# Multimedia: Enhancing Instruction for Students with Learning Disabilities

Cheryl A. Wissick

**Abstract**

This article includes an introduction to the terminology and different types of formats of current multimedia technologies. Integration opportunities and challenges for using multimedia for students with learning disabilities are discussed in the framework of learning environments. Multimedia used as a demonstration station, learning research station, and creation station offers teachers and students possibilities for enchancing the teaching–learning environment.

Due to advances in computer technology and the availability of large storage devices such as CD-ROM drives, numerous educational programs are now published in a multimedia format—the nonlinear or nonsequential presentation of text, graphics, animation, voice, music, slides, movies, or motion video in a single system that involves the user as an active participant. Some multimedia programs serve as a multisensory database of information; others create realistic simulations for content learning. Students with learning disabilities will not benefit from these programs, even with the programs' options for multisensory input and output, without a knowledgeable teacher who can facilitate the instruction. Teachers are challenged to understand multimedia terminology, to become knowledgeable about multimedia technology demands related to the hardware and software, and to create uses for multimedia to enhance the learning environment.

Multimedia terminology is problematic because definitions often vary and the jargon is technical in nature. Multimedia programs have also been described as those that use interactive videodisc, hypertext, hypermedia, or integrated media. The Cognition and Technology Group at Vanderbilt University (1993b) prefers the term *integrated media* (IM) because IM stresses the need to integrate the media, not just present multiple media. Other researchers use *hypermedia* because it implies that the media can be accessed in a nonlinear manner. The term *hypertext* indicates the nonlinear access of text alone. *Interactive videodisc* programs use the combination of the computer for text and graphics with the videodisc to show high-quality photographs or motion video. The videodisc images are usually shown on a separate television monitor, with the text appearing on the computer screen. Some programs incorporate a small window on the computer screen to show the videodisc image. The majority of commercial programs are advertised as "multimedia," "in multimedia format," or having a "multimedia interface." In this article, the term *multimedia* will be used, emphasizing both the multiple use of media and nonlinear access by the user.

To learn the specifics of multimedia technology, teachers can seek out other multimedia users, attend conferences, contact computer coordinators, enroll in classes, or even ask for assistance on the Internet (see Note). Although this takes time and effort, teachers encounter an even greater challenge when adapting this technology for students with learning disabilities. With few specific examples of multimedia use by students with learning disabilities found in the literature, teachers can have difficulty determining which multimedia programs and design aspects will assist or hinder their students.

The purpose of this article is to examine the literature for examples of multimedia use within specific classroom learning environments and relate those applications to students with learning disabilities. For each classroom situation, I will discuss opportunities for students with learning disabilities and the particular challenges teachers would encounter.

## Multimedia Applications Within Learning Environments

Teachers can select multimedia programs to apply in different learning environments: as a teaching and demonstration tool, as an individual learning station or tutor, or as a small group

JOURNAL OF LEARNING DISABILITIES
VOLUME 29, NUMBER 5, SEPTEMBER 1996
PAGES 494–503

creation station where multimedia becomes the tutee (Taylor, 1980). In developing lessons that use multimedia, the integration process can be facilitated if teachers envision in what part of the lesson they will use the technology. The use of multimedia in each of the three learning environments can also be associated with specific teaching events or parts of a lesson (see Figure 1).

By following a model such as Gagné and Briggs's (1979), the teacher could demonstrate or teach with multimedia to gain attention, inform students of the objectives, stimulate recall of prerequisite information, or present important content. Similarly, in applying Hunter's (1982) model of multimedia as an individual learning research station or tutor, the teacher checks student comprehension, provides guided or independent practice, or relates a summarizing activity. The choice to use multimedia as a creation station indicates that the teacher is in the final instructional stages of a lesson and is continuing independent practice, assessing the learning, and providing experiences for transfer.

Given the small amount of time teachers have to learn new programs and adapt the technology, they need to make choices regarding the most effective way to begin the process of technology integration and ways to expand. Teachers also need to envision ways that multimedia can change the way they teach and structure their classroom. Many multimedia projects begin with the student as creator, using multimedia as the tutee (D'Ignazio, 1994; M. L. Miller, personal communication, June 17, 1994; Snyder, 1993). The focus on student as creator and teacher as mediator assists in breaking the mode of traditional teaching. However, will that be the most advantageous way to begin multimedia if no teacher in the school knows how to author or create his or her own multimedia programs? Teachers without a technology background can opt to integrate multimedia as only a demonstration station or tool, later allowing students to use the tools in the learning and research station. As both teachers and students gain skills in the technology, the use of multimedia as a creation station will emerge.

