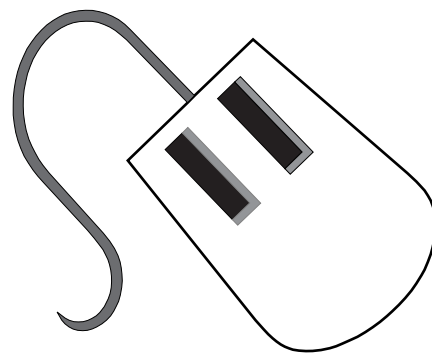


# CHAPTER 5

## Using Technology Tools in Education: An Overview of Hardware

---



Mr. Gophis is a 3<sup>rd</sup> year middle school teacher, teaching 7<sup>th</sup> grade math and English. He takes for granted the way technology has permeated his daily routine. Beside having a TV, VCR, and telephone in his room, he is lucky enough to have a personal laptop and a minilab of 3 computers in his room. Upon getting his coffee to start the day, he boots up his computer; while waiting he goes to his phone and checks his voicemail. When the computer is booted up he checks and answers e-mails from parents and colleagues. He prints off a copy of the morning announcements and posts them on the bulletin board. He then makes his way to the back of the room, boots up the three computers and makes sure the web page he made for this week's writing assignment is ready to go, making sure students can get right to the important information. Sitting at his desk again he checks the computer lab schedule online to be sure that he is signed up for this afternoon. He checks his PowerPoint presentation for his math classes, plugs in his palm pilot and synchs it. He has 5 minutes so he checks the current weather and the top news stories on the web. In a few minutes he will take attendance electronically and then give students handouts of their current grades. Before he leaves for the day he remembers that he has to upload grades and attendance to the parent access program. The bell rings and he heads to the hall for duty.

Computers, in their relatively short existence, have made quite an impact on education. In their early incarnations they were little more than typewriters and electronic flash cards, but with the increased speed and capabilities they have really made inroads.

With today's multimedia computing power it is possible for today's students to do desktop publishing, data searches on the web, data processing, photographic editing and publishing, web page production and publishing, music production, and movie production. They also have within their means the ability to share information on the web, record it to CD or DVD, or publish it as a book. Some teachers even use handheld GPS devices to teach orienteering, math and geography. The only limitations are time, money and imagination.

Computing power continues to increase and become cheaper. In 2003, Apple computer helped Virginia Tech University build a supercomputer with off the rack computers.

The Networked system of 1100 computers cost about 4 million dollars and tested out as the third fastest computer in the world. Other super computers can easily cost 300 million dollars. With cost becoming less of a factor, many other colleges and high schools may like to have their own supercomputer, but might settle for only the 50<sup>th</sup> fastest to save money. The possibilities are amazing, particularly with regard to 3-D rendering and complex modeling that could come out of some of these super machines as more and more are put in the hands of young, curious students.

This chapter is an overview of technology hardware that is currently available and being used in classrooms. There are many more ways to use these innovative devices, however, this is only a sampling.

## ***Computers in the Classroom***

Many of the devices that follow utilize the basic component of a computer, but a computer is useful on its own in many instances. Computers come in many basic forms, the three most common are desktops, laptops, and tablet PCs. (We will discuss handheld (PDA) computing later in the chapter.) Desktops are the most expandable, durable, and allow for the largest screens, for these reasons they make very good student machines. Laptops, when first developed gave away a lot of functionality in order to gain mobility, but today's laptops can do most anything a desktop can do. These are great machines for individuals on the go. Many teachers like the ability to move their computer from classroom to meeting to home. Some schools are now investing in classroom sets of laptops on carts, a kind of mobile computer lab; and some have even purchased laptops for every student in their district. With this portability comes a down side. Laptops are less durable than desktops, less expandable, and much easier to steal. That being said, the state of Maine bought laptops for every 6<sup>th</sup> grader in the state and they realized promising results enough to justify expanding the program to other grades. Finally, Tablet PCs are basically laptop computers that allow you to utilize the screen as a pen driven tablet. This could allow for even greater portability and use in situations where sitting down and typing is out of the question. It could be especially useful in field work.

