Education through Multimedia; Advantages and Limitations

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Abstract

Multimedia developments continuously change the traditional education methods. The convergence in multimedia is increasing the learning capacity and reaching power. The various media like print, audio, video, computer and internet–based media are very important in today's education world. A property designed syllabus through multimedia will give more impact and better results. But ho individual medium has its own advantages and limitations. This paper discusses the advantages and limitations of education through multimedia, which will give the solutions to rectify the problems, while creating and setting–up multimedia lessons and the syllabus.

Introduction

It is not feasible to discuss the role of multimedia in the future of education without paying some attention to the future of education (at all levels) itself. The issues are broad and varied without any evidence to date that there is a foolproof solution that educators may use. Moreover, there is little sign of agreement amongst educators regarding the future structure and function of educational institutions servicing the different sectors. To predict the role of multimedia in such an uncertain climate would be ambitious to say the least. However, by adopting a suitable set of principles, educators are able to set themselves some viable targets which are less prone to the fickle changes in technology.

There is much current debate in the educational community regarding the concepts of putting education "online". A quick visit to any one of the conference listings on the Web will reveal the extent of global investment being made in debating these subjects. Against this background it is probably useful to expect debate to move to a new level. When dealing with the role of multimedia in education, it is obvious that little useful information will result from debate that becomes focused on technological ability rather than pedagogical

strategy; achievement of machines, software and programmers rather than achievement of learners and mentors; and quality of technological wizardry rather than quality of learning experiences and outcomes. That is not to say that the technological parameters and achievements are not important. They are vital, as long as you have suitable educational strategies, goals, experiences and outcomes at which they can be focused.

For the purpose of this discussion, let us simply assume that all that has been stated as technologically possible now actually is, and that if it isn't, it will be by the time all the groundwork has been done to enable its use. Notwithstanding that, if certain achievements are not possible, there is most likely a substitute. From this perspective we are able to move the debate away from the technology and deal with the pedagogy and strategy.

Issues in Distance Learning

Distance education technologies are expanding at an extremely rapid rate. Too often, instructional designers and curriculum developers have become enamored of the latest technologies without dealing with the underlying issues of learner characteristics and needs, the influence of media upon the instructional process, equity of access to interactive delivery systems, and the new roles of teacher, site facilitator, and student in the distance learning process.

History and Media

We find a rich history as each form of instructional media evolved, from print, to instruc tional television, to current interactive technologies. The earliest form of distance learning took place through correspondence courses in Europe. This was the accepted norm until the middle of this century, when instructional radio and television became popular.

In the late 1950's and early 1960's, television production technology was largely confined to studios and live broadcasts, in which master teachers conducted widely-broadcast classes. Unfortunately, teachers who were expert in the subject matter were not necessarily the best and most captivating television talent, nor were the dull "talking head" medium the best production method for holding the interest of the audience. In the early 1970's, the emphasis turned from bringing master teachers into the classroom to taking children out of the classroom into the outside world. This had the negative effect of relegating television to the position of enrichment, which was not perceived as really related to school work. This trend was reversed later in the 1970's, as professionally designed and produced television series introduced students to new subject matter that was not being currently taught, yet was considered to be an important complement to the classroom curriculum. Then, in the 1980's, the pendulum swung back to the basics. The most recent trend has been one of multiculturalism, humanities, and world affairs.

The major drawback of radio and broadcast television for instruction was the lack of a two-way communications channel between teacher and student. As increasingly sophisticated interactive communications technologies became available, however, they were

adopted by distance educators. Currently, the most popular media are computer-based communication including electronic mail (E-mail), bulletin board systems (BBS's), and Internet; telephone-based audio conferencing; and videoconferencing with 1- or 2-way video and 2-way audio via broadcast, cable, telephone, fiber optics, satellite, microwave, closed-circuit or low power television. Audio graphic teleconferencing using slow scan or compressed video and FAX is a low-cost solution for transmitting visuals as well as audio. Mosaic, a graphical interface to the World Wide Web, has become popular in parts of Canada, Europe, and Australia over the past year.

