A Review of the Capstone Interactive Library and the Effect of Multi-media Presentation on Instruction for Special Populations

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Executive Summary

“...learners can better understand an explanation when it is presented in words and pictures than when it is presented in words alone.”

An instructional message is a communication that is intended to foster learning. In presenting an instructional message to learners, designers have two main formats available – words and pictures. Words include speech and printed text; pictures include static graphics (such as illustrations and photos) and dynamic graphics (such as animation and video). For hundreds of years, the major format for presenting instructional messages has been words, including lectures and books. In short, verbal modes of presentation have dominated the method in which we convey explanations to one another and verbal (oral) learning has dominated education.

Multimedia refers to the presentation of material using words and pictures. The case for multimedia rests in the premise that learners can better understand an explanation when it is presented in words and pictures than when it is presented in words alone. Multimedia messages can be described in terms of the delivery media (e.g., amplified speaker and computer screen), presentation mode, (e.g., words and pictures), or sensory modalities (e.g., auditory and visual). The process of multimedia learning can be viewed as information acquisition (in which multimedia messages are information delivery vehicles) or as knowledge construction (in which multimedia vehicles are aids to enhancing the senses).

The major format for presenting instructional material has been verbal. The rationale for multimedia presentations, that is, presenting materials in words and pictures, is that it takes advantage of the full capacity of humans for processing information. When material is presented only in the verbal mode, the potential contribution of the human capacity to also process material in the visual mode is ignored (Mayer 2001).

The use of multimedia presentations in the kindergarten through twelfth grade educational environment may have significant ramifications for special populations. Individuals of all ages who are diagnosed with specific learning disabilities, autism, dyslexia, and hearing impairment may benefit from a multimedia learning environment. In addition, there is emerging evidence that English as a Second Language (ESL) learners may also benefit from this type of instruction.
“Interactive/multi-media is the only consistent format that ensures every learning style can be presented on demand and this ensures the best learning experience can be achieved consistently.”

Potter (2009) in one of his Capstone Interactive Library Study responses notes:

“Multimedia is transforming the special learner environment. Interactive and engaging technology can allow the special learner to take control of their experiences, which is empowering. Customization of the special learner experience during a multi-media/interactive engagement builds trust between the program and user. When trust is established, a deeper sense of commitment is obtained and will allow the user a prime opportunity to learn. Interactive/multi-media is the only consistent format that ensures every learning style can be presented on demand and this ensures the best learning experience can be achieved consistently.”

The America Reads Challenge of the Clinton Administration indicated that about 17% of school-age children are considered poor readers, and millions of children enter school each year without adequate prereading skills. Varied instructional strategies are even more critical for children from families with a history of poor reading, and appropriate reading interventions can compensate to a degree for the lack of exposure to print and for low levels of parental literacy and laptop reading (Lewis 1997).

Levy (2008) concludes that, given that many young children now enter their early years in education as competent and frequent users of digital technology, schools need to identify ways in which to capitalize on the use of multimedia in order to promote confidence and skills in young readers today.

The Capstone Interactive Library capitalizes on the use of multimedia, providing a great interactive resource to be used by teachers, parents, and students to enhance reading and reading comprehension levels.

Figure 1: The Capstone Interactive Library – Welcome Page
“Colorful, eye-catching, stimulating, and inviting, the Capstone Interactive Library is a comprehensive and engaging site to explore. The variety of books in the 206–title library is impressive.”

“... the use of sound, highlighting, and colorful screens help to stimulate several senses which enhances learning.”

Review of the research literature related to multimedia supports many of the design features and content of the Capstone Interactive Library. The library fully integrates the premise that learners can better understand an explanation when it is presented in words and pictures than when it is presented in words alone (Mayer 2001).

Colorful, eye-catching, stimulating, and inviting, the Capstone Interactive Library is a comprehensive and engaging site to explore. The variety of books in the 206–title library is impressive.

Figure 2: The library includes 206 titles of high interest materials on a variety of topics.

Because most children, even special needs children, spend a lot of their time playing electronic games, the use of sound, highlighting, and colorful screens help to stimulate several senses which enhances learning. Users will find that the library will definitely get a child’s attention. A multimedia delivery system for classroom utilization not only effectively engages the students; it also stimulates the teacher as well (Wise and Groom 1996).

The Capstone Interactive Library provides a selection of electronic books that range from the feel of a comic book as illustrated by A Crash Course in Forces & Motion to the more traditional look and feel of a children’s book such as Chicken Little.
Research-based concepts are integrated throughout the library. All of the books utilize **highlighting**.

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**Figure 3:** A Crash Course in Forces & Motion is presented in comic book format.

**Figure 4:** Chicken Little is presented in a more traditional format for younger readers.

**Figure 5:** Words are highlighted as the reader follows the text in Being Active.
“Combining strategies such as highlighting, magnification and audio provides a powerful learning tool for poor readers, particularly special needs students.”

Users have the option of the audio “read to” which allows the reader to have the text read to him or her. However, readers can go through the content without narration if they so choose.

Several selections (e.g., Fawn Braun’s Big City Blues) include the use of text magnification—the font size of text increases as it is read; decreasing as the narration moves on to the next passage.

Combining strategies such as highlighting, magnification and audio provides a powerful learning tool for poor readers, particularly special needs students.

An important component of the Capstone books is the facility for non-linear navigation. “Back and Next” buttons allow the learner...
to progress through the material in a self-paced fashion. Users have the ability to easily navigate back and forth in order to enhance their comprehension of the material. Most selections have “autoplay” or manual navigation functionality (see Figure 6). This feature further allows the reader to control the learning environment.

While the Capstone Interactive Library’s combination of printed text, narration, words, sounds, music, graphics, photos and animation provide an exciting reading experience for students of all abilities; additional features enhance this flexible learning environment.