The type of computer is not the only consideration in looking at computers in the educational setting. Much can be determined by also examining the configuration and

numbers of computers that are available (e.g., are the machines set up in rows or together in groups on tables?). In a one computer classroom the teacher will typically have the main control of the computer because these machines are often used for the teacher to access resources, do grades and attendance, e-mail parents and colleagues, and present information to the class. A minilab of computers in the classroom is another possible situation. In this setting computers are usually used in a "station" kind of setting. The minilab computers have been found to be the most frequently used of computers, and





it lends itself well to the “teachable moment” interaction. A teachable moment typically occurs when a student asks a question that may or may not have anything to do with the topic at hand, but is something of interest and a chance for the teacher to use the moment to help students learn. Computer and other technologies in the classroom are helping to create more teachable moments. Minilabs in the classroom also work well for group projects. Computer labs in a separate room are the best configuration to use

when you want to have students all doing the same type of work at the same time. The computer lab setting might go for a spell without getting much use, but these labs are very useful when every student has an individual assignment and is in need of a computer. A computer lab can help ensure that every student gets to work on his or her own machine.

## ***Input Devices***

Input devices are those items that allow a user to send data to the computer (e.g., mouse, keyboard, microphone). New and innovative input devices are emerging all of the time.

Early childhood teachers may find it useful to utilize touch screens although young students’ tendency to stick their fingers in their mouth may demand a large supply of screen disinfectant. Some students who have a disability may feel more comfortable with joysticks, or one-handed keyboards, or eye-driven inputs among other options.

A great set of tools for the classroom are devices providing the means to add photographs and movies to presentations. These include scanners, digital still cameras, and digital video cameras. All of these devices allow for transfer of images to the computer for use in documents, web sites and also multimedia presentations, but they also ease the editing process by allowing for digital enhancement.

Flatbed scanners are a lot like photocopiers, but instead of printing a copy, they create a digital copy of the image. This allows for editing including cropping, color enhancements, red eye removal, even adding hair to a bald man, all without damaging the original. Technology even allows users to



compress an image (at the expense of quality) so that it can be presented on the web quicker, or attached to an e-mail.

Digital still cameras provide the means to promote all of the above features, along with the excitement of framing and taking the picture in the first place. Digital cameras were originally cost prohibitive for the educational world, but have now come down in price to the point that soon most classes may have one. Digital cameras are wonderful in allowing students to learn to take well-composed pictures because of the instant results, and the ability to erase bad pictures not a waste of money or time. Many classes have used them to create presentations documenting a class field trip, or in developing student portfolios. Many teachers use digital cameras to document student activities, or for taking pictures to send home in school newsletters, or post on class web sites.

The prices for digital video cameras have dropped dramatically. Digital video cameras have all of the above capabilities, even the still picture capability, but it adds sound and motion. Students utilize these feature to create movies (using simple video editing software such as Apple's iMovie) as final projects. Students have used these devices to create commercials for imaginary products to better understand media literacy, and the devices advertisers use. Many of these movies can be compressed and shared through a class web site.

To COME

One other specialized digital camera that is working its way into more and more classrooms is the digital microscope. These cameras range from a sub \$100.00 model that works to 60x

magnification, to professional quality devices that cost well over a thousand dollars. These digital microscopes are basically digital cameras with high magnification lenses. When paired with a microscope they allow you to save images to the computer, thus documenting the specimens for later use in presentations or assessment situations.

## ***Output Devices***

---

The most commonly used output device is the monitor, though printers are still fairly common.

In many classes today 27" to 32" televisions are available. These monitors do a fine job in allowing videos and DVDs to be played for the class, but they are largely inadequate for displaying the contents of a computer monitor. Unfortunately, this is often the cheapest of the presentation solutions, but text is usually quite hard to see from very far back. A plasma display is a much better solution for schools seeking the television-type solution, but at this time the cost is prohibitive.

Many schools have data projectors, which can be connected to computers, VCRs, and DVDs. Projectors cost between \$800 and \$7000 depending on the lumens (a measure of brightness), size (smaller is typically more expensive), and range and size of the output. Most classrooms are not large enough to justify the more expensive projectors, which are

designed more for auditoriums and very large screens. A mid-level or lower-end model might best suit most teacher's needs. Other considerations are determining where your projector will be used (on a cart or hanging from the ceiling); and determining whether the projector will be portable going from classroom to classroom. If you intend to utilize this device with the lights on, you need a brighter bulb and a machine with more lumens. Finally, examine carefully the rated hours of use for the bulbs. Replacement bulbs will usually cost into the hundreds of dollars.