### *Multimedia as a Tool*

The use of multimedia as a tool can increase the teacher's productivity and effectiveness at demonstrating subject

| | Instructional Events (Gagne' & Briggs, 1979) | Instructional Stages (Hunter, 1982) | Instructional Elements (Malouf, Jamison, Kercher, & Carlucci, 1991) |
|---|---|---|---|
| **Tool** Presentation Station | • Gain attention<br>• Inform the students of the objectives<br>• Stimulate recall of Prerequisite information<br>• Present the important content | • Anticipatory set - readiness for learning<br>• Objectives & purpose<br>• Teaching the lesson | • Warm-up<br>• Introductory activity<br>• Developmental activity |
| **Tutor** Learning Station | • Provide learning guidance<br>• Elicit performance or practice<br>• Provide feedback to students<br>• Assess performance | • Checking comprehension<br>• Guided practice<br>• Independent practice<br>• Summarizing activities | • Developmental activity<br>• Guided practice<br>• Independent practice<br>• Assessment |
| **Tutee** Research Station | • Elicit performance or practice<br>• Assess performance<br>• Enhance retention & transfer | • Independent practice<br>• Summarizing activities<br>• Extension activities | • Independent practice<br>• Assessment |

**FIGURE 1.** Instructional uses for multimedia.

matter to the whole class or facilitating group interaction. Teachers and students alike can use multimedia presentations to enhance any subject matter demonstration, lecture, or report. Animation, still-frame video, full-motion video, and high-quality audio can supplement lesson materials to make learning situations realistic.

Teachers have been using multiple media (e.g., slides, films, videotape) to augment their lessons for years. Multimedia offers the capability for combining several media into one unit that can be used interactively, rather than a single-medium, preprogrammed manner, such as with slides or videotapes. In addition, videodisc technology gives the teacher rapid random access to the video-based material and provides high-quality still-frame presentation not generally available with videotape. Using multimedia as a tool, teachers can focus on gaining the students' attention, providing objectives or the anticipatory set, conducting warm-up introductory activities, and then presenting the important concepts (see Figure 1).

**Instructional Opportunities.** Multimedia presentations using videodiscs or multimedia programs can motivate students by enlivening content material with dynamic visual representations of concepts or events. Previously seen and discussed concepts can be connected to new material, thereby stimulating recall of prerequisite knowledge. The connections may be programmed before class time by the teacher and then controlled by use of a computer attached to the videodisc player. If a teacher wants a less technical presentation format without worrying about computer controls or cables, a videodisc player can be accessed with a remote control. A bar code reader can also be used if commercial guides to the videodisc are available with the codes for each frame or motion sequence. The teacher can also develop and print specific bar codes with a special program. In either case, if a particular video segment is desired, the teacher simply scans the bar code that corresponds to that sequence. Each of these devices—bar code, remote control, or computer—provides both teachers and students with varying levels of control and interactivity for instruction.

Teachers can access videodisc-based courses for direct instruction of concepts in a particular content area. Research on math and science videodisc courses has indicated that students, both with and without learning disabilities, who received the videodisc instruction learned significantly more than the students in traditional programs (Engelmann & Carnine, 1989; Woodward & Gersten, 1992). Teachers found the programs manageable and accommodating to the instructional techniques they incorporated, such as frequent feedback, opportunities to answer, and high engaged time. In another study, measuring the Mastering Fractions (1985) videodisc program, Bottage and Hasselbring (1993a) indicated that remedial students' scores were comparable to those of their prealgebra peers on a test of fractions computation. However, the prealgebra peers were still significantly superior in their ability to complete word problems. The results indicate that the program is effective for basic skills but must be paired with contextual examples to assist students in transfer to real-life situations.

Powerful multimedia tools for presentation are ones that are based on stories (McLellan, 1993), because the story presents a familiar information structure. Using specially produced videodiscs, or videodisc versions of feature films, teachers can "anchor" the instruction by providing students with problem-rich situations in a story format. With multimedia comes the opportunity to go beyond direct instruction to provide generative learning environments in which students have a chance for an apprenticeship and to learn how to solve the type of multistep problems that occur in real life (Cognition and Technology Group, 1991). The possibilities multimedia affords to embed basic skill practice within realistic situations provides teachers the opportunity to improve their instruction by giving students with learning disabilities functional life skills. For example, the Cognition and Technology Group at Vanderbilt University produced a series of videodiscs that situate instruction in meaningful narrative contexts that allow students to explore and generate both problems and solutions. The Adventures of Jasper Woodbury (1992) series focuses on mathematical problem solving and provides an example of the interdisciplinary nature of multimedia. Situations that Jasper and his friends encounter, such as recycling cans, are related to activities in math, science, and social studies.