Most books include a separate “Fun Facts” section that offer the reader additional information about the topic. Some “Fun Facts” are integrated directly into the storyboard as in Air, Outside, Inside, All Around. Glossaries are included with most books.

Independent learning is encouraged by the inclusion of links to websites related to the book’s topic(s). The sites are accessed through a separate hyperlink located on the page or, in some books such as Handwriting Evidence, by clicking on the Learn More button integrated into the storyboard.
Research supports the premise that multimedia technology offers ways to help English language learners build vocabulary, achieve reading fluency, and improve comprehension. The Capstone Interactive Library offers numerous titles in both English and Spanish.

Language acquisition is supported as readers easily move between the two languages, supported by narration in English and Spanish, highlighting, non-linear navigation, and all of the other functionality of the Capstone Interactive Library.

Language acquisition is supported as learners are able to not only hear the passages in both English and Spanish but are able to view the passages in both languages.
“Understanding occurs when learners are able to build meaningful connections between visual and verbal representations.”

The advent of computer technology has enabled an explosion in the availability of visual ways of presenting material. The case for multimedia learning is based on the idea that instructional messages should be designed in light of how the human mind works. Humans have two information processing systems – one for verbal material and one for visual material. Words and pictures, although qualitatively different, can complement one another and that human understanding occurs when learners are able to mentally integrate visual and verbal representations. Understanding occurs when learners are able to build meaningful connections between visual and verbal representations. In the process of trying to build connections between words and pictures, learners are able to create a deeper understanding than from words or pictures alone. (Mayer 2001).

Sribhagyam and Crooks (2005) note that the human cognitive system consists of two distinct channels for representing and manipulating knowledge: a visual-pictorial channel for processing pictures and an auditory-verbal channel for processing spoken words (Baddeley, 1986, 1999; Paivio, 1986). These channels have their limits for holding and manipulating knowledge (Baddeley, 1986, 1999; Sweller, 1999). Meaningful learning occurs when learners engage in active processing within the channels, including selecting relevant words and pictures, organizing them into coherent pictorial and verbal models, and integrating them with each other and appropriate prior knowledge (Mayer, 1999, 2001). These active learning processes are more likely to occur when corresponding verbal and pictorial representations are in working memory at the same time.

Macaulay (2003) discusses the theoretical background for multimedia instruction:

Multimedia is the notion of using multiple channels of communication to present information. In more computer-oriented terms it can be defined as the combining of text, graphics, animation, pictures, video, and sound to present information under the control of the computer. However, the use of multiple channels to communicate information is not new, particularly in the area of instruction, where effective
“...the people who used computer-based multimedia instruction performed better in terms of test scores, compared to those who received instruction through traditional classroom lectures.”

communication is highly essential. One good example of the use of multiple channels in instruction is imagery mnemonics, in which text and imagery, for instance, are combined to aid the learning of arbitrary, verbatim material, such as dates, or rote series of items with little or no meaning (Cornoldi, 1988). Empirical evidence suggests that imagery mnemonics can be effective in learning a wide range of topics such as mathematics, language skills, history, and scriptures (Paivio, 1971; Royer & Cable, 1976; Higbee, 1988; Bean, 1990; Parker, Brownston & Ruiz, 1993; Svantesson, 1998; Macaulay, 2002). One explanation for the effectiveness of imagery mnemonics is provided through the dual-coding theory (Paivio, 1971, 1986, 1991; Clark & Paivio, 1991), which states that information, in general, is better learned and therefore more easily retrieved if encoded in the memory as both words and imagery. In other words, information is better learned if encoded through multiple channels or senses. To a great extent, this theory is relevant to why multimedia is generally effective in learning.

Besides anecdotes and subjective reports surrounding the effectiveness of multimedia (Samuels, Biesbrock & Terry, 1974; Rigney & Lutz, 1976; Holliday, Brunner & Donais, 1977; Sewell & Moore, 1980; Bosco, 1986; Fletcher, 1989; Hofstetter, 1994), there is empirical evidence that multimedia can enhance the learning of, at least, certain kinds of information. A review by various researchers (Kulik, Kulik, & Cohen, 1980; Kulik, Bangert & Williams, 1983; Kulik, Kulik, & Bangert-Drowns, 1985; Schmidt, Weinstein, Neimic, & Walberg, 1985; Bosco, 1986; Fletcher, 1989; Khalili & Shashaani, 1994) of hundreds of studies that have investigated the effectiveness of multimedia in learning information suggested that the people who used computer-based multimedia instruction performed better in terms of test scores, compared to those who received instruction through traditional classroom lectures. Topics of interests in the studies ranged from languages, chemistry, and biology, to the procedures for the operation of devices. Equally, the context of the studies varied from primary school education, higher education, and industry, to the military. This may imply that the property of multimedia to enhance learning performance is irrespective of subject area or context.

On the other hand, the effectiveness of multimedia in learning has been associated with factors such as knowledge level and aptitude. In one study, Mayer and Gallini (1990) suggested that multimedia improved recall in college students with low prior knowledge of the operation of automobile drum brakes, while it had no apparent effects on the students with high prior knowledge of the same subject. In another study, by Kunz, Drewniak and Schott,
(as cited in Najjar, 1996), college students with low prior knowledge were found to improve their understanding of meteorology when they used pictures with text, while the same treatment had no effects on the performance of the students with high prior knowledge of the subject. Also, in a study to investigate the effects of aptitude on the effectiveness of multimedia, Blake (1977) suggested that students with low aptitude in spatial and mental abilities learned movement patterns better with moving than with static pictures, while the students with high aptitude performed similarly, irrespective of the type of picture.

