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ASSISTIVE TECHNOLOGY: MEETING THE NEEDS OF LEARNERS WITH DISABILITIES.; By: Duhaney, Laurel M. Garrick; Duhaney, Devon C.., International Journal of Instructional Media, 2000, Vol. 27 Issue 4, p393, 9p, 1 chart

Database: Academic Search Premier

ASSISTIVE TECHNOLOGY: MEETING THE NEEDS OF LEARNERS WITH DISABILITIES

ABSTRACT

This paper discusses the integration and usefulness of assistive technology devices for students with special needs. First, two learning theories, behaviorism and constructivism, and their impact on the integration of technology in learning are discussed. Second, the paper presents several assistive technology devices and highlights how they can assist learners with disabilities.

Assistive technology devices offer powerful possibilities for improving students' learning, particularly students with disabilities. The teacher, however, will make the difference in the integration of assistive technology into the learning process. It is essential that, as a guide for learning, teachers examine assistive technology in the context of instruction and its potential impact on student outcomes (Heinich, Molenda, Russell, & Smaldino, 1999).

A number of assistive technology devices and software are available that, with careful planning and guidance, can play a multifaceted role in the instructional process. These include telecommunication devices for the deaf, high-resolution monitors, speech digitizers and synthesizers, and electronic communication aids. Any of these can be used to implement the following methods: presentation, demonstration, discussion, drill-and practice, cooperative learning groups, simulation, discovery, and problem solving (Forcier, 1999; Heinich, et al., 1999; Jonassen, Peck, & Wilson, 1999; Morrison, Lowther, & DeMeulle, 1999).

Assistive technology can play an important role in the education of students with disabilities because many of these students need special instructional treatment. For example, students with mental retardation benefit from very organized learning situations because of their limited cognitive abilities. Students who are hearing impaired, blind, or visually impaired may need differentiated pedagogical materials. More emphasis should be placed on visual materials for students with hearing impairments than for other students. Modifying instruction for all students, especially exceptional students, requires strong dependence on media, materials and technology and the right choice of these components to fit particular ends (Heinich et al., 1999). Moreover, research has indicated that technology not only can be adapted for use with students with disabilities, but when used can enhance students' educational achievement and self-image (Kober, 1991).

Given the potential of assistive technology devices and software for improving educational outcomes for students with disabilities, this paper discusses learning theories and their impact on the integration of technology in learning. The paper also presents various assistive technology devices and software and highlights their role in the learning process of students with disabilities.

LEARNING THEORIES AND THE INTEGRATION OF TECHNOLOGY

The computer can become a powerful tool if used conjointly with teaching strategies with a solid theoretical basis. Two kinds of theories that are currently of interest to educators are behaviorism and constructivism. Behaviorist and constructivist theories of learning can be used to demonstrate that the computer can be a useful tool in teaching and learning.

Behaviorists believe that the teacher is the manipulator of the environment that is experienced by the learner, and that by tightly structuring the environment, the student's behavior can be shaped to achieve learning. In the behaviorist approach to learning the learner recapitulates the teacher's interpretation of the world (Jonassen, 1996). In contrast to the behaviorist perspective, is the constructivist viewpoint that perceives that how learners construct knowledge depends on what they already know (Forcier, 1999; Jonassen, 1996). Constructivists believe that teachers try to create classrooms in which learners actively construct their own learning (Jonassen, 1996; Jonassen, et al., 1999). Meaning making is at the heart of constructivism (Jonassen, et al., 1999).

Summarized from Roblyer and Edwards (2000), major differences between the behaviorist and constructivist perspectives are presented in Figure 1. Although the tendency in schools is toward constructivism, most classrooms use elements of both. We believe that each of these elements and the technology uses matched to them can be beneficial to students.

Teaching and learning should be based on a grasp of sound theory. Those utilizing assistive technology in the classroom should seek to develop a theoretical base that will enhance their application of computers and computer software in the classroom. While acknowledging the importance of theory, Forcier (1999) cautioned that computer lessons must be consistent with learner expectations. For example, imagine that a teacher has planned a lesson calling for addition with regrouping. The teacher finds a curriculum resource guide for software to use and finds a program that presents addition algorithm. However, the software is based on discovery learning that conflicts with a directive or linear approach that the teacher used in previous lessons. This method frustrates some students whose interests would be better served by software planned around a more linear approach.