Research on the 1990–1991 implementation of the Jasper series in schools indicated that the Jasper groups performed better than the controls in areas of attitude, problem solving, math facts, and standardized test scores (Pellegrino et al., 1992). Only 16 students with learning disabilities participated in this research; individual data on these students are not available. However, Bottage and Hasselbring (1993a) compared the use of video or contextual-based instruction, similar to Jasper Woodbury, to specific instruction in word problems; remedial students were then tested in both contexts. Both groups did equally well on the word problems, but the video-context group scored significantly higher than the word-problem group on the video context problem. Thus the video context seemed to facilitate the students' ability to interpret data in a video context and also in a word context. Many students with learning disabilities are placed in remedial classes and probably function at a level similar to that of the students in this study. Therefore, we could conclude that the use of the video context would assist in transferring knowledge to a variety of situations.

Teachers who do not have access to the Jasper series can adapt feature films, such as *Raiders of the Lost Ark* (1981) or *Star Wars* (1977), to provide motivating lessons for various subjects (Sherwood et al., 1987). Using video-based material, teachers mediate the instruction by arranging the environment so that learners are exposed to specific situations and experiences. Teachers use these visual demonstrations to help students with learning disabilities distinguish important information from incidental, and connect past experiences to the present situation (Hasselbring, Goin, & Wissick, 1989).

Teachers can also use the videodisc as a book with 50,000 pictures (Bull & Cochran, 1987). Any picture in the book can be accessed within about 3 seconds to provide visual images for the content material. Together the students and teacher work in the shared context defining language appropriate to the situation (Bull, Cochran, & Snell, 1988). For an interactive environment, students can take control by locating images they think are appropriate for the lesson or that they will then describe using appropriate language. The vivid visual nature of the activity may stimulate communication and language for students with learning disabilities.

The Windows on Science Programs (1993) have been marketed for teacher presentation and are now packaged with bar codes included in the teachers' manuals. Companies such as Josten's Learning that previously developed programs only for integrated learning labs are now developing teacher presentation stations. Teachers can also use examples from commercial programs to introduce a lesson. For example, in a social studies class studying the South and the Civil War, the teacher might use visuals of Charleston from the interactive program Hurricane Hugo (1990), whereby students could view videodisc-based photographs of Charleston and imagine how the city has changed since the Civil War. In addition, predictions could be made of the effects of the hurricane, then the video would reinforce any predictions.

Multimedia as a tool should not be viewed only as a large class-lecture situation but as any size group working with the teacher. Work has also been done with young children using video-based instruction (Sharp et al., 1993). In small-group settings, children at risk and not at risk worked in either a video context, watching a story on video, or a storybook context, listening to the story with still pictures. All students in the video context performed better than those in the storybook context in answering literal and inferential questions. However, the at-risk students in the video group did not spontaneously generalize the information to other related but nonvideo information. In a subsequent study, students did not achieve a high rate of comprehension from the video alone, emphasizing the need for continuous interaction with the environment.

**Instructional Challenges.** In developing multimedia demonstrations, it is crucial that the teacher consider the format, anticipate students' responses, and plan for high rates of interaction. Multimedia can enhance a lesson by providing appropriate video to illustrate specific information. However, multimedia should not be viewed simply as a vehicle for delivering instruction that is based on current teaching models (Ulmer, 1990). We must use multimedia to progress beyond the lecture format. The developer of the presentation or group activity must anticipate reactions to the material in order to incorporate effective links between related topics that then provide the additional information.

Authoring, or presentation, systems—software that allows the creation of multimedia—provide teachers with the tools to create individual lessons without having to learn a complete programming language. Nevertheless, learning the authoring software and creating the application can take time. In addition to designing the initial concepts for instruction, the teacher is required to organize the information, create the text, design graphics, and create the final links. Teachers must balance the amount of time necessary for creating quality educational multimedia with the extent to which it will be used by students and other teachers. A solution to creating a completely new program from scratch is to use templates, or shells, which are frameworks for the organization of the material and that include all the essential programming. Templates allow teachers to create individual programs and modify the text or video for their students without performing the complex programming (Boone & Higgins, 1991; Cognition and Technology Group, 1994; Wissick, Foelber, & Berdel 1989).