Other studies (Severin, 1967; Levie & Lentz, 1982; Nugent, 1982; Pezdek, Lehrer, & Simon, 1984; Mayer & Anderson, 1991, 1992; Lai, 1998) have demonstrated the effectiveness of multimedia by more specifically investigating the presentation of information, using various combinations of media types. For example, Mayer and Anderson (1991) suggested that college students who used verbal description simultaneously with animation to learn a procedure performed better than those who used the verbal description or animation only. Equally, Lai (1998) demonstrated the combination of text and static graphics to be effective for concept learning. The findings from some studies (Rigney & Lutz, 1976; Royer & Cable, 1976; Bean, 1990; Macaulay, 2002) that have simply asked people to form mental images of the textual material being studied also have suggested that this sort of usage and combination of media can be effective for learning.

However, there are studies (Severin, 1967; Samuels, 1970), which have suggested that using multiple media to present information does not always result in improved communication of the information. Perhaps what such studies have highlighted more than anything else is that multimedia only promotes learning if used properly. For example, the information presented by the different media types must be related, otherwise one media is likely to work against the effectiveness of the other (Bahrick & Gharrity, 1976; Evans & Denney, 1978; Sewell & Moore, 1980; Levie & Lentz, 1982), for example, by distracting the learner (Samuels, 1970).

Macaulay (2003) goes on to note:

One area in which the use of multimedia is rapidly increasing is children’s education. There are now numerous products available under the new category of “edutainment” that are geared towards making children learn while they are being entertained. Again, this trend is mostly predicated on the assumption that multimedia enhances learning in
“Poor readers tend to utilize pictures to aid them as much as possible in comprehending the text.”

Poor readers tend to utilize pictures to aid them as much as possible in comprehending the text. They use the pictures to help decode the words (Kozma, 1991). Kozma feels that authors must take advantage of the text and pictures to facilitate learning. The use of video makes it easier to learn the same information. The poor reading students will utilize audio signals along with the stream of visual information to assimilate the information more effectively. Kozma reports that the combination of audio and visual signals result in a greater depth of understanding than either alone (Puchalski et al. 1992).

Almekhlafi (2006) discusses the concept of constructivism as it refers to the idea that learners construct knowledge for themselves building upon the foundation of their previous learning.

Constructivism is being applied in different fields, one of which is in technology rich classrooms. Collins (1991) pointed out that technology appeared to be coming down on the side of constructivists, who have been trying to change the prevailing societal view of education. According to Collins, studies show that in technology rich classrooms there are many observable changes as opposed to traditional instruction, some of which are: (a) students are more actively engaged, (b) students learn different things instead of all students learning the same thing, and (c) an integration of both visual and verbal thinking instead of the primacy of verbal thinking. Lebow (1993) described five principles of the application of constructivism on technology. These principles are: (a) provide a context for learning that supports both autonomy and relatedness, (b) embed the reasons for learning into the learning activity itself, (c) support self-regulation through the promotion of skills and attitudes, and (d) strengthen the learner’s
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tendency to engage in intentional learning processes, especially by encouraging the strategic exploration or errors. These changes and principles come side by side with constructivism principles. Bailey (1996) pointed out that new technology, such as the use of multimedia, can afford rich opportunities for constructivist approaches in the field of education.

Lanyil et al (1992) discuss the advantages of multimedia software to develop handicapped people’s skills:
- It is an audiovisual medium.
- It is interactive.
- The treatment or situation can be reproduced; the same condition can be repeated several times.
- The display presentation can be set according to individual need. The size, form, contrast, color, size of line width, etc of the objects and background can be selected for best suiting the user.
- It can be adjusted to individual needs.
- Multimedia systems have an effect on more than one sense and can be more effective.
- One can include “games” in multimedia programs.
- The user feels success.
- One can use motivating audio feed.
- It can be used both in individual and small-group therapy.

In addition for children:
- The parent can use (the multimedia program) with success.
- The child should be interested and his/her interest is kept for longer periods of time.
- The multimedia presentation may be perceived as “game-like” by the child thus enhancing user interest.

Levy (2008) concludes that, given that many young children now enter their early years in education as competent and frequent users of digital technology, schools need to identify ways in which to capitalize on the use of multimedia in order to promote confidence and skills in young readers today. It is argued that the medium of computer technology in particular was seen to encourage young children to develop both understandings about texts and the skills needed to read them. This included specific aspects of print awareness as well as a general confidence in handling print. Levy notes:

Until recently, much of this work (research on reading) has been grounded in the assumption that the term ‘reading’ relates almost solely to an ability to decode printed text within the context of paper-based media. Yet many now recognize that the nature of ‘literacy’ is changing
Recent rapid developments in technology mean that digitized media in particular now penetrate the ‘textual landscape’ (Carrington 2005) of children’s literary experience. As a result, accepted understandings of what is meant by the terms ‘reading’ and ‘being a reader’ have become challenged.

It has been widely documented that young children now enter the formal education system with a wide variety of experience in reading multi-modal texts (Carrington 2005; Marsh et al 2005). Given that the term multi-modal is being used in a social semiotic sense, recognizing that ‘meaning and knowledge is built up through various modalities’ (Vasquez 2005) (such as image, sound, symbol and so on), it is clear that modern definitions of reading include abilities to read texts on screen as well as on paper. Evidence exists that children as young as 5 shows sophisticated expertise in on-screen reading’ (Bearne et al 2007). While it is clear that the term ‘screen texts’ relates to many different kinds of media, including television texts (Roberts and Howard 2005), there is much to suggest that computer technology is especially prominent within children’s current screen and multi-modal textual experience (Facer, Furlong, Furlong and Sutherland 2003; Holloway and Valentine 2003).