Print in Education

Print is the foundation of education and the basis from which all other delivery systems have evolved. Examples of print formats are textbooks, study guides, workbooks and case studies. The first distance-delivered courses were offered by correspondence study, with print materials sent and returned to students by mail. While technological developments have added to the repertoire of tools available to the distance educator, print continues to be a significant component of all distance education programs. When creating instructional print materials the developer can focus on content concerns as opposed to the technical requirements of the delivery system.

Advantages of Print:
i. Spontaneous. Printed materials can be used in any instructional setting without the need for complicated presentation equipment.
ii. Instructionally transparent. The medium of delivery should enhance, not compete with, the content for the learner's attention. If the student reads well, the print medium is the most transparent instructional medium of all.
iii. Non-threatening. Reading is second nature to most students. As a result, they are easily able to focus on the content, without becoming mesmerized or frustrated by the process of reading itself.
iv. Easy to use. Given adequate light, print materials can be used any time and any place without the aid of supplemental resources such as electricity, viewing screen, and specially designed electronic classrooms. The portability of print is especially important for rural learners with limited access to advanced technology.
v. Easily reviewed and referenced. Print materials are typically learner-controlled. As a result, the student rapidly moves through redundant sections, while focusing on areas demanding additional attention.
vi. Cost-effective. No instructional tool is less expensive to produce than print. In addition, facilities abound for the inexpensive duplication of these materials.
vii. Easily edited and revised. In comparison to technically sophisticated electronic software, print is both easy and inexpensive to edit and revise.
viii. Time-effective. When instructional print materials are created, the developer's primary focus remains on content concerns, not the technical requirements of the delivery system while focusing on areas that need more attention.

Limitations of Print

Limited view of reality. Print, by its reliance on the written word, offers a vicarious view of reality. Despite the use of excellent sequential illustrations or photos, for example, it is impossible to adequately recreate motion in print.

Passive and self-directed. Numerous studies have shown that higher learner motivation is required to successfully complete print-based courses. To a certain extent, the passive nature of print can be offset by systematic instructional design that seeks to stimulate the passive learner. Still, it takes more motivation to read a book or work through a written exercise than it does to watch a television program or participate in an audio conference with an instructor encouraging student participation and response.

Feedback and interaction. Without feedback and interaction, instruction suffers, regardless of the delivery system in use. By nature, print materials are passive and self-directed. Even with print materials incorporating feedback mechanisms and interactive exercises, it is easy for learners to skip to the answer section.

Dependent on reading skills. Thanks to television, most students have developed fairly good viewing skills by age four. These same children, however, often fail to develop adequate reading skills by age 12. Reading skills must often be improved. Lack of ability in this area cripples the effectiveness of even the most instructionally sound print material and must be overcome if print is to be used effectively.

Instructional Television

Instructional television (ITV) is an effective education delivery system that can be integrated into the curriculum at three basic levels:

Single lesson

Programs address one specific topic or concept, providing a lesson introduction, overview, or summary.

Selected unit

A series of programs providing the content foundation for a learning unit in the course curriculum

Full course

Programs from one or more ITV series may be integrated into a full semester course typically in conjunction with instructional print materials.

ITV may be either passive or interactive. Passive ITV typically involves pre-produced programs which are distributed by video cassette or by video-based technologies such as broadcast, cable, or satellite. In contrast, interactive ITV provides opportunities for viewer interaction, either with a live instructor or a participating student site. For example, two-way television with two-way audio allows all students to view and interact with the teacher (Lochte, 1993). At the same time, cameras at remote sites allow the teacher to view all participating students. It is also possible to configure the system so that all student sites may view one another.

Advantages of Instructional Television:
i.   Since most people have watched television, the medium is familiar.
ii.   Motion and visuals can be combined in a single format so that complex or abstract concepts can be illustrated through visual simulation. The old cliche "a picture is worth a thousand words" rings true.
iii. Instructional television is an effective way to take students to new environments (the moon, a foreign country, or through the lens of a microscope).
iv.   Time and space can be collapsed, so that events can be captured and relayed as they happen.
v.   It is very effective for introducing, summarizing, and reviewing concepts.
vi.   It can be used effectively as a motivational tool.

