Chapter Ten
Educational Multimedia

> I hear and I forget. I see and I remember. I do and I understand.
>
> *Chinese proverb*

> I find that a great part of the information I have was acquired by looking up something and finding something else on the way.
>
> *Franklin P. Adams*

> The Medium is the Message.
>
> *Marshall McLuhan (1911-1980)*

> Affective learning is Effective learning.
>
> *Bernard John Poole (1943-)*

LEARNING OUTCOMES

The term "multimedia" has been used since the early 1960s to describe audiovisual aids (AVAs). The modern interpretation of the term includes a rich set of computer-based AVAs, such as scanners/digitizers, CD-ROM/DVD drives, and digital cameras, along with online resources such as the World Wide Web. These AVAs require computers to coordinate their incorporation into teaching and learning activities, transforming AVAs into AV/IT systems.

In this chapter we will examine all aspects of the modern concept of multimedia, including the following topics.

- Introduction
    - The importance of the senses in learning
    - AV/IT—AVAs go hi-Tech
- The concept of computer-based multimedia
    - Multimedia has added a new dimension to the process of teaching and learning
    - Multimedia authoring tools
- Multimedia Hardware
    - Data capture devices
    - Data storage technology
    - Data display devices
- Software for Media Object Production

- Audio input
- Digital image input
- Output to CD/DVD
- Organizing Media Objects

- Multimedia Courseware
  - Hypertext
  - Hypermedia
  - Hypermedia and the Internet
  - Media Literacy
- Using copyrighted materials
  - FairUse
  - Some Solutions for Schools
- Models

INTRODUCTION

A medium is "an intervening agency, means, or instrument by which something is conveyed or accomplished." (Webster's, 1991). The plural form of medium is *media* which, in the context of education, includes the means to create, store and present instructional content. These include tools, such as chalk and talk, books and computers, slide projectors, video projection, overhead projectors, document cameras[1], audio systems (a CD player, radio), combined sound and video systems (television, digital video cameras, and DVD's), and the media objects themselves.[2]

The term *multimedia* was introduced in the 1960s to describe the combined use of several media, such as film, video, still images, and audio. Today, multimedia has become closely associated with instruction that includes the computer-based technologies that are the subject of this chapter.

The Importance of the Senses in Learning

You will notice that all of the media mentioned above target either the eye or the ear. Of the five human senses, vision is recognized as the most powerful data-acquisition device for the brain. Edward Tufte (1990), a professor of statistics and graphic design at Yale University, explains why the most effective presentation methodologies attempt to convey information visually, rather than verbally alone. "Visual displays of information," he says, "encourage a diversity of individual viewer styles and rates of editing, personalizing, reasoning, and understanding. Unlike

[1] Also known as a visual presenter or visualizer. We will further discuss this device later in the chapter.

[2] You might remember from chapter 5 that a "learning object" is a snippet of data or information that can be shared and recycled in multiple formats.

speech," Tufte says, "visual displays are simultaneously a wideband and a perceiver-controllable channel."

The terms *wideband* and *channel*, as we learned in chapter 7, come from the science of communications. The term *channel* in this context is the same as *medium*, pathway or route, along which data travel. A wideband channel carries more data at higher speeds. A visual display is an example of a wideband channel, carrying more data at higher speeds than simple speech. A visual display is also "perceiver-controllable" in that the person doing the viewing can absorb the data by scanning them at a speed and in a sequence that most naturally fits that person's intellectual strengths. Howard Gardner (1989), in keeping with his theory of multiple intelligences, would agree that each individual assimilates knowledge differently depending on the makeup of his or her mind.

Speech, on the other hand, though it is a powerful medium for communication when used by skilled speakers, is not so easy to digest. It requires more mental effort to assimilate because less information is conveyed at a slower speed, thus requiring more concentration and extrapolation on the part of the listener. Using words to describe a house will take a lot longer and almost certainly will be less effective than showing a diagram or some photos. This is not to say that a verbal description may not be more beautiful. Paradoxically enough, it often is when the writer or storyteller has great skill with words.

Of course, the senses of touch, smell and taste are powerful learning media, too. The signals that are transmitted to the brain by the touch of a snake's skin will quickly dispel misconceptions of sliminess usually associated with a purely visual experience of these beautiful creatures. This is why good teachers intersperse speech with illustrations and mix verbal presentations with active, hands-on learning. The younger the audience, of course, the more important these sensory vehicles for learning are. This is also one of the reasons for the development of websites and computer applications that simulate experiences—field trips, archaeological digs, scientific experiments, life in the past. These create virtual "hands-on" learning opportunities for many students as well as providing visual and audio instruction.

In our world, "media" has another meaning, of course. Two centuries ago, the term *media* was first applied to newspapers (Webster's, 1991). By the 1920s, it had come to be used as a singular noun to describe any means of mass communication and advertising. This is the generally accepted meaning of media today. Indeed, to the average citizen, media means "mass media"—television, movies, radio, newspapers, magazines, the Internet, all of which are used more often than not for entertainment rather than education.

However, the impact of mass media upon the lifestyle decisions, the ethical, political, and purchasing choices made by "the masses," and especially by children, has not gone unnoticed by education. It is precisely because of the powerful appeal of mass media, and their success as communication media, that educators are faced with a new paradox: the media that most threaten the values of the traditional classroom are proving to be highly successful when used as educational tools.

This is clearly stated in *Why Media Literacy Matters*, a position paper from the MediaChannel (Dichter, 2004):

Chapter 10: Educational Multimedia

> The digital age is transforming the quantity, range, and speed of information and communication in our lives. The mass media affect how we perceive and understand the world and people around us, from what we wear, eat and buy to how we relate to ourselves and others. In the 21st century, the ability to interpret and create media is a form of literacy as basic as reading and writing.

Harnessing the mass media, in all of its forms, for the purpose of improving the education of children has always been an important focus of alert teachers in alert schools. This is not an easy task, for the very tools that do powerful good can do powerful damage when their use is unguided, unstructured, inappropriate, or uncritical. That is why the teacher must continue to teach—and to learn.

AV/IT—AVAs go hi-Tech

The term "Audio-Visual" implies that such teaching aids are only audio or visual. But AVAs, of course, also include the sensory tools of touch, taste, and smell to promote learning. Many chemistry, physics, or biology experiments are good examples of low-tech AVAs that are accompanied by interesting other-sensory experiences considered crucial to the success of a lesson. In addition to low-tech AVA, technology in the form of electronic media has been part of the classroom for decades[3]. Dramatic re-enactment and the use of samples ("show and tell" for example) have always been part and parcel of a good teacher's box of pedagogical tricks designed to arouse curiosity in young minds.

In other words, affective learning is *effective* learning; children learn most effectively when their minds are engaged, when they *feel* emotionally involved with what they are trying to learn.

All teachers recognize the advantage of using available technologies to this end, but few teachers have the luxury of exclusive use of stand-alone electronic media players, such as CD players, VCR's and monitors on wheels, let alone "smart classrooms[4]" that include online computers, flat-screen monitors, LCD projectors, scanners, digital cameras and so forth. Some schools have personnel whose job it is to take care of AVA equipment, coordinate its use, make sure it is where it should be as per the schedule, and return it to the AVA center after it has been used. Other schools have centralized AV into a library "media center" to which classes travel at a scheduled time. Most teachers have to make do with what is available and, often, to fend for themselves.

Usually, a great deal of planning and coordination is involved in using AVAs. If special equipment is required, forward planning is necessary and the equipment must be reserved ahead of time before it can be integrated into lesson plans. Assuming the equipment is in working order when it is scheduled to be used, it must be set up before class begins, and disassembled and returned at the end of class in case other teachers have scheduled use of the same equipment. On top of this, the teacher must spend considerable time planning the lesson itself, either reviewing, selecting and organizing multimedia content, or creating original multimedia materials.

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3 Remember that the radio, reel-to-reel film, and film strip are electronic technologies.