Authoring systems also provide the teacher with the tools to "repurpose," or design a new purpose for, commercial video. Feature films and commercial videodiscs (e.g., A World Alive, 1991; BioSci, 1992; National Gallery of Art, 1983; Regard for the Plant [Garanger, 1989]; Salamandre: Chateaux of the Loire Valley, 1988) offer numerous possibilities for creating units that are viable in more than one curriculum area. As photographers and state libraries or archives continue to document their accumulation of slides on such technology formats as videodisc or CD-ROM, the possibilities for classroom use increase. Nevertheless, the video context research conducted with young children (Sharp et al., 1993) indicates that teachers cannot show video without describing and discussing the context in a purposeful dialogue. The video context needs to be presented as a source of information that can be referred to again for a review of information.

Concerns about the hardware prompt teachers and administrators to create innovative solutions. Using a videodisc player with a large-screen monitor is usually sufficient for whole class teaching; however, when both a computer and a videodisc image must be displayed to a large group, then additional projection devices must be available. CD-ROM programs with motion video may need to be used with a high-quality large-screen projection device for students with learning disabilities to interpret the message in the video. Teachers who teach in several classrooms also need to consider the portability of their multimedia presentation equipment, because current costs prohibit equipping all classrooms with this technology.

In summary, the use of multimedia programs with vivid visual representations have shown to be an effective tool for presenting content and assisting transfer of learning to new situations. However, with students who are labeled at risk, remedial, or learning disabled, teacher-directed multimedia lessons on specific skills will not necessarily assist the transfer of learning to real-life situations without meaningful dialogue and activities related to that context. Teachers can assist students in making connections when facilitating large- or small-group interactions. When moving from the use of multimedia as a tool to its use as a tutor, teachers must consider the connections, or "misconnections," that students might make.

## *Multimedia as Tutor*

After a teacher introduces the content of a lesson, she or he provides learning guidance by offering guided and independent practice, eliciting performance, and providing feedback on performance (see Figure 1). At this point in the instructional process, multimedia acts as a tutor or learning station. Programs that typically provide learning guidance (e.g., computer-based instruction, or CBI) are often categorized as (a) drill and practice, (b) tutorial, or (c) simulation. After conducting a meta-analysis on 63 studies that used interactive video instruction, McNeil and Nelson (1991) indicated that the use of multimedia with videotape or videodisc allowed the developers to simultaneously incorporate aspects of drill and practice, tutorial, simulation, and sensory motor skills guidance into one program. The average overall effect size for interactive video in their study was positive as well as slightly higher than those previously reported for computer-assisted instruction without the interactive video enhancements. The ability of multimedia or interactive video to depict real-life situations with applications for a variety of instructional outcomes (i.e., practice of facts, psychomotor skills, application of rules/principles, problem solving) at varying levels might account for this difference between interactive video and computer-assisted instruction.

**Instructional Opportunities.** Students are motivated by these realistic ("you are there") features of multimedia. Simulations based on fantasy or popular feature films provide students with continued enjoyment when they can view and interact with their favorite scenes (Wissick et al., 1989). Students also find incentive to interact if simulations are based on realistic situations that they might actually encounter. Students' attention is sustained because they can directly manipulate these materials to solve the problems. For students with learning disabilities, the teacher might suggest search strategies and ask specific questions, and then allow the students to explore different paths to locate their answers using multimedia's nonlinear capabilities.

Following teacher or program guidelines, students can explore the program and locate information. To help students record information immediately, teachers should look for programs that incorporate an electronic notepad. Using programs such as The Storyteller (1992) or Hurricane Hugo (1990), students can note any connections they make when they are investigating the programs. McLellan (1992) reported on the development of the Cheyanne Bottoms project, in which students interacted first with guided tours, then storytellers, and finally interactive scenarios. A notebook and toolbox were provided in both structured and unstructured real-world situations.

The Cognition and Technology Center at Vanderbilt (1994) has designed several projects that promote literacy and incorporate the important aspects of multimedia. Using the Peabody Literacy Program, students can speak to a tutor, view videos from a videodisc on important topics, and then read passages about the topic. The students practice reading using the repeated reading, choosing the correct passage from three examples. Students' reading is monitored through a voice recognition system (a component being incorporated into new multimedia computers). This capability allows students to practice independently yet be provided with corrective feedback.

In addition to programs that are specifically designed for learner guidance and practice, programs developed for large-group instruction can be modified for individual student use. Creating a learning or review center with multimedia presentation materials, such as the videodisc-based programs described previously, provides the teacher with additional means to individualize for students who require extra practice or who are absent and miss the introduction to the material. Although students who view a lesson individually might not gain the experience obtained from teacher direction and class interactions, they are nevertheless exposed to the original content presentation. When students are absent, teachers seldom have time to repeat the content presentation for just those students. In this situation, multimedia acts as a teacher's assistant.