Limitations of Instructional Television
i..   Broadcast quality ITV is expensive to create.
ii.   Video production is time consuming and can be technically demanding, often requiring relatively sophisticated production facilities and equipment.
iii. Sites choosing to interactively participate in an ITV program may require specialized equipment, facilities, and staffing.
iv.   Most pre-packaged ITV courses use a mass media approach to instruction aimed at the average student. As a result, they can be ineffective in serving students with special needs.
v.   When used passively, without interaction, its instructional effectiveness can be limited.
vi.   Unless professionally produced, completed ITV programs often look amateurish.
vii. Once completed, ITV programs can be difficult to revise and update.

Interactive Videoconferencing in Education

Interactive Videoconferencing (IV) is an effective tool that may be used in education settings. This system can be integrated into the distance education program with minimal adaptation to the curriculum and course and is designed to support two-way video and audio communication between multiple locations.

Advantages of Interactive Video
Interactive video can be effective because it:
i.   Allows "real time" visual contact between students and the instructor or among students at different sites.
ii.   Supports the use of diverse media (Reed and Woodruff, 1995). Blackboards, handwritten documents, and videos may be incorporated at all sites.
iii. Enables connection with experts in other geographical locations (Reed and Woodruff, 1995).
iv   Can provide access to at-risk or special needs students (Woodruff and Mosby, 1996).
v.   Provides additional access to students at remote sites.

Limitations of Interactive Video

As with any technology, interactive video has its limitations:

i.   The initial cost of the equipment and leasing the lines to transmit conferences may be prohibitive.

ii.   Companies which produce codec's have each developed unique methods of compression which are incompatible, although protocols have been established to allow communication among brand names. However, this "universal standard" compromises resolution and quality to a certain degree.

iii. Unless a strong effort is made by the instructor, students not located with the instructor may remain uninvolved in the course.

iv.   If visuals, like handwritten or copied materials, are not properly prepared, students may have a difficult time reading them.

v.   If the "pipe" that carries the transmission among sites is not large enough, the students may observe "ghost images" when rapid movement occurs in "real time" (Reed and Woodruff, 1995).

vi.   If the system is not properly configured, class members may observe an audio "echo" effect (Reed and Wooduff, 1995). The result is audio interference that detracts from the learning environment.

Instructional Audio

Interactive instructional audio tools for the educator include the telephone, audio conferencing, and short-wave radio and streaming audio. Audio conferencing can be audio-only or supported by enhanced image or data transmissions - audio graphic conferencing. Audio-only conferencing typically utilizes the public telephone system to link together people at two or more locations.

Advantages of Instructional Audio

Audio conferencing is relatively inexpensive to install, operate and maintain.

i.   Uses available telephone technology or simple computer microphone/recorders and can reach many students.

ii.   It is interactive and allows direct student/teacher participation as well as student-to-student interchange.

Limitations of Instructional Audio

i.   Can be very impersonal when used alone with the absence of body language, and visual clues.

ii.   Content that can be delivered is limited to an oral format.

Computers in Education

In recent years, educators have witnessed the rapid development of computer networks, dramatic improvements in the processing power of personal computers, and striking advances in magnetic storage technology. These developments have made the computer a dynamic force in distance education, providing a new and interactive means of overcoming time and distance to reach learners.

Computer applications for distance education fall into four broad categories:

i. Computer Assisted Instruction (CAI) - uses the computer as a self-contained teaching machine to present discrete lessons to achieve specific but limited educational objectives. There are several CAI modes, including: drill and practice, tutorial, simulations and games, and problem-solving.

ii. Computer Managed Instruction (CMI) - uses the computer's branching, storage, and retrieval capabilities to organize instruction and track student records and progress. The instruction need not be delivered via computer, although often CAI (the instructional component) is combined with CMI.

iii. Computer Mediated Communication (CMC) - describes computer applications that facilitate communication. Examples include electronic mail, computer conferencing, and electronic bulletin boards.

vi. Computer-Based Multimedia- HyperCard, hypermedia, and a still-developing generation of powerful, sophisticated, and flexible computing tools have gained the attention of distance educators in recent years. The goal of computer-based multimedia is to integrate various voice, video, and computer technologies into a single, easily accessible delivery system.