Puchalski, Simonsen and Cook of Glennbrook North High School in Northbrook, Illinois (1992) developed a program (dubbed TEAM) that integrated interdisciplinary curriculum, cooperative learning, and interactive multimedia technologies in order to improve instructional delivery systems to at risk students in science, mathematics, social sciences, and language arts. These students were not successful in the traditional academic curriculum. A high proportion of these students are learning disabled. Although an oversimplification, it may be useful to view one type of learning disabled student as a “visual learner” - a student who learns primarily through the visual modality. Unfortunately for this type of student most information in a typical class is transmitted through the auditory modality - by the teacher talking, explaining, or lecturing to the class. The use of interactive multimedia technology for the TEAM project allowed the teacher to make such modifications with a minimum of disruption and distraction to the lesson. The use of multimedia was especially appropriate for the TEAM students.

In a 2003 article, Ahmet and Kopec discuss the need to embrace multimedia technology in education:

With the recent technological developments, an opportunity has emerged to introduce more efficient instruction into the classroom. The traditional blackboard approach is gradually giving way to more interaction between the instructor and students. Multimedia can be defined to be
“Multimedia should be employed as the centerpiece for an emerging pattern of instruction. It can promote independent and cooperative learning, and improve performance of low achievers and special student populations, while heightening interest in learning, writing, and research.”

Ahmet and Kopec further discuss the results of a break-out session of the 1996 National Science Foundation workshop:

An outcome of was the understanding of Instructional Technology’s ability to:
- provide access to world-wide resources;
- facilitate the accumulation, generation, and presentation of data;
- provide tools for analysis and modeling of more or deeper and more realistic examples in a short time;
- enable enquiry and extend the human capability to visualize, organize, and analyze data; and
- provide immediate feedback to the student, either from the technology itself or the facilitator/instructor.

It was further mentioned that the effective use for IT was characterized by applications that:
- stimulate students and engage them with the material, such as role playing simulations; and
- illustrate the workings of complex systems by exploring cause-and-effect relationships, or demonstrate microscopic, molecular, or hypocritical scenarios;

Dede, a contributor to the 2001 Change Agent Roundtable Occasional Paper, noted that among the unique capabilities of sophisticated computers and telecommunications is the ability to enable the success for all students through special measures to aid the disabled and the disenfranchised. (Project Kaleidoscope & Sigma Xi, 2001).

Elements of the ideal multimedia-enabled classroom are proposed by Ahmet and Kopec (2003):
“Multimedia applications can enhance student learning.”

Multimedia has two key uses:
• natural presentation of information through text, graphics,
• images, audio, and video; and
• nonlinear navigation through applications to access the needed information.

Multimedia-enabled computers and peripherals therefore provide a multi-sensory experience in exploring our world. This experience enhances lectures, research, and personalized instruction by allowing the individuals to control and manage multimedia navigation.

Several statistics from different sources show the effectiveness of multimedia in education:
• Multimedia applications can enhance student learning. Active learning indicates what percentage we remember: 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we hear and see, 70% of what we say, and 90% of what we both say and do (Todd, 1997).
• According to the United States Department of Defense data, we have short-term retention of approximately 20% of what we hear, 40% of what we see and hear, and 75% of what we see, hear, and do. Trainees complete courses with multimedia in one-third the time of those receiving traditional instruction, and reach competency levels up to 50% higher. In most cases, the overall cost of instruction is lower (Oblinger, 1991).
• In broad terms, computer-based instruction works. It offers a 10 to 20% improvement in performance over conventional training methods and a one-third reduction in time on task. They [trainers] can reduce the amount of time that a trainee spends learning by one-third (Fletcher, 1991).
• Students retain 20% of what they see, 30% of what they hear, 50% of what they see and hear, and 80% of what they see, hear, and interact with (Shelly, Waggoner, Cashman & Waggoner, 1998).

The key elements in an ideal multimedia-enabled classroom are: Networked computers, storage devices, printers, scanners, LCD projectors, electronic white boards, digital cameras and camcorders. Several different types of devices may be needed in the classroom depending on the course material in question.

Macaulay (2003) conducted research on the effects of multimedia on learning in non-English-speaking third world children. The performance scores of two groups of 18 children were recorded immediately before and after using either multimedia or no
Interactive multimedia and knowledge-based systems offer great promise for conducting education over long distances.

Interactive multimedia and knowledge-based systems offer great promise for conducting education over long distances. One application is home schooling. Personal computers, educational compact discs, on-line databases, and networks will make home schooling increasingly effective. The beneficiaries will include not simply those children whose parents opt for year-round home schooling, but also those who are homebound due to illness or bad weather and those with special learning needs that cannot be met in their school. The technologies can also be used to augment normal school education, somewhat like homework assignments (Halal and Liebowitz 1994).

Cavanaugh in a 2002 article notes:

According to CAST (Center for Applied Special Technology), in order “to reach learners with disparate backgrounds, interests, styles, abilities, disabilities, and levels of expertise,” educational materials should be flexible and adaptable for all learning styles (1998). The modern eBook and reader appear to meet those conditions. Studies have identified advantages for struggling readers in using electronic text technology applications because of the nature of electronic text over paper-based text (Reinking, Labbo, McKenna, & Kiefer 1998). Electronic text can provide scaffolding advantages for students that include voice output, interactive dictionaries, and note taking to assist in achieving learning success (Anderson-Inman & Horney 1999). Limitations inherent in standard paper-based print text can present barriers for dyslexic and visually impaired students. The use of eBooks makes information more accessible to students with disabilities; material in digital form offers many advantages and accommodations for students with or without disabilities.