4 You will remember that we discussed the Smart Classroom in chapter 5.

This is all very well if one is teaching three or four 40-minute classes a day (no more than two if the school is on a block schedule). But most K-12 teachers are lucky if they have *one* free, so-called "planning" period, each day ("planning" is often a euphemism for "recovery"). Under such circumstances it is understandable that there is no stampede to plan lessons around multimedia in view of the logistical problems involved. Indeed, rather than plan lessons at all, teachers sometimes arrange for the showing of this or that video with the objective of filling time for which they have been unable to adequately plan! Other teachers, by default, rely on a predominance of verbal presentation of subject matter, with the chalkboard (or whiteboard) as the medium of choice.

This is not to disparage the chalkboard. As a free-form, ad hoc visual aid it takes some beating and will continue to be a feature of classrooms for some time to come—at least until computerized equivalents of the chalk board, such as the SmartBoard, become the rule rather than the exception. Mocsny (1987) reminds us just how versatile a teaching tool the chalkboard is. "Walk into any [classroom]," he says, "and observe the chalkboard. Less than half the scribblings can be represented directly by ASCII[5] characters. Instead, one sees a freewheeling set of sketches, graphs, equations, symbols, arrows, etc. The skilled instructor throws it all up there while conducting a [class]."

The chalkboard is thus unlikely to be replaced by technology. But it has been *improved* by technology. Electronic chalkboards (*SmartBoards*), now commonly used in business environments, accommodate free-form, hand-drawn text and graphics (Fig. 10.1).

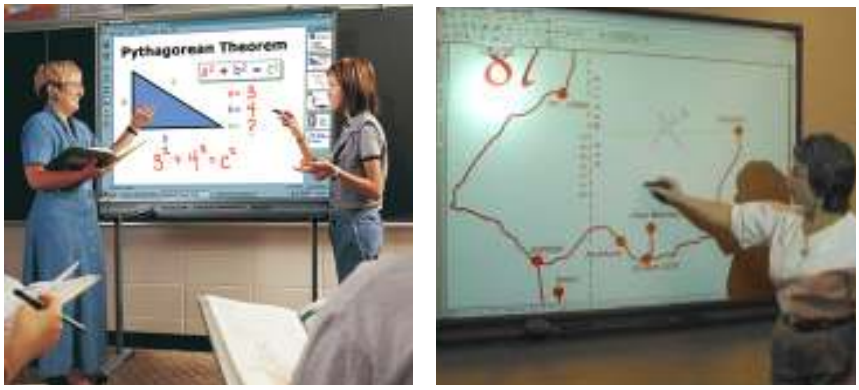

Fig. 10.1 Portable and wall-mounted *SmartBoards*

SmartBoards also have the added feature that the user (teacher or student) can download a "snapshot" of the contents to a printer or archive it as a digital document. This is an example of a *media object*.

The computer, because of its ability to "talk to" stand-alone electronic AVAs such as televisions, cameras, and laboratory equipment, is transforming AVA into AV/IT (audio-visual instructional technology), a more hi-tech and computer-centric term embracing all *multimedia* technologies

[5] You may recall that ASCII (the American Standard Code for Information Interchange) is a system for representing characters (text and other symbols) in the 1s and 0s of computer language so that they can be stored inside the machine. Appendix A lists the complete set of codes.

and applications. By both centralizing control and, increasingly, centralizing digital content, the computer makes it possible to teach and learn with multimedia—without the fuss. As argued in chapter 8, the Internet is itself becoming a significant multimedia tool because of its scope, currency, and ease of accessibility both in and out of the classroom. AV/IT centers, whether smart classrooms, e-Learning classrooms, or classrooms-on-wheels, are increasingly central to new teaching and learning models. Teachers who have had the opportunity to use a multimedia system in the classroom, with online access to globally-available media and the hardware and software to create something new with this media, have quickly recognized what an empowering tool computer-based technology is, as much for themselves as for their students.

There will continue to be an important premium placed on careful lesson preparation, of course. Good teachers welcome any technology that helps them incorporate intellectually stimulating interactive multimedia material into their lessons. Teachers are finding that computer-based multimedia, whether online or not, can help them respond even to ad hoc reactions from, and spur of the moment interactions with, their students. More to the point, teachers are discovering that their students are able to work on multimedia projects by themselves.

As any teacher knows, the best way to learn a skill or concept is to teach it to others. Using the same logic, the best way for students to learn is by having the opportunity to teach, including the preparation of multimedia materials so that they can make presentations to their classmates.

So teachers are voting with their feet. If they are given a realistic opportunity to use multimedia in the classroom, they are doing so. In the ensuing sections we will examine why this is the case. We will begin by discussing computer-based multimedia, the plusses and some of the cautions inherent in its use. Then we will examine the basic components of multimedia systems. After that, we will look at the concept of hypermedia, which combines multimedia with hypertext for nonlinear data access and presentation. Finally, we will look briefly at some model schools and school programs which are experimenting with technology-rich learning environments, including the use of multimedia.

THE CONCEPT OF COMPUTER-BASED MULTIMEDIA

Teachers have always employed many means to capture children's attention and thus promote learning. As such, multimedia, interpreted broadly, is nothing new. Yet, in general, we rely on very basic tools to express the ideas conceived in the brain. As Wurman (1989) observed: "There are only three means of description available to us—words, pictures, and numbers. The palette is limited. Generally the best instructions rely on all three, but in any instance one should predominate, while the other two serve and extend. The key to giving good instructions is to choose the appropriate means."

In the classroom, teachers and students alike rely on words, pictures and numbers to convey ideas. These are the basic tools of intellectual conversation. But there are many ways in which words, pictures and numbers can be conveyed and many ways in which they can be supplemented and supported. The concept of multimedia encapsulates these many ways—full motion video, still images, text and sound—in which words, pictures and numbers can be

delivered for the purpose of conveying meaning. The concept also encapsulates the technologies used to store, edit, project, and transmit the data that are the raw material of meaning.

Multimedia Has Added a New Dimension to the Process of Teaching and Learning

Multimedia has allowed educators philosophically to escape the concept of education as a regimented experience, just as C&C, the Internet and e-Learning, which we studied in previous chapters, have allowed educators philosophically to escape the concept of the closed classroom. Students who are given access to multimedia courseware[6], whether as individuals or in groups, can take control of their own learning, constructing knowledge at a pace and in a direction that suits their needs and desires.

Otts, et al (2004) express this idea in compelling terms when they write:

> The MTV generation quickly loses interest in math topics presented on the chalkboard by some old fuddy-duddy 60's fossil lecturing about polynomials and rational numbers. A step forward is the use of the overhead projector, but students require even greater stimuli to hold their attention. Use of multimedia brings teaching methods into the 21st Century and helps students catch the dream of success in the 90's and beyond. Multimedia offers avenues for presenting material not possible with other methods, such as: (1) interaction, (2) animation to demonstrate concepts, (3) sound cues, (4) incorporation of stimulating visual effects such as flashing, and (5) nonlinear progression. . . New capabilities allow teacher-made [presentations] to be accessed via the internet, allowing students the opportunity to study at home.

The use of multimedia software applications is not new. Arithmetic and reading applications, for example, became available as soon as the PC and the Apple could support the level of video and audio required[7]. *Reader Rabbit* and *Math Blaster* were two highly successful early learning multimedia applications. Today's computers, including laptops, can all support the multimedia educational applications available on CD-ROM, some of which we highlighted in chapter 6. All subject areas have been enriched by multimedia, and in some academic areas, notably science, multimedia CD-ROMs and DVDs are replacing texts. *Plato Life Science* (http://www.plato.com/products.asp?ID=38) is just one example. Increasingly, multimedia CD and DVD content is included (sometimes at an extra cost) with history and other texts.

Multimedia, of course, can also be created. For the most part, as pointed out in Bruder (1991), "homegrown approaches in classrooms around the country have become the unofficial testing ground for multimedia—with positive results. Stories abound of ultra-motivated students and rejuvenated teachers working interactively, manipulating and creating projects, [and] producing concrete examples of things they have learned."

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6 Multimedia as a learning environment includes the thousands of educational software subsumed under the title of CAI (discussed in chapter 6).

7 This required the development of RAM memory and affordable digital video and audio cards.

Additionally, multimedia has made great inroads into making it possible for students with assistive needs and disabilities to learn with technology. For some, the audio or visual component of a text or learning unit is the only possible means of instruction, drill, practice, or tutorial.