Teachers can use multimedia to establish cooperative groups as an instructional strategy for helping students in life skills, such as social learning and group problem solving. Many multimedia programs have been developed that foster cooperative learning groups. For example, Tom Synder Productions develops computer and multimedia programs that provide each student or group of students with a role and specific tasks to accomplish in that role. In contrast, the Adventures of Jasper Woodbury Series creates a context for cooperative learning by allowing students to define their own subproblems and create their own roles in the solution (Cognition and Technology Group, 1993a).

Results of the comparison of cooperative groups versus individuals indicated that students working in groups of two to three attained higher scores than students working individually or in larger groups (Cockayne, 1991). However, students working in groups sometimes take longer to complete tasks than students working individually, due to time needed for discussion and reaching consensus on answers. Students working together can often help each other with program control and problem solving that they might not have as individuals. An additional benefit of cooperative groups is that they lend themselves to students' working creatively to enhance retention and transfer. Research with cooperative groups of mixed ability levels, such as those including students with learning disabilities, provides insight for teachers on how to structure and manage groups when using multimedia to facilitate instruction.

Repman, Weller, and Lan (1993) indicated that high-ability eighth graders working in mixed ability groups scored dramatically lower than high-ability students working individually or those working in homogeneous pairs. Low-ability students working in either homogenous or mixed pairs scored higher than students working individually on a multimedia ethics program. Signer (1992) observed the use of an interactive video program with fourth and fifth graders. She noted that in dyads of high- and low-ability students, the high-ability students frequently took control of the keyboard. In studies such as these, although not specifically labeled, students with learning disabilities would have been considered part of the low-ability group. Apparently low-ability students benefit from either homogeneous or heterogeneous cooperative groups. Low-ability students may work better with another low-ability pair, rather than with a high-ability student who monopolizes the computer. The teacher would need to assign students to groups carefully, making sure that the achievement of the high-ability students does not decline as a result of a mixed pairing.

Multimedia that enhances regular basal text has had a positive impact on the reading progress of low-achieving students in kindergarten through third grade (Boone & Higgins, 1993). A 3-year study was conducted to analyze the effects (a) of each year and (b) longitudinally. The first year, significant improvement was noted for both the whole class and the low-ability groups. For the second year, although whole class differences between the control and experimental groups were not significant, the lower ability students outperformed their control counterparts. In the third year, significant improvement was noted only with low-ability students in groups for kindergarten. Unfortunately, in the third year of this project, the control classes were contaminated by students who had been in experimental groups the previous years. The multimedia enhancements assisted students' ability to gain reading comprehension and decoding skills independently.

Multimedia can also offer a large database of information from text, visual, motion video, and aural sources. After reviewing several multimedia programs, Wilson and Tally (1991) described the database as the basic component of multimedia discovery-oriented programs. Using this database, the student has different means of accessing the information and various tools for manipulating the data. Many programs on CD-ROM exploit the ability to mass large amounts of text via data links. Encyclopedias in text format have been used as a database of information for years, and now these tools are available in multimedia format. Edyburn (1991) studied the fact retrieval skills of students with and without learning handicaps using different database mediums and found that students performed better when they were assigned tasks as opposed to self-selecting tasks. They also used menu-driven programs more efficiently than those with the possibility of open searching. Thus, the format for searching the database is crucial if students with learning disabilities are required to access this type of learning and research station independently. To use databases that rely on the user to provide commands for searching, students with learning disabilities will need to have specific training on the prerequisite searching skills.

The use of learning stations is most prevalent in schools with integrated learning systems. D'Ignazio (1994) reported that students favor integrated learning systems because they are more interactive than a lecture setting with teachers. With computer-managed programs, teachers need to monitor program levels or activities so that students who have difficulty with the basic skills are not forced to remain on a level that hinders higher order thinking skills. These programs have management features that allow students to progress at their own pace. However, teachers of students with learning disabilities must, again, look carefully at the programs and match their students' learning styles to the appropriate levels or activities.

**Instructional Challenges.** Students without prior knowledge, such as students with learning disabilities, will need to be guided by the teacher or the multimedia program or be given only small amounts of individual control in the use of multimedia (Gay, 1986; Hooper & Hannafin, 1988; Kinzie, Sullivan, & Berdel, 1988; Locatis, Letourneau, & Banvard, 1990; Morrison, Ross, & Baldwin, 1992), until they reach such a level of proficiency that they can access the options for navigation and assistance independently. Teachers also need to examine programs for the links that they allow or encourage. Teachers and designers should be consistent with screen design by using color or patterns to denote changes in levels, or using sound to cue links. Many programs use icons to depict the main menu selections. Teachers may need to teach some students with LD how to use the icons and offer strategies for remembering the icon representations.

