computer-Based Instruction, 18*(1), 1-6.
- Morrison, G. R., Ross, S. M., & Baldwin, W. (1992). Learner control of context and instructional support in learning and elementary school mathematics. *Educational Technology Research and Development, 40*, 5-13.
- National Gallery of Art [computer software]. (1983). New York, NY: Videodisc.
- Pellegrino, J. W., Hickey, D., Heath, A., Rewey, K., Vye, N. J., & Cognition and Technology Group at Vanderbilt University. (1992). *Assessing the outcomes of an innovative instructional program: The 1990-1991 implementation of the "Adventures of Jasper Woodbury"*. Nashville, TN: Learning Technology Center, Vanderbilt University.
- Raiders of the lost ark [Film]. (1981). New York: Paramount Home Video.
- Repman, J., Weller, H. G., & Lan, W. (1993). The impact of social context on learning in hypermedia-based instruction. *Journal of Educational Multimedia and Hypermedia, 2*, 283-298.
- Salamandre: Chateaux of the Loire Valley [computer software]. (1988). Santa Monica, CA: Voyager Co.
- Sharp, D. L., Goldman, S. R., Bransford, J. D., Hasselbring, T. S., Moore, P., Brophy, S., & Vye, N. (1993, April). *Developing strategic approaches to narrative structures with integrated media environments for young, at-risk children*. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.
- Sherwood, R. D., Kinzer, C. K., Hasselbring, T. S., Bransford, J. D., Williams, S. M., & Goin, L. I. (1987). New directions for videodiscs. *The Computing Teacher, 14*(6), 10-13.
- Signer, B. R. (1992). A model of cooperative learning with intergroup competition and findings when applied to an interactive video reading software. *Journal of Research on Computing in Education, 25*, 141-158.
- Snyder, J. (1993). Hooking them with hypermedia—In any subject! *Hypernexus, 4*(2), 17-19.
- Star wars [Film]. (1977). New York: CBS Fox Video.
- The Storyteller [Computer software]. (1992). Columbia, SC: Star Express.
- Taylor, R. (Ed.). (1980). *The computer in the school: Tutor, tool, tutee*. New York: Teachers College Press.
- Thorpe, B. (1993). Kids can create videodisc reports. *The Computing Teacher, 20*(5), 22-23.
- Truett, C. (1994). CD-rom, videodiscs, and new ways of teaching information and research skills. *The Computing Teacher, 21*(6), 42-45.
- Turner, S. V., & Dipinto, V. M. (1992). Students as hypermedia authors: Themes emerging from a qualitative study. *Journal of Research on Computing in Education, 25*, 187-199.
- Ulmer, E. J. (1990). High-tech instructional development: It's the thought that counts. *Educational Technology Research and Development, 37*(3), 95-101.
- Wilson, K., & Tally, W. (1991). Looking at multimedia: Design issues in several discovery-oriented programs (Tech. Rep. No. 13). New York: Bank Street College of Education.
- Windows on Science, Updated Version [Computer software]. (1993). Warren, NJ: Optical Data.
- Wissick, C., Foelber, M., & Berdel, R. (1989). The repurposing of Raiders of the Lost Ark: Hypercard design and research on classroom use. In R. Fox (Ed.), *Proceedings of the Society for Applied Learning Technology Eleventh Conference on Interactive Videodisc in Education and Training* (pp. 8-10). Warrenton, VA: Society for Applied Learning Technology.
- Woodward, J., & Gersten, R. (1992). Innovative technology for secondary students with learning disabilities. *Exceptional Children, 58*, 407-421.

(continued from p. 492)

- Shaw, S., McGuire, J., & Brinckerhoff, L. (1994). College and university programming. In P. J. Gerber & H. B. Reiff (Eds.), *Learning disabilities in adulthood: Persisting problems and evolving issues* (pp. 141-151). Stoneham, MA: Andover Medical.
- Vogel, S. A. (1987). Issues and concerns in LD college programming. In D. J. Johnson & J. W. Blalock (Eds.), *Adults with learning disabilities: Clinical studies* (pp. 239-275). Orlando, FL: Grune & Stratton.
- Vogel, S. A. (1993). The continuum of responses to Section 504 for students with learning disabilities. In S. A. Vogel & P. B. Adelman (Eds.), *Success for college students with learning disabilities* (pp. 83-113). New York: Springer-Verlag.
- Wilkison, P. (1989, January). [Interview with Loring Brinckerhoff, director of Learning Disabilities Support Services at Boston University]. *RFB News*, p. 8.
- Wilson, D. L. (1992). New federal regulations on rights of the handicapped may force colleges to provide better access to technology. *The Chronicle of Higher Education, 38*(21), 1, 21-22.