Multimedia Authoring Tools

Coordinating the graphics, video, animation, text, speech, and sound in the development of a multimedia presentation is complex. For this reason, authoring software has been developed to assist students and teachers in this task. Authoring tools that are common in educational circles are Microsoft's *PowerPoint*, Roger Wagner Studio's *HyperStudio™*, *KidPix*, *MicroWorlds*, Cricket Software's *Clicker*, *eZedia*, and Apple's *AppleWorks Presentation* and *iMovie™*. More powerful (and expensive) presentation tools include Adobe-Macromedia's *Director*, which runs on both Apple and Windows platforms. Adobe markets products called *Shockwave* and *Flash*, which are popular tools for including animation in web page design.

In chapter 11, we will discuss the process of using multimedia courseware to develop presentations and, in that context, we will take a closer look at web page authoring tools. Before we discuss the special value of a growing subset of multimedia called *hypermedia*, we need to take a look at some of the tools necessary for the creation and viewing of the various media elements of multimedia courseware.

MULTIMEDIA HARDWARE

Today's standard classroom multimedia system includes all the components of a basic computer system—the computer itself, a color monitor, a CD/DVD read/record drive, a printer (which should be high resolution with color capability), speakers (internal or external), a headset, a mouse (or equivalent), and a keyboard or other input device. As we saw in chapter 7, the digital classroom also has a high speed connection to the Internet and should have a voice communication system as well.

Multimedia requirements have led to the extension of the basic computer system to include multiple tools for the creation, editing, and playback of multimedia. These technologies are constantly changing as innovation improves on the state-of-the-art. Luckily, hardware has a useful "life" of longer than the six months it takes to improve upon it. But at least you will get some idea of the kinds of tools available to help you teach and, above all, to help your students learn. There are three categories of multimedia hardware:

- data capture devices that are necessary to capture or convert information to the digital format that can be handled by the computer;
- data storage technology that is large enough and fast enough to facilitate easy use of digital material;
- data display devices that are good enough to allow the user to view multimedia material in the most convenient and high quality manner possible.

The following sections provide a closer look at these categories of multimedia hardware.

Data Capture Devices

Scanners Scanners are used to digitize flat (usually paper based) images or text so that they can be stored and manipulated by a computer. Flatbed scanners are most commonly found in classrooms (Fig. 10.2 on the next page illustrates a flat-bed scanner.) Fixed "pass-by" scanners and handheld scanners are often used in the library and for security control tasks within a school.

In chapter 2 we discussed the process of digitizing. You may recall that this process converts analog data—typically images (pictures, documents, and so on) or sound (speech, music, and so forth)—into the digital 1s and 0s of machine language. It is important to understand why the digitization of data is so valuable to us.

Fig. 10.2 Hewlett Packard flatbed scanner

Financial managers like to talk about "leveraging" the value of an investment. They might advise you to make a relatively small investment in this or that stock or venture in the hopes of making a high return. In the same way, we use a lever when we want to use a small amount of effort to move a large object. Leveraging, in other words, helps us get the most out of what we possess, whether it be money, or strength—or data. The fact is that, once data have been captured in digital form, their value can be leveraged more effectively than if they remained undigitized. This warrants further explanation; so perhaps a specific example will make it clear.

A teacher might organize a class project to put together a weekly newsletter highlighting the genealogy and family of one student in each issue. Students are informed that they will be including a photo alongside each article they write. The photos the students bring to class will usually be on paper, developed from a negative. The only way such photos can be used in the newsletter is by physically pasting them into the text. If this means they have to be cropped to make them fit, they can't be un-cropped. Effectively, the original photos might have to be destroyed. If the students working on the newsletter decide to move things around, they will have to unpaste (unglue!) the photos and hope that they will not regret having cropped them in the first place, and so on, and so forth. Photos and other pictures on paper are thus awkward to work with because they are inflexible.

If, on the other hand, you collect your students' photos and scan them into the computer, they become digitized and, as such, they can be duplicated, cropped, restored, moved, enhanced, dubbed, and otherwise manipulated and saved in a myriad of edited versions. The value of the original photos, once digitized, has thus been *leveraged* in an infinite variety of ways—without detriment to the originals. The digitized student photos are much more useful because they are in a more flexible format[8].

In general, a scanner digitizes a page as if it were a whole image. It makes no attempt to differentiate one part of the page or image from another. Special software on the computer itself is used to manipulate the scanned image, to prepare it for use in a specific project, to organize it in a digital archive, or to print it for distribution in hard copy. Specialized attachments for scanners make it possible to easily scan business cards, slides, negatives and transparencies, further increasing the value of this tool to a school. Scanners are generally "bundled" with the required software applications and many imaging applications, such as *Photoshop Elements* and *iPhoto* "talk" directly to most scanners.

Scanners can be used for text as well as for images, a useful tool for the teacher wishing to digitize teaching materials and tests, out of print texts, and news articles. The technology used to do this is called optical character recognition (OCR). OCR software must be installed on the computer accepting the scanner input and converting "images" of characters to editable text.

The Library of Congress, along with other libraries and museums, is currently in the process of scanning every image and every page of every book and document in its collections, indexing and storing them in digital form. Digital libraries leverage the already highly valuable knowledge contained in books, and the perhaps more important knowledge contained in photographs, movies, audio recordings and other primary source material, by making that knowledge easily available over digital media, primarily the Internet where schools are concerned. This ongoing project is available at the Library of Congress website (http://catalog.loc.gov/).

Audio and video digitizers Like scanners, these devices convert analog (continuous) sound and video into the digital (discrete) 1s and 0s of machine language so that they can be stored and edited in the computer. If one is using a regular analog video camera, after the recording has been made it can be digitized using the video digitizer. Once digitized, the video can be stored in any one of many formats and processed in the computer. Once again, flexibility is the major advantage of this process. Multimedia computers with video-in capability contain a built-in sound digitizer. Sound, for example, can be recorded in digital form, then cleaned up once it has been digitized by removing unwanted "noise". All that is necessary for this today is a plug-in microphone and a sound editing application.

[8] You might wonder why we are still talking about paper photographs when digital cameras and digital developing to CD are so readily available. It is most likely that a teacher in this scenario will have to deal with both paper and digital images, depending upon the student, the content of the newsletter, and the economics of the school.

Hardware exists today to convert every format of video (including old movie "reels") to a DV (digital video) format, generally as easily as connecting two replay devices to a digitizer[9]. One of the main uses of this technology is to create "canned" lessons that combine many short video clips into a single lesson package., something that previously meant running several VCR tapes in sequence. In another use, students are able to use "home movies" and clips from TV shows to enhance their projects, generally with the addition of voice-over narration and titles.

Teachers should be alert to the growing impact of *digital television*, a medium that is making inroads into the "home entertainment" world. Programming-on-demand has been, for many years, possible through educational off-air (and after-hours) recording of much educational programming, but this new trend makes it possible for a teacher to download (to DVD or TiVo) an advertisement free broadcast at any time of day, for use at a future time[10].

Digital video and still image cameras Video cameras, or camcorders, are useful for recording events of interest in any subject area. A digital video camera bypasses the conversion process, recording digital data (audio and video) directly onto its own internal memory or onto a removal memory medium. Fig. 10.3 illustrates the JVC mini-digital video camcorder.

Fig. 10.3 The JVC-GR-DVP3 mini-digital video camcorder

Once in the computer, video can be edited, and commentary added along with music. These are tasks once handled by professional video production crews, but the software available today for Macs and PCs makes it a relative snap. Students quickly learn the technical aspects of video editing. The resourceful teacher provides project ideas in the context of which the students can learn. Remember, the teacher is the facilitator of learning, not the fount of all knowledge. Once teachers step back and delegate rather than control, the students have more opportunity to exercise ingenuity and to learn by doing, which is the best kind of learning.

[9] Many of the new miniDV cameras can be used as digitizers if they have enough memory. Necessary cables are often included.

[10] Cable programming is subject to much less scrutiny than public TV broadcasts, in terms of it use in the classroom (Willard, 2002-03).