Students using e-books may benefit from portability and a more engaging presentation of content, especially through the use of images and multimedia. E-books allow the user access to audio files for pronunciation guides, for example, or videos illustrating scientific concepts. However, very little of this material is, or will be, accessible to learners with sensory disabilities without a concerted effort to incorporate access enhancements into production plans, standards and technologies. Launched in 2003, the National Center for Accessible Media’s Beyond the Text project evaluates available
“English Language Learners (ELL) students are the fastest-growing K-12 population in the country. Heinze (2004) suggests technology offers some easy ways to help these students build vocabulary, achieve reading fluency, improve comprehension, access curriculum content, and strengthen their home-school connections.”

E-book software and hardware for multimedia capability, as well as for general accessibility to users who are blind, visually impaired, deaf or hard of hearing. The goal of the project is to enable users with these disabilities to easily locate, activate and utilize accessible multimedia content within various e-book formats, and software and hardware devices. Activities in support of this goal include researching and producing demonstration models, developing recommended practices and contributing to specifications that support the creation of accessible images, audio and multimedia. Building upon NCAM’s ongoing research into Web-based multimedia accessibility, the Beyond the Text project will identify the needs of deaf and blind users in the design of user interface, navigation systems, and the presentation of audio, video and illustrations. NCAM will help developers learn to apply methods for improving e-book multimedia navigation, as well as provide users the knowledge to create captions and audio descriptions for video and audio presentations (Freed 2004).

In September 2001, GlobalEnglish announced a new state-of-the-art multimedia coursework for general English learners. Developed by a team of English language experts, each assignment in the GlobalEnglish curriculum engages and motivates the user to learn by using sound, flash movies, slide shows and graphics to thoroughly present specific language points (grammatical forms, functional language and vocabulary). Following each of these presentations, the learner has the opportunity to practice and produce the language that was taught. For example, each assignment includes a speaking practice exercise using record/playback and speech recognition technology to allow the user to produce the new language in a simulated conversation.

Yeh and Lehman (2001) conducted research on the effects of learner control and learning strategies on English as a Foreign Language (EFL) learning from interactive hypermedia lessons. One important finding was that an interactive hypermedia environment was able to help the students in Low Ability groups to become more effective learners. Interactive hypermedia provided an ideal environment to do language learning strategy training for students with lower levels of language learning strategy use.

English Language Learners (ELL) students are the fastest-growing K-12 population in the country. Heinze (2004) suggests technology offers some easy ways to help these students build vocabulary, achieve reading fluency, improve comprehension, access curriculum content, and strengthen their home-school connections. In the upper-elementary and middle-school grades, students study content areas in greater depth and are exposed to more complex vocabulary and complicated concepts. With just a textbook, ELL students may experience enormous difficulty. Multimedia instruction and projects offer students hands-on, engaging ways to explore the content and concepts presented.
Cummins noted in a 1998 article discussing design of a computer-assisted text-based ESL/EFL learning system that the more target language text learners read and comprehend, the more of the target language they learn (see Dupuy, Tse & Cook, 1996; Elley, 1991; and Krashen, 1993).

Cummins describes a classroom scenario where ESL students are supported by electronic media:

A partial solution to the problems faced by María (and millions of English language learning students like her across the United States) is proposed in the e-Lective Language Learning system.

Let us also suppose that all the selections in the high school English literature program have been made available on CD-ROM by the publisher (an increasingly common practice). María will be enabled to participate in Edgar Allen Poe’s nightmare by highlighting and clicking any word she does not know as she reads the passage. She can choose what kind of support she wants. At her stage of English language development she may choose initially to get Spanish translation equivalents for the words she does not know and cannot infer from context. At a later stage, when she re-reads the passage, her teacher may suggest or she may choose to access English dictionary definitions and synonyms to expand her knowledge of word meanings in English. She may also focus to a greater extent on cognate relationships between the English words and Spanish, and on grammar and usage information related to words she initially did not know. Thus, she can use the same text to deepen her knowledge of English vocabulary and structures beyond the recognition level.

Getting access to each of these meanings takes María a matter of seconds as compared to the much longer period typically required to look a word up in a conventional dictionary. Thus, María’s attention is only minimally distracted from the search for meaning in the text. Furthermore, María will notice that almost all of these words have cognate connections with Spanish and at the click of the mouse she can gain access to more information on these cognates and develop her strategic competence in inferring the meaning of cognates.

In summary, when students come to a word or phrase they do not understand, they can click on the word and obtain any or all of the following supports: (a) a dictionary definition in English, (b) a first language (L1) translation equivalent, (c) the English pronunciation of the word, (d)
The students enjoy and are much more responsive to learning with (the multi-media system) than they were to the traditional approach...Their eyes come alive as they explore English with digitized pictures and sounds.’ (THE Journal, 1992).

grammatical information related to the word or phrase (e.g. verb tenses), (e) idiomatic or useful expressions, (f) English/L1 cognate information where cognates exist. Thus, the system facilitates ESL students’ access both to the curriculum and to the structure and functions of the target language itself.

Through two U.S. Department of Education grants, Jean and Donald (2000) developed multimedia CD-ROMs for Mexican American deaf children to help them learn reading skills as well as learn about Mexican American culture with folktales and animal stories (Andrews & Jordan, 1998). They also developed multimedia CD-ROMs that focused on solving math word problems over six math grades of difficulty using multicultural names, stories, and themes. While the project was aimed specifically at users of ASL (American Sign Language), they translated materials into Spanish for children and adults learning English as a second language. The researchers note:

Multimedia offers a promising tool for teaching languages. Stories can be written in two or more languages, and each can be accessed by the click of a button on a page. Multimedia is especially useful for children who rely on sign language. Dictionaries of sign-language video movies can be built right into the stories. Multimedia pages offer “hot buttons” that access three languages.