Curricular/instructional issues can be addressed by implementing strategies with behavioral and constructivist roots. Instructional problems that can be addressed by a behavioral strategy are the high student teacher ratio, the numerous required skills to teach, and insufficient time to deal with individual learning differences. To counter these problems, self-instructional materials, drills, and tutorials can be used to teach required skills. Conversely, Web-based learning appears to foster constructivist curriculum goals. They not only advance the use of cooperative groups but promote the involvement of students in the learning process by using graphics and other devices students find interesting (Roblyer & Edwards, 2000).

ASSISTIVE TECHNOLOGY AND LEARNERS WITH DISABILITIES

Research indicates that technology has had a positive impact on students' learning (Kober, 1991; Sivin-Kachala & Bialo, 1993). Key findings of this research reveal that not only does technology improve students' cognition and affect, but it promotes cooperative learning. Moreover, the research reveals that it is how teachers adapt and utilize the technology that makes a difference and not the technology in and of itself.

Although there is some agreement that technology is educationally beneficial, the research results have not strengthened the case for its impact on teaching and learning. Yet, Roblyer and Edwards (2000) not only encourage the expansion of technology in education, but also offer several reasons why its continued use is justified. For example, they believe that technology-based methods have promoted several motivational strategies such as gaining learner attention, getting learners to create their own technology-based products, and empowering learners to take control of their own learning. They also believe that technology can facilitate unique learning environments to make traditional learning environments more powerful and effective by linking learners to information sources, helping learners visualize problems and solutions, and connecting learners to learning tools.

While we agree that technology has obvious appeal for improving educational outcomes for students, teachers must ensure that it accommodates the needs of students with disabilities. The diversified needs of these students (e.g., learning disabled, behavior disorders, mental retardation, blind or visually impaired, deaf or hard of hearing, physical disabilities) require different technological resources and applications. For example, assistive technology devices have been designed to improve educational outcomes for learners with disabilities.

Readers should consider these factors when selecting and using assistive devices. The user should ensure that the assistive device (a) can be integrated into the student's instructional program, (b) can endure rapid technological changes and, if warranted, can be upgraded, and (c) can be easily maintained and that technical support, repair or maintenance is available. Additionally, school districts should ensure that teachers receive the necessary training and support to use assistive devices and services. One important

reason for this is that teachers often provide students the motivation to use assistive devices.

Before continuing, we must define the term assistive technology devices. The Technology-Related Assistance for Individuals with Disabilities Act of 1988 (Tech Act) defines assistive technology devices as any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities. The promise offered by this law is that a student with a disability will be offered any assistive devices and services necessary to enhance his or her educational experience (Behrmann, 1995; Ray & Warden, 1995).

Speech and Language Impairments

Students with speech and language impairments may have a wide-range of disorders including articulation problems, delayed speech development, or impairment of language function. Various assistive devices have been developed for use with students with speech and language impairments. For example, the Dyna Vox is a communication aid that makes it easy for learners with speech impairments to create messages and speak them electronically with a simple touch. With DECtalk (Digital Equipment Corporation) technology, the Dyna Vox will give personalized voice output (e.g., different voices ranging from child to adult, male and female tones). The liberator, a communication tool, is available to persons who cannot speak, and can be used as a writing tool (Ray & Warden, 1995).

Hearing Impairments

Students who are deaf or hard-of-heating may benefit from amplification depending on whether the hearing loss is conductive or sensorineural. In the case of a conductive hearing loss, amplification can be helpful; however, with a sensorineural hearing loss amplification, may be of little or no help. Regardless of whether a student has a conductive or sensorineural hearing loss he/she could benefit from several types of computer-assisted programs such as sign language tutorials (Roblyer & Edwards, 2000).