Perhaps a team of students has decided to research some aspect of life in the local community. Perhaps a class has been given the project to produce a video record of a field trip to some place of historical, ecological, scientific, ethnic, or other interest. A school might have different groups of students every week prepare a half-hour news show. To be effective, the video and other material assembled for such projects must be carefully designed, directed and scripted, much like any movie. Each of these activities greatly benefits students because they require, and develop, creativity, problem-solving skills, and communication skills.

Today, the digital camera is a useful tool for capturing still images in a digital form that can be edited in a computer. Fig. 10.4 illustrates the Sony Mavica DSC-P71 digital camera, which takes still images primarily, but can also capture as much as 1 hour of video in standard resolution mode[11] depending on the storage capacity of the media used.

The digital image is captured on internal memory, memory card or memory stick instead of on a roll of film. This picture can then be downloaded immediately (via USB or firewire) for viewing or for incorporation into word-processed documents, slide shows, posters, or presentations in general. The pictures stored on the camera can be erased and replaced with other shots without the delay and expense of film processing and developing, generally with "on board" camera tools.

Fig. 10.4 The Sony Mavica DSC-P71 digital camera

Students and teachers use such a camera for projects which involve the production of printed reports of all kinds and, increasingly, for digital projects of all kinds. In the Do Something About It section at the end of the chapter you will have the opportunity to further brainstorm ideas on how to incorporate audio, video, and still image technology into the curriculum.

Electronic instruments Electronic music is another useful adjunct to a multimedia system, especially if the teacher or one or more of the students in the class has learned to use the piano keyboard, guitar or other electronic instrument. Connecting to the computer via a MIDI[12] interface (cable and port), such instruments can be recorded, and even controlled, from the computer. Modern electronic keyboards can be programmed to provide tempo, beat, harmony,

[11] Most digital cameras can switch between high resolution and low resolution modes, the difference being the quality of the image (dpi) and the number of images that can be stored in the camera's memory.

[12] Musical Instrument Digital Interface, which is an industry standard

timbre, and other musical features that make inexperienced, even untalented, players sound good. Inexpensive software, such as Apple's *GarageBand*, do all of this and more, providing a child-friendly composition environment even if the only "electronic instrument" is the hands and voice. Fig. 10.5 illustrates the Kurzweil PC 88mx keyboard.

Fig. 10.5 Kurzweil PC 88mx keyboard

In a sense, electronic music keyboards are to music composition and production what a word processor is to writing. A word processor enables one to form words on the page by pressing the appropriate keys on the keyboard. Electronic music keyboards enable the beginner to generate harmonic sound by pressing keys on the keyboard. As a result, learners can more quickly produce presentable, even entertaining, music. This immediacy of pleasing response can have a powerful motivational effect, encouraging the learner to repeat the experience and progress to the next level of skill. As we noted already, this does not obviate the need for a good teacher. Quite the contrary, a good teacher will capitalize on the advantages to be gained from the electronic keyboard to introduce a wider audience of children to musical skills.

Many interesting exercises can revolve around the musical features of multimedia systems. These include music composition and independent tutorials, which are the focus of some excellent CAI software such as eMedia's *Learn to Play Piano* (bundled with a MIDI keyboard) and *Juilliard Music Adventure* from Tom Snyder/Scholastic.

Aside from its uses in musical and technology education, digital music media created in the classroom or computer lab by a student[13], for his or her own project, has the advantage of being safe from copyright infringement, no small matter when projects are made available to a large audience. We will investigate copyright considerations later in this chapter.

Bar code readers Imagine that you are giving a lesson on the American Revolution. You have a multimedia system with a DVD player (or laserdisc[14] player) and a large screen in position

[13] With the popularity of the iPod and similar devices, and the availability of songs and entire albums online, students of course are quick to insert someone else's audio into their projects.

[14] Even though laserdisc players are not longer manufactured, they were once a sizeable, and educationally sound, investment for a school, and have therefore been maintained by many AV/IT departments. DVDs with indices and keys are now serving the same purpose in the classroom.

for the class to view projected material. In one hand you have your lesson plan, in the other a wireless (remote controlled) hand-held bar code reader such as that illustrated in Fig. 10.6.

Fig. 10.6 Symbol LS 4000 hand-held bar code scanner

At various points in the lesson you plan to show art work, video clips, or photos of original documents, so you have positioned the appropriate bar code at each of those points in your written lesson plan (or you are using a lesson plan already designed to accompany the DVD). When the time comes to show each media element, you scan the bar code on your lesson plan with the bar code reader and immediately, without any fuss, the media is displayed on the screen. The image is high quality, the sound is crisp and clear, the lesson comes alive.

The bar code is exactly the same as those to be found today on every item sold in stores. The black and white stripes stand for 1s and 0s (sound familiar?). The bar code reader shoots a beam of light at the bar code. Black stripes absorb the light, so there's no reflection; this will be recorded as a 1 (one) in the computer controlling the player. White stripes reflect the light; this will be recorded as a 0 (zero). The combination of 1s and 0s makes up the address of the location on the disc where the art work, video clip, or photo is stored.

This sounds like a simple way out of a teaching quagmire—and it was. Use the technology if you can find it. Otherwise, you will find that educational DVD's and content rich websites, and those created in-house, provide hypermedia navigation systems (discussed later in this chapter), much like those used by cable TV's programming screens, mall kiosks, and commercial DVD videos.

Probes and Microscopes Real-time display of collected data is a powerful AV/IT experience. Imagine, for example, collecting heart-rate data from a physical education fitness class—and displaying class averages and individual results on a monitor for all to see. Imagine also the impact of an elementary school lesson on leaves, or the biological diversity and similarity of hair, which uses a digital microscope to project, and save, "close up views" for the entire class. Teachers who are able to use these inexpensive devices find that they stimulate curiosity and

discussion much more than words or text images. Fig. 10.7 shows a temperature sensor that can be used with a laptop computer or a handheld device.

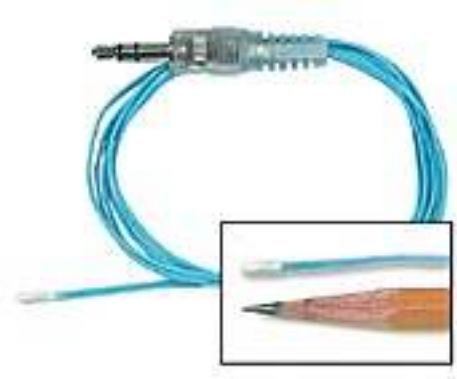

Fig. 10.7 Temperature sensor from Pasco

Data Storage Technology

CD-ROM, DVD These two storage formats appear identical; each is a flat disk identical to a music CD. Both use laser technology to "write" still and full-motion images, text, and audio, including multilingual sound tracks, making them available for integration with other curriculum materials and incorporation into lesson plans. There is a significant increase in storage capability, however. A CD-ROM will hold up to 750MB of data; a DVD will hold up to 17GB, the equivalent of several full-length movies[15]. Today, CD-ROM/DVD-R and RW (Read and Read-Write) drives have replaced the "floppy disk" drive[16] in most desktop and laptop computers.

Not surprisingly, there has been some impetus to develop educational materials for these two formats. Many texts in math, science and technology come with CDs or DVDs (or both) containing multimedia resources, and often quizzes and tests, to supplement the printed material. Copyright free CDs of images, photographs, fonts, design templates and audio clips are readily available for purchase and in some subject areas, notably drama and history, there has been significant development of both formats for the delivery of primary source and simulation instructional materials. There has been some development of CD and DVD self-contained texts, the *Fresh Science* curriculum from ScratchCat being one of the newest, but this has not taken off as much as many educators had hoped it would[17].

One growing use of writable CD-ROM and DVD disks has been to create in-house "media object" archives. Such media, when within the bounds of copyright use, can be duplicated and distributed to multiple students, classrooms and schools.

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15 More often, you will find DVD-R discs recording around 5GB of data, or two hours of video.

16 Like the laserdisc, the floppy disk still exists. Portable floppy disk drives, connecting via a USB port on the computer, are often found in classrooms and labs.

17 A major reason for this, as we will discuss later in the chapter, is the rise of the Internet as a tool for the delivery of multimedia content.

Moreover, many teachers have discovered that 35mm film can be developed onto CD-ROM, in addition to or in place of standard photo prints, giving them instant digital images and further leveraging the available technology.