Multimedia also lets you explore information at your own pace while combining printed text, narration, words, sounds, music, graphics, photos, movies, and animation on one computer page. Pages can be linked together sequentially or can branch off into new pages called hypermedia.

Patrick Newton, a three-year veteran of English-language instruction at Charles Blackstock Junior High School, located in Oxnard, California, holds a specialist credential in Bilingual/Bi-cultural Education. After realizing the limitations of the traditional method of instruction, Newton sought to improve his ESL program using multi-media tools designed by Davidson & Associates of Torrance, California. ESL students spent two 45-minute periods in the ESL classroom each day. Beginning students, many of whom had just arrived in the country, were paired with more experienced peers, who helped them adjust to their new culture and classes. Several students who completed the classes and became fluent in English have returned to work with Newton as teacher’s aides, earning extra credit.

The system has been in use since December, 1991, and Newton notes dramatic changes in his students. “The students enjoy and are much more responsive to learning with (the multi-media system) than they were to the traditional approach...Their eyes come alive as they explore English with digitized pictures and sounds.” (THE Journal, 1992).
Peng, Fitzgerald, and Park (2007) describe the development of multimedia stories produced by ESL children using a children-as-designers approach. The rationale for the project was based on the use of technology to help second-language learning children express their culturally-diverse backgrounds and perspectives. Stories were produced by ten foreign-born international children from six countries working with nine educational technology graduate students from the USA and three other countries. Qualitative methods were used throughout the semester-long project to observe children, take field notes to document the process, capture design artifacts, conduct formative evaluation and final interviews, and write process reflections. The multimedia stories that emerged were rich expressions of children’s culturally-diverse perspectives related to their folklore, family beliefs, and adjustments to a new country. The children successfully participated as design partners by writing and illustrating their stories and by sharing decisions about multimedia features in the stories. Although challenged by the one-semester timeline to learn high-level multimedia software and complete the stories, graduate students were positive about their experience working with children in an authentic design project. The results support the effectiveness of technology as an intercultural, collaborative bridge to support multicultural education and student-centered learning for children as well as developers.

Instructional materials designed and developed using multimedia have provided exciting potential learning opportunities thanks to advancement in information technology, making their pedagogical effects on learning and teaching worth examining. Reading comprehension takes place when a previous acquired schema stored in the long-term memory is retrieved to assist the processing and understanding of new unfamiliar information (Anderson & Pearson, 1984). The process of transforming incoming information/knowledge elements into schemata requires considerable cognitive mental effort. Native language speakers typically encounter difficulties in reading when they have gaps in their content knowledge. Insufficient background knowledge hinders top-down processing of the new information, and limited language competence of second/foreign language learners makes the decoding process even more difficult. For ESL/EFL learners with low prior knowledge of a subject matter, instructional strategies need to be integrated into the course material. Instructional materials developed using multimedia are believed to be able to facilitate learners’ information processing, and to enhance effective cognitive encoding due to the multiple representations that trigger both verbal and visual modes of processing in human beings (Lin and Tsuiping 2007).

Multimedia presentations use techniques which also can help make learning accessible for people with print disabilities.”
rich media documents to the needs of an individual reader. Other than this presentational adaptation, it also becomes necessary to support the reader in building a mental model of the document structure based on temporal and interactive issues related to print disabilities. Langer (2003) discusses an implementation of personalizing both multimedia content and document structure:

Information in various electronic formats covers every imaginable topic and is easily available to everybody. The rapidly growing performance of computer systems and their miniaturization allows for a widespread use of multimedia documents. Most of these multimedia presentations are designed for mainstream recipients, although they use techniques which also can help making them accessible for people with print disabilities. Print disabled user groups are blind, partially sighted, deaf and dyslexic people. Their individual requirements concerning media formats and presentation techniques differ greatly.

Interactive multimedia systems raise other issues on reading strategies and navigation. A multimedia book, as every printed book, can be read in different ways, according to the reader’s goals and expectations. Reading for pleasure usually is a linear process (for example reading a novel), whereas the goal of finding a particular piece of information is often achieved by the use of indices or search engines and jumping to different parts of the documents without reading all of them.

Creating multimedia books for all users means to fulfill the expectations of mainstream readers as well as the requirements of print disabled users. The following needs can be identified within the different groups of print disabled readers (Petrie et al 2002). Blind readers prefer text as Braille output and audio presentations, whereas deaf users appreciate graphics, video clips and translations into sign language. Partially sighted people need enlarged views, short lines of text with increased inter-line spacing or special colors and contrast. The latter applies to dyslexic users as well and can be used in combination with animation of text phrases based on highlighting. The following table summarizes the user groups and their preferred presentation formats.
### Summary of User Requirements

<table>
<thead>
<tr>
<th></th>
<th>Blind</th>
<th>Partially Sighted</th>
<th>Deaf</th>
<th>Dyslexic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech Output</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Good Descriptions Of Images And Graphics</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Descriptions In Videos</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vary Font Style And Size</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Vary Text And Background Color</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Enlargement Of Images, Graphics And Video</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Text Or Graphic Output For Speech And Auditory Signals</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Extensive Use Of Pictorial, Graphic And Video Material</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Sign Language Translations</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Increase Line Spacing, Line Length</td>
<td></td>
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<td>x</td>
<td>x</td>
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<tr>
<td>Word-By-Word Or Sentence-By-Sentence Highlighting Of Text</td>
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<tr>
<td>Presentation Of Information In Short And Simple “Bite Sized” Chunks For Ease Of Reading And Comprehension</td>
<td></td>
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</table>