Captioned programming is also available for students who are deaf or hard-of-hearing. Captioned programming provides subtitles for television and other video presentations so those learners who are hearing impaired can read what others hear (Roblyer & Edwards, 2000; Hairston, 1994). These programs create a learning environment that helps students with hearing impairments improve their reading and language skills by providing them with an auditory and visual context for learning new information. One example of a captioned program is RAPIDTEXT. RAPIDTEXT is a system in which text can be entered at a steno keyboard at rates of 120-225 words per minute. When this type of captioning is used in an education setting, the stenographer enters the teacher's words which are displayed to the student on a computer monitor (Lewis, 1993).

Telecommunication devices for the deaf (TDD) allow many individuals with hearing impairment to communicate over the telephone. Using a TDD, an individual who is deaf is able to communicate with someone who has a TDD or Phone Communicator. The user who is deaf calls an operator who also has a TDD. The operator then calls a hearing person and, using the TDD, relays the information. TDD can also be used for e-mail, which can enhance the user's communication skills. Other advantages to using TDD include practice in building writing, reading, and thinking skills.

The frequency modulated (FM) system is the most frequently used special amplification method in a variety of educational settings for students who are hard-of-hearing. The teacher wears a microphone on the chest that is connected via a cord to a small body-pack transmitter that may be clipped anywhere on the clothing. The student wears a lightweight FM Radio receiver tuned to the frequency of the teacher's transmitter. This picks up the signal, converts it to an equivalent electrical pattern, and amplifies and shapes it to the child's needs. Advantages of using the FM system include (a) the teacher and student can move around without losing the signal, and (b) the student can switch from listening to the teacher to listening to the atmosphere around him/her (Sanders, 1993).

Learning Disabilities

Text- and graphics-based software that support the writing process may be best suited to students with learning disabilities whose problems "extend beyond difficulty with the physical demands and conventions of writing" (MacArthur, Graham, & Schwartz, 1991, p. 231). Some students with learning disabilities experience difficulty organizing materials, developing ideas, and revising their writing. Text- and graphics-based software, in addition to effective writing instruction, can help motivate students to write, can facilitate the

physical process of writing and editing, and can build self-confidence (Bahr, Nelson, & Van Meter, 1996, p. 27).

Computers and word processing software make revision of writing and reorganization of ideas much easier. Grammar, spellchecker, dictionaries and thesaurus programs assist in the mechanics of writing. However, some students have problems in using the dictionary and thesaurus feature because of difficulty with word recall or spelling. Word prediction software may help such students because it offers several choices of words that the student can select (Behrmann, 1995; Sandholtz, Ringstaff, & Dwyer, 1997). Holzberg (1994) reported that students who might otherwise have been incapable of writing an essay, paragraph, sentence, or even a word on paper discover they can write with a word processor.

A number of students with learning disabilities encounter problems in solving math word problems. A software program called Math Word Problems has been designed that can help these students practice reading skills, sort out relevant problem information, choose correct operations, and complete computations accurately. The software is designed to enable a teacher to customize many aspects of the problem task. For example, it is possible to choose the number of times a student may attempt a problem, the operations required, and the level of difficulty. If the level chosen is too hard or too easy, the program automatically moves to a different level. Problems are presented one at a time and the student types the response. An advantage of using this program is that it provides feedback when a student is unable to answer correctly (Lewis, 1993).

In the interest of equity in assessment, many teachers need to make testing modifications for students (e.g., students with learning disabilities, physical disabilities, visual impairments, hearing impairments, and mental disorders. Assistive devices such as talking calculator, Braille notetaker, Visualtek, Optacon, or typewriter may sometimes be used to help the examinee in reading questions, computing, or recording responses (Ray & Warden, 1995).

Physical Disabilities

Various assistive technology devices have made the computer a useful tool for students with physical disabilities (Forcier, 1999). A variety of switches, optical pointers, voice-controlled devices, and word prediction software have been designed to help students with physical disabilities (e.g., students with cerebral palsy) who have difficulty using traditional input devices such as the mouse and keyboard (Clinton, 1993).