Portal small storage formats Students and teachers creating multimedia projects in the classroom or computer lab often find that storage of media files becomes a problem. For this reason, many schools have invested in *flash* disks, an inexpensive mini-hard drive that can be worn on a lanyard or keychain and connects to the computer via the USB port. Fig. 10.8 shows the DiskGO flash drive. Flash drives are available in many memory sizes, from about 128MB to over 4GB, with a subsequent variation in cost. At the smallest level, they are accessible to most families, and many students may have their own[18].

Fig. 10.8 DiskGO flash drive

Other schools are investing in portable technologies for image and video storage, such as Compact Flash and Smart Card memory cards that are used in digital cameras. When also used with a plug-and-play card reader (or a card-reading photo printer) these make it possible for many students to share one camera for project development. The relative inexpensiveness and ease-of-use of these portable formats, compared even with the CD or DVD, make them increasingly popular in today's schools.

External hard and tape drives Only those teachers who undertake major multimedia projects, such as serious film, a TV station, or video instruction, will need this much data storage. However, it is included here with an important caveat: Never underestimate the amount of storage a multimedia project will require! The most frequent cause of school network failure is "media overload," caused by moving too many large data files through a network at once, as virtually every college and university discovered in the hey-day of Napster. On a smaller scale, many teachers have learned the hard way that the classroom computer's hard drive, or the computer lab network, is not up to the job of storing files for even a simple multimedia project. External hard drives are often portable, although not nearly as portable as the technologies listed above. They do, however, store gigabytes of data and connect to the computer via the ultrafast *firewire* technology, making them useful for multimedia project development as well as backup. Tape drives, which use removable magnetic tapes to store data, are generally used for essential

[18] This is of concern to many schools and teachers, for personal drives can be used to transfer applications, images, and viruses that do not "belong in school."

server backups and archiving, for the tapes can be physically stored in a separate location, accessible in case of fire, virus attack or other disaster.

Computer and Network Storage For small media files and file distribution, the fastest storage, and sometimes the only storage, is on the classroom computer hard drive. As long as the teacher, or a knowledgeable student, remains constantly aware of the memory available on the computer(s), this is a safe system. In fact, most media files, especially large files, should be opened only after moving them off of external storage media and onto a local drive.

The computer network, including the Internet, is a good solution for teachers wishing to make media files, or "learning objects," available to others anytime, anywhere there is an Internet connection. A broadband network connection is recommended, however, for uploading and downloading media files over a dial-up or P2P connection can be painfully slow. Apple's *.Mac* account, which is actually storage space on a remote computer, is one example of the inexpensive commercial solutions to media storage. Networked schools generally make storage space available to students and teachers on the school's data server, which in some cases can be accessed from home.

Data Display Devices

Projection systems Often there will be situations where the computer will be used to display material to a large class group. A teacher may want to demonstrate software, or display data sets, or display graphics developed from data sets, or display work such as word processing which is the product of group collaboration. In such situations, the small size of the computer screen makes it impractical for working with more than one or two students at a time[19].

For whole class multimedia presentations it is useful to have in the classroom a large screen along with high-powered video projection. Ideally the projector, to which a computer or other digital hardware can be connected, will be ceiling-mounted. This way, the projection is unlikely to be blocked by student or teacher movement around the classroom. The expensive projection equipment is also safely out of the way. Fig. 10.9 illustrates a typical installation for a ceiling-mounted projector.

Fig. 10.9 Ceiling-mounted projector

[19] Some laboratories have installed on each computer a "monitor monitoring" application, such as *NetOpSchool* or *Show and Tell*, that allows the teacher to project one desktop to all stations.

Chapter 10: Educational Multimedia

In a truly "smart" classroom, all devices that can be projected (slide projectors, DVD/CD-ROM, laserdisc, computer, document camera, TV, videocams) are controlled from a central podium, which functions much like a kiosk to give the instructor control over the media he or she elects to display.

The LCD projector can also be set up on a cart or a desk (Fig. 10.10). This has the advantage of portability. The projector can be taken on the road for presentations at conferences and so forth, or moved from class to class within a school building as the need arises. Portable projectors are less expensive. They have the added advantage of being "plug-and-play," allowing teachers with laptop-using students to easily show presentations directly from their personal laptops.

Fig. 10.10 Projector set up on a desktop

Visual Presenters/Document Cameras Devices such as that illustrated in Fig. 10.11 are excellent, in combination with a projector (which is often part of the device), for the display of a wide range of three dimensional objects, as well as transparencies and paper-based text or graphics. Everything from a Palm pilot training session to a lesson based upon maps or artwork can be enriched by projection, rather than hampered by the need to pass the visual display around the room.

Fig. 10.11 Sony's DC-13 document camera connected to the ceiling-mounted projector

Large screen, high resolution color monitors The monitor is naturally at the heart of a multimedia system. Indeed, one can say that the quality of the monitor affects the quality of the entire system. No matter how powerful the computer is, or how extensive the collection of instructional DVDs, or how super the sound system, if the images displayed on the screen are not large enough or crisp enough, the impact will be impaired.

The monitor/receiver should be at least 25" (measured diagonally from, say, the lower left corner to the top right corner of the screen) with a screen resolution of 640 pixels by 480 pixels at the low end, and 1024 pixels by 768 pixels at the high end. You may recall from chapter 3 that pixels are picture elements or dots on the screen. The more pixels your screen can individually paint, the greater the precision of the image displayed, which translates into higher resolution. The larger the screen, however, the higher the resolution needs to be in order to maintain a sharp image. An average resolution may look quite good on a small screen, but the same resolution will look less sharply defined on a larger screen.

Video display technology has advanced to the point now where large screen, flat panel, high definition digital displays, either LCD or plasma, are available for use in the well-heeled home. It is a matter of time before they will become ubiquitous in schools as their popularity brings down the price. Apart from the dramatically improved picture quality, the flat panel feature means that the displays (up to several feet in diagonal dimensions) can be hung on the wall, or even be built into the wall. New developments based upon nanotechnology and plasma technology, are making it possible to replace "wallpaper" with digital displays, surely ideas of the future, but nonetheless coming ideas. The multimedia classroom of the future will be very different from that of today.

Touch screen systems Voice recognition and touch screen systems can motivate students because of the intuitive nature of the interaction. To-date, few applications have been devised that use touch screen in the classroom environment,[20] but this technology, along with voice recognition, is becoming more popular for interactive computer systems in public spaces, businesses and so forth. It is likely that the technology will find increasing application in schools and the home because of the ease of use afforded by touch and speech.

One extension of the touch screen is the interactive *SmartBoard*, which enables teachers and students to control and interact with a computer application by manipulating, or "touching," its projected image. This is a wonderful way to make a lesson come alive!

Speakers If the quality of the audio output that is built into the computer system that controls the multimedia system is unsatisfactory it is a good idea to add external speakers. This inexpensive enhancement can make an appreciable difference to the quality of the multimedia experience.

Virtual Reality and Student Controllers No discussion of the multimedia classroom of the future can be complete without virtual reality headsets and student media controllers, technologies currently on the drawing board. There is no reason for the learning experience to be the same for every student in tomorrow's classroom. Students will take on the role of explorer, with or without maps. The teacher will guide students to selected materials, engage students

[20] One that does is *Clicker*, a presentation and writing application for early readers.

individually and form collaborations, observe and assess interactive learning, and develop follow-up instructional strategies. In other words—teach.

Here is a vision of the future developed by Mark S. Valenti (2002), a designer of educational spaces:

> An instructor enters classroom #104. As she does, the identification in her bracelet automatically connects to the Web-based control system, which immediately begins to configure the presentation system, network, and room fixtures to her preferences. By the time she sets her briefcase beside the desk, the surface display on the desk has her parameters set, the class Web site is online, and the lights, window treatments, and sound system are being adapted. Students settle in, adjusting heads-up displays and getting out their wireless pens. The instructor waves her hand over the display on the desk surface and turns to the front wall and to the image that appears there, a three-dimensional representation of [course content]. . . Twenty-two students in seven states scribble on digital tablets. Another forty will access the files within twenty-four hours.