Advantages of Computers

Computers can facilitate self-paced learning. In the CAI mode, for example, computers individualize learning, while giving immediate reinforcement and feedback.

i. Computers are a multimedia tool. With integrated graphic, print, audio, and video capabilities, computers can effectively link various technologies. Interactive video and CD-ROM technologies can be incorporated into computer-based instructional units, lessons, and learning environments.

ii. Computers are interactive. Microcomputer systems incorporating various software packages are extremely flexible and maximize learner control.

iii. Computer technology is rapidly advancing. Innovations are constantly emerging, while related costs drop. By understanding their present needs and future technical requirements, the cost-conscious educator can effectively navigate the volatile computer hardware and software market.

iv. Computers increase access. Local, regional, and national networks link resources and individuals, wherever they might be. In fact, many institutions now offer complete undergraduate and graduate programs relying almost exclusively on computer-based resources.

Limitations of Computers

i.   Computer networks are costly to develop. Although individual computers are relatively inexpensive and the computer hardware and software market is very competitive, it is still costly to develop instructional networks and purchase the system software to run them.

ii.   The technology is changing rapidly. Computer technology evolves so quickly that the distant educator focused solely on innovation "not meeting tangible needs" will constantly change equipment in an effort to keep pace with the "latest" technical advancements.

iii. Widespread computer illiteracy still exists. While computers have been widely used since the 1960's, there are many who do not have access to computers or computer networks.

iv.   Students must be highly motivated and proficient in computer operation before they can successfully function in a computer-based distance learning environment.

The Internet and Education

The Internet is the largest, most powerful computer network in the world. It encompasses 1.3 million computers with Internet addresses that are used by up to 30 million people in more than fifty countries. As more and more colleges, universities, schools, companies, and private citizens connect to the Internet either through affiliations with regional not-for-profit networks or by subscribing to information services provided by for-profit companies, more possibilities are opened for distance educators to overcome time and distance to reach students.

With access to the Internet, educators and their students can use:

i.   Electronic mail (e-mail) - Like postal mail, e-mail is used to exchange messages or other information with people. Instead of being delivered by the postal service to a postal address, e-mail is delivered by Internet software through a computer network to a computer address.

ii.   Bulletin boards - Many bulletin boards can be accessed through the Internet. Two common public bulletin boards on the Internet are USENET and LISTSERV. USENET is a collection of thousands of topically organized newsgroups, covering everything from supercomputer design to bungee cord jumping, and ranging in distribution from the whole world to single institutions. LISTSERV also provides discussion forums on a variety of topics broken out by topic or area of special interest.

iii. World-Wide Web (WWW) -The WWW is an exciting and innovative front-end to the Internet. Officially WWW is described as a "...wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents" (Hughes, 1994). The WWW provides Internet users with a uniform and convenient means of accessing the wide variety of resources (pictures, text, data, sound, and video) available on the Internet. Popular software interfaces, such as Mosaic and Netscape,

facilitate navigation and use of the WWW. The central organizing feature of the WWW is the "home page". Every organization and even every individual user of the WWW can create a home page that contains whatever information they want to present. The hypertext capabilities of the WWW facilitate linking of information within your own home page and with all other home pages on the WWW.

The World-Wide Web (WWW/WEB)

The Internet is the world's largest, most powerful computer network connecting personal computers, sophisticated mainframes, and high speed supercomputers around the globe.

In 1989, a group of scientists at the European Laboratory for Particle Physics (CERN) in Geneva, Switzerland, began developing an Internet tool that provides a way to link textual information on different computers. The object was to overcome issues of incompatibility and utilized a new way of linking made possible by computers, called "hypertext". The CERN project resulted in an innovative front-end to the Internet, now referred to as the World-Wide Web (WWW / Web).