Some students with physical disabilities cannot use their hands to operate a computer and such students can, for example, use switches or voice commands to bypass the lack of motor control over arms and hands. Also, the HeadMaster, a mouse emulator, allows a student who is unable to operate the computer with the hands to use the head to do so. As the user moves his/her head, the headset and control unit works together to measure the rotation of the user's head and moves the cursor on the computer screen. Activation of the attached puff switch (user puffs into a straw-like device) or other control interface makes the selection. Software programs that project an image of keyboard on the display permit full keyboard operation (Ray & Warden, 1995).

Ray and Warden (1995) reported the following fives to standard keyboards for students with limited motor control.

- A keyguard that is a keyboard overlay with holes positioned over each key. The overlay helps to stabilize the user's finger, hand, or stick movement.
- Touch screens allow interaction with a computer by touching the screen rather than by using a keyboard or switch.
- Touch pads that can be used to make selections from menus.
- Keylatchers may be used to lock specific keys.

Visual Impairments

Some students with visual impairment have vision problems (i.e., blindness, partial vision, low vision) while others have decoding problems (e.g., cannot recognize letters). Many students with vision problems or visual perceptual difficulties encounter problems in reading some letters and words. For example, a student with a specific learning disability or traumatic brain injury (TBI) may see b as d, p as q, or saw as was (Bender. 1998; Ray & Warden, 1995). Many of these students find reading challenging and may benefit from an auditory alternative. The DigiVox is an example of an assistive device that makes computer use possible for

students with print reading difficulties. The DigiVox is an output device that can record a quantity of spoken messages for all occasions and replay them with a simple touch whenever they are needed (Ray & Warden, 1995). The computerized Kurzweil Reading Machine that scans printed documents and converts text into electronic speech can also be beneficial to students who are blind or visually impaired (Heinich et al., 1999).

Screen magnification programs are available to enlarge print for students who are visually impaired. These programs adjust the size of text and graphics, and control the number of lines and words per page (Galvin & Scherer, 1996). Roblyer and Edwards (2000) noted that the VISTA program could be used to produce large-print screen output. A mouse is used to manipulate the cursor and size of the display.

Braille 'n Speak, a personal notetaker, is also available to assist individuals who are blind or visually impaired. It has a built-in speech synthesizer, is battery-powered, and contains a seven-key keyboard. The device is portable, measuring 8 by 4 by 1 inch, and weighs about one pound. The user enters Grade 2 Braille, and the device translates it to standard text. That text can be read aloud and/or stored in Braille 'n Speak's 200K memory. The device offers adaptable features including word processing commands and spell checking, a filing system, a built-in talking clock, talking calendar, talking calculator, and talking stop watch. Braille 'n Speak is available in English, Spanish German, and Italian (Lewis, 1993).

CONCLUSION

It is important that educators recognize the significance of assistive technology devices and software and how they can support instruction and facilitate learning for students with disabilities. It also is imperative that teachers examine educational theories and how they may guide the use of assistive technology in the teaching and learning process. In light of legislative support for providing students with disabilities with assistive technology devices and services, implementation of these devices is likely to increase. Therefore, it is crucial that teachers be trained to use assistive technology devices and software to maximize learning for students with disabilities. Simply providing a teacher or student with an assistive technological device does not guarantee any increase in skill for either party. Integrating assistive technology in any form in the classroom must be done by considering process as well as product, and with an eye toward long range goals for learning outcomes.

FIGURE 1: COMPARISON OF BEHAVIORIST AND CONSTRUCTIVIST PERSPECTIVE

Behaviorist	Constructivist
Teacher-centered	Learner-centered
Teacher as possessor of knowledge	Teacher as member of learning community
Teacher as disseminator of information	Teacher as facilitator and coach
Learning as an individual activity	Learning as a cooperative activity
Emphasis on testing	Emphasis on alternative, authentic or performance-based assessment
Focus on lectures	Focus on discovering and constructing knowledge
Emphasis on rote memorization	Emphasis on application and understanding

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Source: International Journal of Instructional Media, 2000, Vol. 27 Issue 4, p393, 9p
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