Educational multimedia is thus a central component of the 21st Century school, joining web-based communication systems and e-Learning on center stage.

SOFTWARE FOR MEDIA OBJECT PRODUCTION

We will deal in chapter 11 with some key tools that students and teachers can use to create multimedia, hyperlinked projects. Before using these productivity tools, however, the individual media objects must be created, refined, and made compatible with the productivity application. Each media technology has its own set of tools.

Audio input is achieved by one of five means:

"Ripping" a sound clip from one digital medium (often a CD) for use on another requires a software application designed to isolate a sound track and/or section of the track, copy it, and send it to an editor. *QuickTime Pro* is one application that can do this; other applications are freely available on the Internet.

Recording sound with an internal or external microphone requires nothing but a sound card or sound digitizer (which can be a separate device and is often built into a computer), an inexpensive microphone, and software to manage the record/save process. Such software often comes preinstalled on multimedia computers and many versions are available free for Internet download.

MIDI input requires a MIDI-enabled device, such as a guitar or keyboard, and an application that can collect the data stream, display it as a musical score, and save it in the desired format. Band-in-a-Box from PG Music and GarageBand from Apple are two such applications.

Digital music creation software allows the student, without a MIDI instrument, to create, edit and save audio files simply by manipulating the software's menus or using the keyboard. *Music Ace* is one example.

Downloading a sound file from the Internet, from a CD or DVD sound archive, or from another computer on the network requires nothing more than access to the files and an application on the local computer that can play them. *Real Audio*, *Microsoft Media Player* and *iTunes* are the most used media for replay. Today's students and classrooms may include an iPod or similar device for storage and replay of sound objects.

Many productivity applications will do one, if not all, of these tasks. Once saved to the local computer (or other storage media), the audio file must often be edited in some way so that it is compatible with the end product's needs. There is a wide range of applications for this task as well, but look first for editing tools in the input/capture application. A good sound editing tool will: save in multiple formats, allow the user to "crop" the sound, copy/paste sound clips, and add multiple sound tracks (for voice-over-music, for example). Many applications allow users to significantly transform a sound, fun for students but often not necessary.

Digital image input is generally achieved though scanning, direct import of a digital file (from a camera, saving device, or the Internet), or the creation of original "computer art." Few images, icons, WordArt files or drawings are perfect as created or imported. Many, if not all, of them will require some "tweaking," if only to reduce the file size and guarantee compatibility with the production tool of choice. You may remember that tools for the editing and manipulation of digital images were discussed in the Productivity Software sections of chapters 5 and 6. Of all tools, these are the ones with which the teacher should become most familiar. As is true with sound editors, a good digital image editor must be able to convert files from one format to another (always including .gif and .jpg), crop, and enhance by combining with other graphical elements and text. Most digitizing hardware tools come with a basic image editor.

Digital video input is a slightly different can of worms. "Raw" video footage, unless intended for "live" replay (videoconferencing, lecture film, performance video) generally requires a significant amount of editing. Nothing can be more rewarding that a student video project, but the teacher who undertakes to guide such a learning adventure must have access to video editing software that can be used easily by the students. Whether filmed in-house, ripped from DVD, TV, VCR or other prerecorded footage, or downloaded from an Internet resource, the video will need to be cropped (significantly) and titles and credits will need to be added. Apple's *iMovie* and Microsoft's *MovieMaker* can easily be used by students as young as elementary school. There are many choices for video output format and the best tool allows users to save or export final videos in more than one format (including the memory-saving QuickTime format).

Output-to-CD/DVD is accomplished with yet another software tool, generally shipped with the recording or input device in "light" form or included in operating system. Roxio's *Toast* and Apple's *iDVD* are commonly used tools. Teachers use this application to create (or "burn") their own audio, video, and multimedia CDs and DVDs. It can be as simple as copying individual files to an application's "in" window, or as complex as creating a fully indexed and hyperlinked autostart application, complete with menu (read about it below).

Organizing media objects can be done the hard way or the easy way. As you know by now, an organized and sensible system of folders-within-folders is an organizational necessity. But applications also exist to further streamline the saving, cross-referencing, and eventual recovery of multimedia. Some of these are web-based, some sit on a server, others reside on the individual computer. Teachers should work with the technical support personnel of the school or district to learn to access and use these timesaving applications.

HYPERMEDIA SYSTEMS: BRINGING IT ALL TOGETHER

Goldfarb (1991) describes hypermedia as "the union of two information processing technologies: hypertext and multimedia. Hypertext information is accessed in more than one order. Multimedia information is communicated by more than one means." Hypermedia, then, is media accessed in more than one order, an order controlled by the user. It is this interactivity that makes hypermedia such a powerful tool for teaching and learning.

Hypertext

Hypertext is text that has *links*[21] embedded within it, forming a web of connected information, rather like the neural network that we call the brain. When we think, we often rely on associations that direct us along a path that represents our train of thought. The more experience and learning we have absorbed in the past, the more associations we are able to draw on—hence the value of education. A hypertext system is designed in a similar way, allowing the reader to jump from one piece of information to another in a semi-random, *nonlinear*[22], order. This contrasts with the traditional page-by-page, start-to-finish linear order in which we tend to work our way through a book, a video, or a piece of music.

Early hypertext systems were purely text-based. An online database was comprised of publications or other textual materials, and the associations or links were bound to words and phrases within the same document or in documents elsewhere in the database. The user would select or highlight a set of characters and tell the system to find more material related to the selected text. The system would then conduct a rapid search of the entire database and either list the locations where items of related interest could be found for the user to choose from, or inform the user that there was no other text associated with the selection. This is similar to the "search" function found in web browsers, applications and operating systems.

Today, hypertext (sometimes called "clickable text" because the standard cursor changes to a pointer when over a link and the user clicks the mouse to follow it) appears in World Wide Web documents, in most word-processed documents (where it is often called a *bookmark*), and in multimedia presentations of every kind.

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21 Short for *hyperlinks*, which are references (words, images) that move the user from one place in a hypertext document to another, or to an outside document or file.

22 Nonlinear means non-sequential or, essentially, random. In principle, the user selects the order in which to access the information or file.

Hypermedia

In 1987, John Sculley, former CEO of Apple Computer, Inc., had this to say about hypermedia: "Hypermedia ... means that you don't have to follow a predetermined organization scheme when searching for information. Instead, you branch instantly to related facts. The information is eternally cross-referenced, with fact linked to fact, linked to fact" (Goodman, 1987).

Client[23]-side hypermedia are those created for purchase as application courseware by schools or families, or those created by the students and teachers themselves. In this category fall CD-ROM dictionaries and encyclopedias and hypermedia texts. The category also contains many "edutainment" games, such as *Civilization*, that can be used to supplement both content and concepts in a learning unit, and CD-based text/learning software, such as Decision Development Corporation's *DDC Science* and *DDC Social Studies 2000*.

It is easy to see why many teachers are eager to find a hypermedia CD-ROM or DVD that is appropriate for the classroom, for the content is preselected by a production team and, by the nature of the medium, limited. A good multimedia product will be rich in primary source material, whether it be photographs, audio and visual archives, digitized documents, maps, statistical data or recorded performances, and will provide interpreted information and summations that are consistent with the curriculum. With such a product, students interact with the system, determining for themselves the pathway that they will take through the knowledge base. They can use the note taking tools that often accompany the system to develop projects/presentations of their own, drawing on the audiovisual and textual material to meet their academic needs.

The drawbacks to such materials have been significant enough to slow down product development: quality control is often lacking and the cost of producing (and thereby buying) an excellent product often makes its use in the school, laptop classroom or lab (times 20 or more student users per class!) prohibitive. For this reason, commercial educational hypermedia is often broken into separate CD's by purpose (primary sources, media clips, etc.) and bundled with printed texts (or available for an additional price).

This is not to say that the teacher has to give up hope of using, or developing, hypermedia. All of the presentation tools introduced in this and earlier chapters create hyperlinks and embedded media files of just about every type, and those that do not do so today will do so tomorrow. Remember that *making* media is often a more powerful education experience than *using* media! There is more about this in our section on Media Literacy. Tools for making hypermedia products will be explored in chapter 11.