When presenting content to a larger group, the teacher needs to have access to only one station; however, several stations might be needed if individual students are to use multimedia programs for learning guidance. Cooperative groups working at a station can reduce the need for equipment.

Assessment of student learning with multimedia is another concern. If students are accessing multimedia, with its rich audio and visual component, in a nonlinear manner, should they be evaluated with paper-and-pencil memorization questions? Two questions are being asked by researchers and developers interested in authentic assessment: First, is student evaluation being conducted in the same format as learning is occurring? Second, are innovative evaluation techniques required if students are assessed on more than just factual knowledge? Without alternative assessments, teachers will not be aware of the related information that students are learning incidentally. If schools really want to prepare students for lifelong learning and help them acquire the ability to transfer skills to real situations, then assessment methods need to change (Bottage & Hasselbring, 1993b; Pellegrino et al., 1992).

In summary, teachers can employ multimedia when they want to guide students' learning and create social situations that promote lifelong learning. Teachers do have to examine programs carefully and structure the learning environment to maximize the use of multimedia by students with learning disabilities. Cooperative learning groups can assist students in learning group problem-solving skills only if teachers effectively monitor the groups, along with individual achievement and affect. Programs that incorporate verbal feedback to the students, allowing all portions of text found in the program to be read, will be more beneficial than programs that allow only direction screens to be read. With the expanding capabilities of computer hardware, it will be easier to incorporate voice recognition systems into multimedia programs, thus offering students with disabilities corrective feedback on their reading responses. Then, as students become proficient in using multimedia programs, they will probably want to create their own products rather than using commercial materials.

## *Multimedia as Tutee*

As a creation station, multimedia becomes the tutee (Taylor, 1980), and the student is now in charge of the teaching and learning. In this way, the teacher gains valuable information about how the student has processed and synthesized information about a topic. Although the teacher can provide independent practice, assess performance, and promote activities that enhance retention and transfer (see Figure 1), unless students have the ability to transfer information to new situations, knowledge remains inert (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). The students can use the computer to create their own reports, thus becoming the researcher, designer, developer, and, finally, the producer.

**Instructional Opportunities.** D'Ignazio (1989) described students and teachers as multimedia explorers, willing to take risks, make mistakes, and improvise. Students experience self-efficacy because they make personal choices about their projects and even act as producers and developers for teachers who have little time to devote to developing multimedia lectures. Students then learn how to interact with teachers as clients and develop products according to their client's outline or specifications.

When multimedia is used as a creation station, the *process,* rather than the product, becomes important (Bull & Cochran, 1991; D'Ignazio, 1994); this shift of focus forces the teacher to assess learning differently. Critical to the use of multimedia is the emphasis on the processes of creating, problem solving, and decision making. Students working together to coordinate video, audio, text, and presentation order are engaged in problem solving beyond just one solution to a problem. They must choose and create the links, pictures, or definitions for concepts that they consider important to the overall project. With CDs, videodiscs, slides, and tapes, students doing research have access to original information on events in history. If students want to relate past information with a relevant current situation, or with people in their community, they can produce their own photographs or videos to be added to the report. After students conduct in-depth research on specific topics and develop multimedia reports to present the material, they might become the experts in their class—and possibly the school—on that topic (Cognition and Technology Group, 1991, 1994). The implications for the self-esteem of students with learning disabilities, a group traditionally lacking in this area, are obvious.

Turner and Dipinto (1992) used descriptive data to document the creation of multimedia reports on mammals in science. Thirty-seven seventh graders in a kindergarten-through-eighth-grade university school worked in pairs for 35 minutes twice a week for 8 weeks. The researchers used observations, interviews, reflections, and analyses of student stacks for content and links to evaluate the overall project. All students were able to learn enough Hypercard (a multimedia authoring program) to complete a computer report within the 8 weeks. The teacher reported that she lost about 6 weeks in the curriculum completing the unit but that by spring was only 3 days behind the previous year. She felt that the work done with Hypercard allowed the students to synthesize the materials better so that subsequent units were covered more quickly than in previous years.