Multi-media educational approaches for teaching persons with autism have proven to be effective at different levels but the field is largely undeveloped. A commonly, if not universally, held view of the nature of autism is that it involves a ‘triad of impairments’. There is a social impairment: the person with autism finds it hard to relate to, and empathize with, other people. Second, there is communication impairment: the person with autism finds it hard to understand and use verbal and nonverbal communication. Finally, there is a tendency to rigidity and inflexibility in thinking, language and behavior. Much current thinking is that this triad is underpinned by a ‘theory of mind deficit’ - people with autism may have a difficulty in understanding mental states and in ascribing them to themselves or to others. There is good evidence that computer-aided learning is well accepted by students with autism and is of great potential benefit to them. Despite this potential, however, the field remains relatively unexplored. Multimedia systems with varying levels of interactivity, that can be paused, speeded up and repeated endlessly, with graphics and animations, can be developed (Moore et al 2000). There appears, then, to be a great potential for beneficial multimedia systems for students with autism. Various articles reference the use of multimedia for teaching literacy to pupils with autism, allowing the student to construct a sentence in text and receive “immediate multi-channel feedback”; provision of a program that might “provide a stimulating and motivating learning environment for children with autism who are trying to capture the essence of reading”; and, a “picture communication” approach for teaching communication.
Instructional technology offers the following components to students with special needs:

- Extra practice to promote mastery skills;
- Development of writing abilities to convey understanding in content-based curriculum;
- Simulations and problem-solving opportunities to assist in mastering national, state, and local curriculum standards; and
- Overall access to the general education curriculum.

skills to severely handicapped “autistic-like” students, involving the use of programmable communication. Moore and Taylor (2000) indicate that results of the multi-media approach include reductions in ‘non-social behaviors’ and increased verbal interactions.

Behrmann and Jerome (2002) in discussing assistive technology for students with mild disabilities note that Public Law 100-407, the Technology-Related Assistance for Individuals with Disabilities Act of 1988 (Tech Act) was designed to enhance the availability and quality of assistive technology (AT) devices and services to all individuals and their families throughout the United States.

Public Law 105-17, the Individuals with Disabilities Education Act (IDEA), uses the same definitions for assistive technology as the Tech Act and mandates that assistive technology be considered in developing Individualized Education Programs (IEPs) for students with disabilities. IDEA also emphasizes access to the general education curriculum for all students with disabilities.

The Tech Act and IDEA define an AT device as any item, piece of equipment, or product system (whether acquired off the shelf, modified, or customized) that is used to increase, maintain, or improve the functional capabilities of a child with a disability.

Motivation is often increased through the desktop publishing and multimedia capabilities of computers. A variety of fonts and styles allow students to customize their writing and highlight important features. Graphic images, drawings, video, and audio can provide interest or highlight ideas.

Multimedia gives the student the means and the motivation to generate new and more complex ideas. Access to the general education curriculum is emphasized by IDEA and includes the ability to obtain materials as well as the ability to understand and use them. Many students with mild disabilities have difficulty gathering and synthesizing information for their academic work. In this arena, Internet communications, multimedia, and universal design are providing new learning tools.

Over the past two decades, we have learned that instructional applications via software and multimedia tools can provide individualized experiences that are critical for many students who require accommodations (Wissick & Garner, 2002; Edyburn, 2001). We know, for example, that instructional technology offers the following components to students with special needs: (a) extra practice to promote mastery skills; (b) development of writing abilities to convey understanding in content-based curriculum; (c) simulations and problem-solving opportunities to assist in mastering
national, state, and local curriculum standards; and (d) overall access to the general education curriculum.

Today, the internet extends multimedia and hypermedia lessons via a flexible, accessible, and ever-growing tool. That is, the Internet integrates these components as well as extends previous technology applications by combining many of these features in a cost-effective and accessible format that is often designed with considerations for all learners. Thus, the broad use and access to the Internet have created significant advantages for individuals with disabilities, their families, and related educational professionals with an unknown even greater future potential.

Multimedia applications for reading are not limited to the Internet but the use of the Internet has expanded opportunities for teaching and learning in the special education classroom, specifically for students with mild disabilities. For example, Literacy Access Online was developed to assist students in the reading process. The site centers on stories that are developed by Literacy Access, written by visitors to the site, or available via other Web-based resources. For each story, pre-reading activities help the reader relate to the story, review upcoming vocabulary, and predict story events through pictures and other media. As the child reads the story, he or she can select hyperlinked vocabulary that offers audio pronunciation assistance to help with vocabulary building. Comprehension questions organized throughout the story encourage the reader to reflect on the passage while graphics offer a contextual illustration for the student. Post-reading activities include a series of activities that further promote comprehension as well as teach phonic skills in relation to the specific story. Likewise, the site offers reading strategies to improve students’ reading comprehension skills. For parents or teachers, lists of motivational strategies offer suggestions for encouraging, monitoring, and rewarding children during the reading activity. Also included are links to internal and external resources to help facilitate, plan, and guide reading sessions (Smith and Meyen 2003).
Conclusions

There is evidence that multimedia is a positive learning approach for special populations:
- Multimedia can provide support for cognitive processing or enhance memory and recall.
- Interactive technologies have been found to support children’s emotional development.
- Computers are intrinsically motivating for most children.
- Technology can be a powerful compensatory tool - it can augment sensory input or reduce distractions.
- With adapted materials, children with disabilities no longer have to be excluded from activities.
- The use of multimedia supports access to the general curriculum in inclusionary environments for all special populations.

Traditional educational approaches must be replaced or supplemented in order to more effectively deliver teaching and learning to individuals categorized as autistic, learning disabled, dyslexic and/or who may have auditory or visual impairments. Existing research indicates that English language learners as well as youth categorized as “at-risk” benefit from multimedia approaches as well.