Hypermedia and the Internet

Online and standalone multimedia encyclopedias such as *World Book Encyclopedia* are examples of hypermedia databases. The user selects an item for study and, in the course of the study, may want to delve more deeply into a related topic with links to a video clip, diagram, photo, and so

[23] The *client* in this case is the individual user of the product. Most licensing allows for one user on one computer per CD-ROM.

forth. Following links, the user might be drawn to all kinds of information on a voyage of discovery which, like that of Columbus on his voyage to the Americas, may not end up at the originally intended location, but which, notwithstanding, may well have a happy outcome.

The Internet itself, of course, is the quintessential hypermedia environment. Sculley thought of this hypermedia environment in the context of a standalone desktop computer system. But once the World Wide Web was invented by Tim Berners-Lee in the early 1990s, it wasn't long before users could access a global information network of "eternally cross-referenced data" that went way beyond Sculley's 1987 dreams[24].

The rise of the Internet, with relatively inexpensive authoring tools that facilitate the distribution of multimedia objects, is attractive for classroom use because it can be endlessly configured and it is free (after, as you learned in chapter 8, the cost of access). It should be remembered, however, that just about anyone can post a multimedia web page. Students and teachers today, in search of multimedia learning and following hyperlinks, often "surf the web" for information, sailing like Columbus from link to link on grand adventures in uncharted territory—hopefully with a goal in mind. Directing and harnessing these multimedia adventures has become one of the greatest challenges faced by the teacher.

Information Literacy was discussed in chapter 8. You will remember that it contains three skill elements: searching for information, organizing and sharing information, and constructing learning based upon information found. In is in constructing effective research projects that teachers can guide students through the hypermedia rich Internet. Without such a structure, they will be sidetracked by the allure of the very media that can be the highway to learning. We provided a link in chapter 8 to the American Library Associations Information Literacy resources, a link so important that we are repeating it here:

http://www.ala.org/aaslTemplate.cfm?Section=Information_Power&Template=/ContentManagement/ContentDisplay.cfm&ContentID=19937 (remember that this link will download a file).

Media Literacy

Multimedia is a powerful medium for teaching and learning, condensed in the hypermedia Internet experience. Wilson (1991) describes the educational value of the myriad dimensions of multimedia when she writes:

> The adults of tomorrow will need to be skilled at accessing, filtering, and managing such multidimensional [multicultural and multi-sensory] information. And they'll need to be able to reflect on it, question it, and customize it for their needs.
>
> To do this well—to succeed in the information age—interpretive skills such as problem-solving, creative thinking, and a sense of open inquiry are becoming more important than ever. As the complexity of life and work compounds and the boundaries blur between the educational process and life beyond school, abilities such as coping with multiple points of view, working with others, and conflict resolution will become ever more central. As educators, we'll have to treat these skills as key educational goals.

[24] Wikipedia (http://www.wikipedia.org/) is perhaps the fastest growing example of such a hyperlinked research goldmine.

Chapter 10: Educational Multimedia

By condensing access to multiple media on the Internet, schools are providing students with information and misinformation presented in forms that are often manipulative, rather than educational. Media Literacy is a growing field of study and an instructional approach that seeks to address the skills cited by Wilson. Much like Information Literacy, which is focused up critical analysis of Internet-delivered information, Media Literacy is centered upon the multimedia and mass media content of the student's education and experience. Summarizing Hobbs et al (2003), it is the responsibility of the teacher using media and the Internet in the classroom to:

- not merely view (or listen to) media, but engage students in discussion *about* the media, and do so from multiple points of view;
- seek out, discuss and question the values and purposes of the creators of the media used in the classroom and found on the Internet;
- not merely create media (although creation is an important part of literacy), but think critically about the impact and use of the different ways in which media can be presented.

Luckily, there are good resources for teachers at all levels who wish to learn more about media literacy. Not surprisingly, these are centered in several websites, one of the most current being CML (Center for Media Literacy), http://www.medialit.org/.

USING COPYRIGHTED MATERIALS

It will be useful here to consider again the problem of copyright, which we first discussed in the context of the Internet in the previous chapter, and which we will return to in the context of software piracy in chapter 15.

Fair Use

When scanning or downloading copyrighted text and images[25] in order to incorporate them into presentations or newsletters or other media, schools in the United States are covered, in general, by what is known as the doctrine of "Fair Use." This set of guidelines, enacted by Congress in 1976 and expanded in several amendments to cover multimedia use in schools, sets limits as to the size or scope of media object that can be used by students and teachers, how much it can be transformed, and the legitimate uses to which such copied, ripped or downloaded objects can be put. According to Willard (2002-03), four factors are involved in the Fair Use doctrine:

1. **What is the purpose of using the copyrighted work?** If your use of the material is for the purposes of non-profit teaching, you may not be infringing on copyright as long as you don't abuse factor 3 below.

[25] All products of creative effort or individual expression are copyrighted in the United States; no © or registration is required. Works published or created previous to 1923 are in the "public domain" unless copyright has been renewed through republication, sale or other means. Works published from 1923-1963 may be in the public domain if copyright has not been renewed. Authors may choose to place their work in the public domain or grant permission for limited use for education; look for notice to this effect.

2. **What is the nature of the copyrighted work?** Copying artistic work of various kinds is usually more legally sensitive than copying instructional material ("factual works"). But teachers are hardly likely to be sued on this account if they act within the constraints of the other three factors of the Fair Use doctrine.
3. **What is the amount of work copied in relation to the copyrighted work as a whole?** If a teacher copies whole chunks of texts—say, several chapters—and, without permission from the author, hands them out to students, this could well be seen as an infringement of copyright. The same "distribution" violation occurs when teachers, or students, post someone else's work (a poem, an image, a song, etc.) to a website where it can be publicly viewed or even downloaded. Software is another case in point. When you copy software, you copy the entire work. Schools which make unlicensed copies of software for use by students are obviously violating the Fair Use doctrine.
4. **What effect does the use of the copyrighted work have on the potential market for that work?** Artists, composers, photographers and writers of books or software devote years of effort to their creations. Their work may be their only means of livelihood. If copying undermines that potential, it stands to reason that this would be an infringement of the Fair Use doctrine.

Some Suggestions

We will take a more extensive look at this issue of copyright in chapter 13. For now, remember the four criteria above when judging whether you are “fairly” making “use” of other people’s work and remember always to:

- request permission to use large media files of any type, such as videos or whole songs;
- display copyright information with the image, sound or video file, even if it is in the public domain;
- give proper bibliographic citation for all media used;
- resist the temptation to copy multimedia CD-ROMs, software applications or other purchased or borrowed collections of project media;
- include on the title page of every project an acknowledgement that your work "contains media used under the doctrine of Fair Use";
- encourage students to create their own media or to use that created and freely distributed by others[26];
- invest, if possible, in "copyright free" media collections;
- create a multi-school archive of copyright-free media materials or objects;
- develop a web page listing websites where copyright free (to education) media can be downloaded;

[26] Local teenage bands are often eager to have their compositions recorded for project and video use.

- teach students about copyright by informing them about the copyright of *their* work; get written permission before printing or displaying student work to a website or newsletter.

It is important for teachers to teach their students about copyright, Fair Use and correct citation forms. The ease with which students can now download media from the Internet, over the World Wide Web or P2P connections, has led to serious copyright infringement issues in the first few years of this century. Furthermore, it becomes plagiarism when students present all or part of the work of another as their own. In addition to teaching about it, modeling correct citation and use of media resources is essential. The teacher who fails to follow Fair Use guidelines is sending a powerful message to students.

MODEL SCHOOLS

Let us conclude this chapter by looking briefly at what happens when teachers are given the time, training, and logistical and technical support to produce "break the mold" schools that incorporate into their curricula the computer-based teaching and learning technologies and methodologies that have been profiled in chapters 4 through 10. The following projects are representative of the many other schools where a serious commitment has been made to integrating the computer into the curriculum.