Technology projects with students as creators have been described in the literature and in popular technology magazines (Cognition and Technology Group, 1994; Snyder, 1993; Thorpe, 1993). Preliminary results from a similar technology integration project in process in the Rochester (NY) City Schools indicates that comparable results are possible with at-risk students (M. L. Miller, personal communication, June 17, 1994). The underlying goals for the project included getting the students to come to class, remain on task, and make connections in the curriculum. A group of at-risk 10th graders created multimedia presentations on global studies. The teachers worked together to create an integrated curriculum with a thematic unit focused on "Balance and Stability in a Changing World." They used a multimedia authoring program to combine information and report on facts gained in social studies, science, math, and English regarding a particular country. The students related their final projects to their global studies exam and accessed specific facts with the multimedia program MacGlobe (1992). The students worked on their reports during activity time, at lunch, and after school. They were held accountable to complete the project on time and present it to the class. Observations indicated that the students created connections between the factual information that they were learning in each of their content classes.

**Instructional Challenges.** As with any learning activity, teachers must guide the learning and creative processes of students producing multimedia projects. The projects reported earlier indicate that students achieved academic success when teachers committed to integrating technology into their curriculum. The science teacher who worked with Turner and Dipinto (1992) demonstrated that the original time to work on the material provided advanced understanding later. Unfortunately, many teachers and administrators are not willing to consider the year's long-range goals, or even lifelong learning. In the Rochester Project, as with many projects, a facilitator was assigned to work with the teachers on curriculum and technology and with the students on learning the authoring package and completing the projects. Will a greater gap exist in our schools if some students are not provided opportunities for multimedia creation because their teachers do not have sufficient training to implement this type of project, or their school does not have a technology facilitator?

When multimedia projects are completed, teachers must remember to separate content from production quality and to value the students' information over the production effects. Huntley (1991) warned that the danger in multimedia is a heightened preoccupation with style, appearance, and effect at the expense of intellectual content and emotional depth. Both teachers and students should be aware of the glitz and fancy wrappings of a multimedia report. If teachers or students become absorbed by the media or the authoring system, then they frequently spend too much time on the graphic details or isolated parts of text. Students also have to learn to be ethical producers concerning copyright laws. For example, Truett (1994), reporting on the use of CD-ROM and videodisc technology among media specialists in North Carolina, cited an increase in plagiarism. With easy access to original sources and to capturing and copying data, students have to understand what constitutes ethical use and cite their sources accordingly.

Once students complete their multimedia projects, teachers must develop clearly defined criteria for evaluating the products. Multimedia projects and research do not lend themselves to simple assessments with right and wrong answers. Teachers have to gain expertise in evaluating projects that might have outstanding content but poor design and presentation quality, versus projects with fancy graphics, color, animation, and other effects but insubstantial content. In an effort to evaluate the outcomes of learning with multimedia, teachers can ask students to create portfolios of their work, which provide teachers with a progression of skills throughout the year. With the importance placed on process, then teachers can have students maintain logs, or journals, of their work in which they can record insights about the content material and comments about the process of working cooperatively with other students. Although portfolios and multimedia reports might not provide the exact scores that achievement tests do, they provide students with skills that they will use in lifelong learning.

## Conclusions

Multimedia provides teachers and students with a powerful tool to access a combination of media for enhancement of instructional events and learning. Furthermore, multimedia provides the learner with a nonsequential means to interact with a combination of media, thereby increasing motivation, maintaining attention, stimulating cognition, and illustrating content or facts. With multimedia, teachers, students, administrators, and teacher educators have new potential to change the way schools are structured and the way they teach and learn.

How will multimedia affect or enhance instruction for students with learning disabilities?

- Multimedia has the potential to enhance instruction at all levels of instruction when sound instructional principles are applied to the selection of programs, but teachers must integrate it into instruction as a tool, instead of just a supplement to the curriculum.
- Instructional designers and developers must go beyond the traditional models for instruction that have driven technology development in

the past. Developers should be encouraged to create templates for teachers, allowing them to incorporate their own text, graphics, and video into advanced programs without dealing with the details of programming.

- Multimedia programs need to be developed for use with different hardware configurations, allowing teachers who do not have all the hardware access to certain aspects of the programs as they build on their configurations.
- Teachers and students must be aware of the "big picture," or the overall goals of the lesson, so they are not swept away by the glitz and attend only to the production and not the content.
- Possibly the greatest potential of multimedia is that it allows teachers to create environments where students can be researchers and creators of products for reports, becoming experts in certain subjects.

The full potential of multimedia applications has not been realized. Teachers and students must continue to use multimedia to perform feats previously thought impossible, instead of applying multimedia to current traditions. Although the effects will not be noticed for several years, teachers and students must continue to use this new technology to reach new levels of invention and integration.