In 1993, the National Centre for Supercomputing Applications (NCSA) at the University of Illinois, pushed the CERN scientists' idea further by creating a software tool Mosaic, which is an easy to use graphical user interface that permits text, graphics sound and video to be hyperlinks. It is now referred to as a "Web browser".

Web browsers permit users to connect to the Internet and facilitate accessing information located on another remote computer. Documents created to be viewed by a browser are formatted using Hypertext Markup Language (HTML).

The Web for Education

The WWW and Web browsers have made the Internet a more user-friendly environment. The ability to integrate graphics, text, and sound into a single tool means that novice users do not have to struggle with such a steep learning curve. In addition, organizations and individuals can create home pages independently and link to other Web pages on their own computers or to pages created by others on different computer systems.

For educators, the WWW provides an exciting new opportunity for distance teaching and learning.

i.   The WWW can be used by the distance educator to build a classroom home page.
ii. The instructor can also provide links to information on the WWW that would be useful to students in the class.
iii. In addition, the home page can link students to a discussion list or LISTSERV that set up for student communication.
iv. It is also a relatively simple matter to use the home page to create forms that students can fill out and that will end up being sent to you as an e-mail message.

Developing Home Page

Properly designed home pages will encourage thought, discussion and active participation by your distant students. The following elements can be included in your class home page.

i.   Course and Instructor Information ... Include such items as course topics to be covered, your office hours, textbook information, course objectives, and grading policies.

ii.   Class Communication ... Provide access to your e-mail, link to discussion groups that you have set up for student-to-student communication, and create forms that your students can use to report problems or provide biographical information about themselves.

iii. Assignment and Tests ... Distribute assignments and tests, provide for online completion or submission, and give solutions, hints, or samples of what you expect.

iv.   Materials covered in the classroom ... Make lecture notes and handouts available either as Web pages or as downloadable files.

v.   Demonstrations, Animation, Video, Audio ... This is more complex that other suggestions and will require that your students have access to computers with sound and video cards.

vi.   Reference Material ... List materials in print and electronic form that supplement the textbook. To avoid copyright problems, electronic articles should either be written by you or in the public domain. In addition, provide links to other pages which cover information on the topic, similar courses that may also be available on the WWW, your university library, and other on-campus resources that may help your students complete the course.

Distance educators who are ready to develop a web presence, should avoid the following pitfalls:

1.   Rushing in without a master plan. Don't get so caught up in learning HTML and developing the home page that the purpose for developing your presence on the WWW is lost. Spend less time struggling with HTML, developing amusing graphics or playing with possible background and more time considering the purpose and content of the home page. Before you start your home page:
    i.   Think about your reason for developing a Web presence.
    ii.   Become familiar with new software tools for developing home pages.
    iii   Utilize information that already has been developed for your course
    iv.   Look at what is already available

2.   Laying out home pages poorly and inconsistently. To avoid ugly and confusing home pages, consider the following:
    i.   Consulting sites on the WW which provide information on home page layout and style.
    ii.   Utilizing a consistent format for each of your pages.
    iii. Keeping page lengths short. In cases where page information is long, index internally so that your students can jump to specific information as needed.

3. Using unnecessarily large graphics or including sound/video clips. Consider that while graphics can add appeal to home pages, pages which take too long to download frustrate students and may force them to beat a hasty retreat. If your home page requires extensive use of graphics t demonstrate points, warn your students. If you plan to use sound or video clips, you will need to be sure that all your distant students have access to computers that have sound and video cards installed in them.
4. Letting the home page become out-of-date. The home page should be an ongoing part of course development. Make sure that you add or change information as necessary. Periodically verify whether other Web pages to which you are linking still exists.

Conclusion

Today, political and public interest in distance education is especially high in areas where the student population is widely distributed. Each region has developed its own form of distance education in accordance with local resources, target audience, and philosophy of the organizations which provide the instruction. Many institutions, both public and private, offer university courses for self-motivated individuals through independent study programs. Students work on their own, with supplied course materials, print-based media and postal communication, some form of teleconferencing and/or electronic networking, and learner support from tutors and mentors via telephone, web pages, video cassettes or E-mail.