Christian Brothers College High School in St. Louis, Missouri opened its new AV/IT facility in the fall of 2004. Integral to the design of the physical school is a state of the art audio system and wireless networking. All students have laptops and there is not a single chalkboard in the school. The following describes the standard teaching station:

> The old oak teacher's desks are gone. In their place are bi-level teaching podiums in each classroom that offer audio, video, Internet, phone, and security access, as well as a traditional workspace. Multimedia control is from either laptop computer (that slips into a docking station) or from a Crestron CT-1000 touch panel embedded in the teaching station surface itself. The Crestron interfaces with a cable-TV connection, a Sony VPL-PX11 LCD projector (to a 72-inch Smart interactive white board that allows access and control of any application projected from a laptop source), a document camera, a Samsung DVD-R, and a VCR. Audio/video sources and the laptop are tied to the in-ceiling loudspeaker system. The A/V components in each classroom are housed in an equipment closet and connected through a conduit connected to the teaching stations. (Cont, 2004)

The School at Columbia University is a new k-8 charter school founded by Columbia University. Housed in five floors of a city building, it was designed around technology that can be used seamlessly by its young students. The following excerpt from The School's self-description (2003) explains its vision for use of technology:

> . . . the audiovisual technology employed in each classroom encourages students to demonstrate their understanding of the curricular objectives using various media. As such, the use of technology goes well beyond drill, practice, and rote computing to challenge students to first comprehend curricular concepts and then coherently

> demonstrate their own understanding. This involves not only comprehension of how one communicates effectively, but also discerning the inherent strengths in specific media chosen for one's message. Such skills are increasingly important in an age that depends heavily on the generation, communication, and processing of information.

Unlike CBC, The School places its AV/IT controls in the hands of students as well as teachers. In place of a central podium, classrooms have a wall-mounted control panel with push-button control of the various technologies. Like CBC, The School relies upon laptop, rather than desktop technologies, in this case the Apple iBook. They provide an almost 1-1 ratio of laptops to students.

These two programs as too new for there to be valid measurement of the impact of the technology on student learning. However, other programs have provided insights into probable outcomes.

The WEB Project is not a school, but a non-profit organization based in Vermont. Dedicated to using multimedia and communication technologies to improve student performance in school and to support the development of problem-solving, critical thinking and reasoning in students in rural Vermont, the project uses online tools to link students to "experts" and mentors. Creative media projects, largely centered upon musical composition and visual arts, are designed and completed by students in collaboration with the online team and other students. The program was selected as a Promising Program by the US Department of Education. The following is from the report of the Education Technology Expert Panel (2002) on the WEB Project:

> As a result of their participation in the WEB Project, students improve their technology skills as well as their performance in the arts by engaging in discussion with mentor experts. There is greater student engagement in learning tasks when students are using the technology to design and deliver products and performances than when working on traditional classroom projects or assignments. In addition, students exhibited increased time on task.

Moreover, Sherry et al report in their summary of the first three years of the project (2002) that in addition to improvements in student academic motivation and problem-solving skills, teachers learned through their involvement in the program. This learning involved new technology and telecommunication skills, but also new teaching and assessment methodologies and the willingness to accept multimedia projects in the place of traditional reports and essays.

Helen King Middle School in Portland, Maine has embraced the project-based Expeditionary Learning model, which is a New American Schools design. Highlighted by the George Lucas Educational Foundation, the programs is described by Diane Curtis (2004) in this way:

> At least twice a year, students, who stay with the same group of teachers for two years -- a practice called "looping" -- undertake 4- to 12-week interdisciplinary projects. Besides incorporating such subjects as art, science, and language arts, the projects include well-considered use of computer technology, which has been enhanced by the decision of the state to provide all Maine seventh and eighth graders with iBook laptop computers.

Chapter 10: Educational Multimedia

Not all King Middle School students produce technology-based projects to represent their learning, but all learning outcomes are non-traditional, in the sense that they are not on paper and they are not assessed by testing. Since the school undertook this technology-enabled program, "test scores have shot up -- a major accomplishment for a student population that is 60 percent low-income and 22 percent refugee and that comes to school speaking 28 different languages. Following years of below-average scores on the state achievement test, King students began outscoring the state average in six out of seven subjects in 1999, and they even moved into the top third in some subjects." (Curtis).

These model programs are not yet the rule, for many reasons. Among these are cost, which is prohibitive for many schools and districts; professional development for teachers, which is costly in both money and time; distrust of the shift in classroom pedagogy from traditional "teacher-centered" to more "student-centered" learning models that focus upon collaboration and inquiry; and distrust also of the related shift away from traditional assessment methods, such as benchmark testing, and toward rubric and other authentic assessment methods.

You should know, however, that there are a growing number of large and small resources to help schools move forward with the adoption and integration of new multimedia technologies. We will cover grants and funding options in a later chapter, but you might want to take at look at The George Lucas Educational Foundation (http://www.glef.org), which does not make grants, but it does disseminate, through a multimedia website, models for effective innovation and resources for teachers and administrators.

LOOKING BACK

This chapter has argued that multimedia, which does NOT remove the need for careful lesson planning, takes much of the hassle out of using AVAs, especially when the teacher has access to a classroom multimedia system. Multimedia CD/DVD and Internet-based programs that replace traditional textbooks are becoming increasingly available to schools and copyright free "media objects" can easily be shared by classrooms, schools and districts.

We have seen that students are increasingly creating multimedia projects and presentations to synthesize and share learning, and that evidence suggests that engaging students in a multimedia representation of learning increases both motivation and learning outcomes.

Model classrooms, schools and school districts worldwide are leading the way for others. We can learn from them by reading about them,[27] by attending conferences where their representatives present feedback from their experience, and by visiting these schools in order to see for ourselves what can be achieved. American education is a sleeping giant that appears to be on the verge of waking up. Let us hope so, for if the giant sleeps too long, it may wake up to a world that has passed it by.

[27] *Technology & Learning* (www.techlearning.com) , *MultiMedia & Internet @ Schools* (http://www.infotoday.com/MMSchools/default.shtml), and *edutopia online* (http://www.glef.org) are just three of the journals highlighting school use of multimedia.

Chapter 10: Educational Multimedia

LOOKING FORWARD

In chapters 4 through 10 we have discussed the range of applications of computer-based technology in schools. In chapter 11, we will examine specific ways in which teachers and students, but especially students, can use programming and authoring tools to design and create their own applications for teaching and learning. At various points in earlier chapters we have discussed the idea of "writing to learn." We have also discussed a related concept, that of "teaching to learn"— the best way to learn is to teach, as any teacher knows. So when students create electronic portfolios of learning materials and share them with classmates they are, in effect, teaching themselves and their classmates, too.

But giving computers to students before giving them to teachers is like putting the cart before the horse—it is definitely not the way to foster the best kind of computer use in schools. No matter how sophisticated computer-based learning systems become, children will always need the teacher as director/manager of the learning process. Therefore, teachers must first come to understand and appreciate the impact that computers can make by becoming confident computer users themselves.

Successful applications of computer technology occur in environments where planning and design are supported by leadership at all levels and informed by experience. The best leaders empower their associates. When schools initiate technology projects, those responsible for overseeing the projects should call on all available expertise from the top down; without commitment at all levels, attempts at innovation will fail. As Becker observed in *Technology & Learning* (November/December 1992), "...people generally forget about a key element to success: "buy in" on the part of teachers and administrators."

The empowerment of those involved at all levels of an organization is a practice promoted in the concept of quality control circles (QCC), long advocated by Dr. W. E. Deming and J. M. Juran (Berger, 1986). The idea behind QCC is that the people with direct hands-on involvement with a project are the ones best placed to monitor and influence the quality of the end product. Deming and Juran's ideas, promulgated during the 1950s, fell on deaf ears in America; however, they found a receptive audience in Japan, when that country was struggling to recover from the devastation of World War II. Twenty years later, Japan was emerging as a leading industrial power. The name of the game was quality brought on by empowerment of the people closest to the production of the end product.

In the case of schools, the end product is the education of students; teachers are closest to the students, so they are in the best position to influence the quality of education with the students' best interests at heart. Teachers therefore must be empowered. They must be given the time, the tools, the training, and all the support they need. Without this empowerment, the teachers cannot be blamed if the schools fail to meet stated educational goals. With it, teachers can make the difference, because they are trained and have the heart to do so. When they are empowered by leadership in these real terms, teachers can use the resources provided by technology to become the facilitators of quality education, putting students in control of their own learning and thus empowering those students in their turn.