Interactive media removes the social situations that can be confusing, frustrating, and challenging for someone with autism. The interactive options available through technology provide the end user the ability to customize their experience; and, this allows the user to advance their skills and make adjustments as they grow and become more successful. Interactive media can build confidence, skills, and opportunities to learn and practice the necessary skills required to function and interact in society and with others in a proper manner.

In addition, literature/literacy can be introduced in a non-threatening and appealing manner to students on the autism spectrum. Research indicates most individuals with autism are primarily visual learners. The web-based library can be particularly interesting for students who either may not be able to or may not be interested in reading a book. The combination of the audio and the words will facilitate a better comprehension of the subject matter for the special needs learner.
"Being able to self pace and review material multiple times is extraordinarily beneficial to those with all different types of sub-diagnosis under the dyslexia category."

The web-based (and individually accessible) Library is a positive feature for individuals with autism who find it difficult to interact with other people. Such contact can be very confusing and overwhelming. For this reason, many autistic students find use of the computer fun and motivating.

For dyslexic students, interactive media is absolutely critical in order to address auditory processing disorders and the comprehension challenges. Being able to self pace and review material multiple times is extraordinarily beneficial to those with all different types of sub-diagnosis under the dyslexia category.

Further benefits for the dyslexic population may be an increase in the frequency and amount of reading. The Capstone Interactive Library would be an enjoyable experience for this group. With the availability of fiction and nonfiction selections, increased reading experiences will lead to an increase in vocabulary. The sound feature will help the dyslexic student build fluency and prosody as they begin to read along. The highlighted words feature ensures that the dyslexic student is attending to the print and focusing on the structure of the word as they read along. The program can be a powerful tool for dyslexic students who struggle with right to left directionality when reading.

Interactive media helps a user hear the proper pronunciation of words, experiment with the best options for building successful comprehension skills for use in school and work environments. This can also challenge the user to identify communication patterns and triggers that are necessary for success in society. This aspect of multimedia may be applicable to all special populations including ESL students.

Multi-media approaches provide opportunities for second language learners to function individually, in both small group formats and large group format; the approach in the Capstone Interactive Library also allows for both auditory and visual learning. Both strategies have been proven successful with second language learners. Highlighting the word as it is read is also an asset to these students.

The multi-media approach appeals to learners of all populations, not just “special populations.” It has a unique way of engaging individuals who find reading particularly difficult.

Additional considerations related to learner motivation and the uses of multimedia should be considered as well. Research on multimedia learning has produced a vast body of findings which, however, are not yet being integrated into a comprehensive framework of reference. For a considerable time, cognitive centered approaches
“Multimedia may be the greatest educational revolution since the invention of the printing press.”

have dominated the literature. Although motivational variables are now being taken into account, there is still a large gap in regard to an adequate representation of motivation in multimedia learning. This gap is an important concern given the various challenges and obstacles, such as navigational problems, distractions, and cognitive overload, learners have to face due to the very nature of hypermedia. A promising area of theory that can help concerning this matter is represented by volition, an old concept in the study of human motivation and action (James, 1902), which has been reestablished within recent developments in psychology, such as the theory of action control (Kuhl, 1984). A volitional framework to supplement the mostly cognitively-based research on multimedia learning may serve as a basis for critically reviewing and reinterpreting current research findings. In particular, the volitional framework can be applied to common phenomena in multimedia such as lost in hyperspace, cognitive overload, and seductive details together with other obstacles to persistence and learning (Deimann, Markus; John Keller 2006).

While more research is warranted in the use of multimedia learning for special populations, this study supports the contentions of Ahmet (2003):

Multimedia may be the greatest educational revolution since the invention of the printing press. (1) The integration of computing and communication technologies has shown a proven potential for effectiveness in many sectors of society including finance, manufacturing and medicine. It also offers great promise to enhance education in all stages from kindergarten to college.

Collectively, Instructional Technology tools:

- enable experimentation with complex, real-life problems through modeling and simulation;
- create interactive environments to receive immediate feedback;
- facilitate collection and presentation of data;
- provide access to world-wide information sources;
- allow self-paced learning;
- support the development of interpersonal communication skills; and
- encourage collaboration among students and instructors.

Many multimedia technologies are relatively new in developing educational tools. The basic premises about the use of multimedia in learning need to be investigated with respect to the new findings in learning principles. The limited numbers of case studies such as the Classroom 2000 Project provide some evidence that supports the potential value of information technologies, but extensive research is required to be able to reach general conclusions.
Although computer and communication technologies have unique capabilities for enhancing learning, the infrastructure of a multimedia-enabled classroom is complex and implies many radical changes in all areas including curriculum development, pedagogical approach, faculty training, and organizational matters. The funding of such an infrastructure is a challenging financial issue at the institutional, state, and federal government levels.
References


Heinze, Juliette (2004). ‘Supporting English Language Learners: technology offers easy ways to boost your students’ language fluency and academic achievement. (ELECTRONIC LEARNING).’ Instructor (1990). Scholastic, Inc.,


Lányi1, Cecília Si; Tilinger1, Ádám; Szabó1 Julianna; Pál1, Attila; Lányi, Zsuzsanna. (1992). User Interface design question in developing multimedia software for handicapped children. University of Veszpréms. Colour and Multimedia Laboratory. H-8200 Veszprém, Egyetem u. 10. Hungary


Levy, Rachel (2009) You have to understand words ...but not read them: young children becoming readers in a digital age. Journal of Research in Reading VL: 32 NO: ’1 Pg: 75-91. United Kingdom Literacy Association


Wise, Mary; Frank Groom, “The effects of enriching classroom learning with the systematic employment of multimedia.” *Education. Project Innovation (Alabama)*: 1996.

For more information: www.CapstoneInteractiveLibrary.com