**ABOUT THE AUTHOR**

***Cheryl A. Wissick*** *is director of the Educational Technology Center and an associate professor in programs in special education in the College of Education at the University of South Carolina. Her research interests include using multimedia for students with disabilities and assisting faculty to integrate multimedia into their teaching. She is involved in the development of an interactive videodisc project that provides preservice teachers in regular and special education with anchored instruction on the characteristics of students with learning disabilities. Address: Cheryl A. Wissick, 274 Wardlaw, University of South Carolina, Columbia, SC 29208. Internet: CherylW@ed.sc.edu. World Wide Web: http://www.ed.sc.edu/can/bio.html*

**NOTE**

*A growing resource for multimedia can be found on the electronic highway. Some teachers have direct access to list services on the Internet. For others who need access to information on special education and multimedia, NCIPnet would a resource. NCIPnet is the network of the National Center to Improve Practice, a project funded by the Office of Special Education Programs, U.S. Department of Education. NCIP's mission is to expand and improve the ways in which technology is used with students with disabilities. Users of NCIPnet are those interested in conversing about issues related to technology and special education. With the support of a network facilitator, participants converse about effective practice, share information and resources, and help each other solve problems. Topics that have recently been explored online are multimedia, technology for visual impairment, and inclusion. For more information on NCIPnet, contact Denise Ethier, Network Coordinator, 617/969-7100, x2422, or 617/969-4529 (TTY).*

**REFERENCES**

A World Alive [computer software]. (1991). Santa Monica, CA: Voyager Co.

Adventures of Jasper Woodbury [computer software]. (1992). Warren, NJ: Optical Data.

BioSci [computer software]. (1992) Seattle, WA: Videodiscovery.

Boone, R., & Higgins, K. (1991). Hypertext/hypermedia information presentation: Developing a hypercard template. *Educational Technology, 31*(2), 21–30.

Boone, R., & Higgins, K. (1993). Hypermedia basal readers: Three years of school-based research. *Journal of Special Education Technology, 12,* 86–106.

Bottage, B. A., & Hasselbring, T. S. (1993a). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents in remedial math classes. *Exceptional Children, 59,* 556–566.

Bottage, B. A., & Hasselbring, T. S. (1993b). Taking word problems off the page. *Educational Leadership, 50*(7), 36–38.

Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 115–141). Hillsdale, NJ: Erlbaum.

Bull, G. L., & Cochran, P. S. (1987). A book with 50,000 pictures: Logo and videodiscs. In T. Lough & G. Bull (Eds.), *Conference proceedings East Coast Logo exchange* (pp. 34–38). Arlington, VA: Meckler.

Bull, G. L., & Cochran, P. S. (1991). Learner-based tools. *The Computing Teacher, 18*(7), 50–53.

Bull, G. L., Cochran, P. S., & Snell, M. E. (1988). Beyond CAI: Computers, language, and persons with mental retardation. *Topics in Language Disorders, 8*(4), 55–76.

Cockayne, S. (1991). Effects of small group sizes on learning with interactive videodisc. *Educational Technology, 31*(3), 43–45.

Cognition and Technology Group at Vanderbilt University. (1991). Technology and the design of generative learning environments. *Educational Technology, 31*(5), 34–40.

Cognition and Technology Group at Vanderbilt University. (1993a). Designing learning environments that support thinking: The Jasper series as a case study. In T. M. Duffy, J. Lowyck, & D. H. Jonassen (Eds.), *Designing environments for constructive learning* (pp. 9–36). Washington, DC: Nato ASI Series.

Cognition and Technology Group at Vanderbilt University. (1993b). Integrated media: Toward a theoretical framework for utilizing their potential. *Journal of Special Education Technology, 12,* 71–85.

Cognition and Technology Group at Vanderbilt University. (1994). Multimedia environments for developing literacy in at-risk students. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 23–56). San Francisco: Jossey-Bass.

D'Ignazio, F. (1989). Welcome to the multimedia sandbox. *The Computing Teacher, 17*(1), 27–28.

D'Ignazio, F. (1994). Teachers' jobs: Opportunities for change and growth. *The Computing Teacher, 21,* 52–53.

Edyburn, D. L. (1991). Fact retrieval by students with and without learning handicaps using print and electronic encyclopedias. *Journal of Special Education Technology, 11,* 75–90.

Engelmann, S., & Carnine, D. (1989). Supporting teachers and students in math and science education through videodisc courses. *Educational Technology, 29*(8), 46–50.

Gagné, R. M., & Briggs, L. J. (1979). *Principles of instructional design* (2nd ed.). New York: Holt, Rinehart & Winston.

Garanger, M. (1989). Regard for the Planet [computer software]. Santa Monica, CA: Voyager.

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 heterogenous 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.