Formats of Print Materials

Various print formats are available, including:

i.   Textbooks. As in traditionally delivered courses, textbooks are the basis and primary source of content for the majority of distance-delivered courses. While textbooks should always be critically reviewed before adoption, this is especially critical when the learner and the instructor are not in daily contact.
ii. Study guides. Typically, distance educators use study guides to reinforce points made during class and through the use of other delivery systems. They will often include exercises, related readings and additional resources available to the student.
iii. Workbooks. In a distance education context workbooks are often used to provide course content in an interactive manner. A typical format might contain an overview, the content to be covered, one or more exercises or case studies to elaborate the points being made, and a quiz or test (with answer key) for self-assessment. In addition, there is typically some form of feedback, remediation, or "branching" loop to recycle students through the instruction as needed.

iv. Course syllabus. A comprehensive and well-planned course syllabus is the foundation of many distance-delivered courses. It provides course goals and objectives, performance expectations, descriptions of assignments, related readings (often by session), grading criteria, and a day-by-day overview of the material to be covered. The syllabus must be as complete as possible in order to guide the students through the course in the absence of daily contact with the instructor.

v.   Case studies. If written imaginatively, case studies are an extremely effective instructional tool. In fact, case studies are often designed around the limitations of print and intended to spark the students' imaginations as they place themselves in the particular case under consideration. Many case studies present a content-based scenario. They raise questions, pose alternative solutions, and then branch students to different sections of the text. There, the consequences of the selected alternative are described.

The Technology of IV

Most IV systems utilize compressed digital video for the transmission of motion images over data networks such as high capacity Integrated Services Digital Networks (ISDN). The video compression process decreases the amount of data transmitted over the lines by transmitting only the changes in the picture. By minimizing the bandwidth required to transmit the images, video compression also reduces the transmission cost.

Interactive videoconferences are often transmitted on dedicated T-1 phone lines. These high speed lines are very effective for videoconferencing, but they are typically leased circuits with an expensive monthly cost. The fixed monthly charge is usually based on distance, not usage. Therefore, the cost effectiveness of IV systems increases with use. Interactive videoconferencing systems can operate at different data rates, at various fractions of T-1 capacity, enabling the transmission of multiple simultaneous videoconferences over the same T-1 circuit. An IV system can also share a T-1 circuit with other digital data uses such as Internet transmissions or file transfers.

Point-to-point

Interactive videoconferencing is commonly used to connect two locations using sophisticated computer technology. The core of IV is the codec (coder/decoder). This is the electronic device that transmits and receives the video signals that the class members will see on their television monitors (Galbreath, 1995). It may be easier to think of the codec as an extremely sophisticated modem. A modem takes digital data and transmits it over regular phone lines. The codec takes analogue signals, compresses and digitizes them, and transmits the signals over digital phone lines (Woodruff and Mosby, 1996).

Other types of equipment, such as television monitors, are needed to make IV successful. In addition, various forms of instructional technology can be incorporated into IV, including video cassette recorders/players, microphones, cameras, and computers (Reed and Woodruff, 1995).

Point-to-Multipoint

Some systems are also capable of simultaneously connecting more than two sites through the use of a multi-point control unit, or MCU. Multi-point conferencing can be effective although the scheduling, technical, and logistical dimensions of MCU conferences can be imposing.

Dial Out Capability

A relatively new "dial out" feature, allows the use of multiple telephone lines to connect two or more sites in the same conference. Simultaneously accessing multiple lines may be difficult in small areas. In addition, the cost of the telephone line usage may be prohibitive since the cost of the call would be multiplied by the number of lines utilized in the conference.

Types of Videoconferencing Systems

1. Small room videoconferencing. This system is designed primarily for small groups (1–12 participants) at all sites seated around a conference table (Woodruff and Mosby, 1996).
2. Classroom videoconferencing. This type of system usually uses high quality AV components, codec's, and an interface that allows all participants to be seen on the monitors.
3. Desktop videoconferencing. This system utilizes a personal computer and videoconferencing software. These systems are less expensive, but offer limited resolution. They are most effective for individual and small group use (Woodruff and Mosby, 1996).

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