Some schools will have interactive white boards that can work in conjunction with your computer and a projector. You can think of these pieces of equipment as being a digital chalkboard. As you work through a presentation on the white board you can advance frames in a presentation by touching the board much like you would click your mouse under normal circumstances. A big benefit over normal white boards and chalkboards is that anything you write on the interactive white board is transferred into your presentation right on the computer. The most common solution for an interactive white board is called a Smart Board<sup>®</sup>. A Mimeo<sup>®</sup> serves a similar function and is a device that captures text and drawings from the white board and saves them as graphics so that you can use them in future presentations. One disadvantage to having an image is that you cannot decide later to correct a spelling error in the text because the computer will not recognize the text and only sees the letters, words, sentences, and paragraphs as one image; not individual characters like when you work in a word processor. The Mimeo works through sensors that you attach to the white board that are wired to your computer. The colored pens are placed in battery operated holders. When you write on the board the sensors track the movement of the pens and transfer the image to your computer. Many teachers will use these captured images to post lecture notes so that absent students may catch up more easily.

Projecting the contents of a computer screen for teachers and students is a major hurdle for many teachers because of the cost associated with the various solutions. Most presentations also include sound, and the small speakers that come with computers are really designed for those sitting close by and not nearly loud enough for a whole classroom. More powerful speakers are necessary for the well thought out presentation station. Powered speakers are external speakers that plug into the headphone jack of most computers. They include an amplifier and their magnets are shielded to prevent damage to your computer and monitor. Amplifying sound enough for all to hear adequately in the classroom can get quite costly. If you need portability or to fill a larger room the price will be higher as quality speakers increase in price as they get smaller. Carefully selecting speakers to meet your educational needs is critical, so compromising on costs for speakers should be resisted.

## ***Data Access***

---

In many ways the value of technology in the classroom is really the importance of easier access to data. This data access benefits teachers, administrators, students and parents. The Internet is, in most cases, what makes this wealth of information available.

Wireless networking, especially for laptop computers, is becoming more and more commonplace throughout the world. There are coffee shops, airports, and hospitals all around the world that now have wireless networks available. Schools are no exception. Many districts have found that going wireless allows for Internet access without the expense of retrofitting older buildings with wired networks. Wireless also makes mobile

laptop labs fantastic tools for students. And, while wireless technologies have a great many benefits, the security aspect of wireless networks is still a weakness. Anyone with a computer and a wireless card may have access to your network unless extra security measures are taken.

As the number of schools with broadband Internet access and robust networking grows, Video streaming is becoming a favorite method for accessing educational video. Utilizing resources like United Streaming ([www.unitedstreaming.com](http://www.unitedstreaming.com)), teachers are able to search a library of videos by subject area, grade level, and educational objective. They can then preview this video and select all of the video or just portions for inclusion in a particular lesson. This allows teachers greater access to educational video, gets the product there with greater speed, and allows for more flexibility in the final product.

School weather stations are also a way for students and teachers to access up to the minute data for class work. With a wireless hookup they also have access to unlimited quantities of weather data from the national weather service and a host of other sources. They can access archival records and current satellite maps. Many schools have also become part of the local weather network, reporting to news stations the current readings in their specific locations, which can help with Doppler radar readings.

Many other scientific instruments are available and are usually connected to computer using USB ports. This allows students to set up experiments and monitor the data automatically over a longer period of time. Much of this data can be accessed and shared over the web.

Classroom, school, and district web sites can be an instrumental part in the communication process of schools and parents. If a teacher has an e-mail address posted, parents can email questions at their convenience, and teachers can make home contact when they have their prep time. This can alleviate the endless rounds of phone tag that seem to rule a teacher's day. With a classroom website parents and students can look into coming events, homework assignments, and completed projects. With web-enabled student management systems like Power School from Apple, parents can track student attendance, grades, missed assignments, even lunch room accounts and purchases. Finally, District websites can quickly alert parents and students to school closings etc. while allowing an easy access point for sports and event schedules and district news. The Internet is successfully closing the gap between parents and schools in ways that were nearly impossible prior to these new technologies.

## ***Storage Solutions***

---

The size of student projects and other data now requires more storage space than just a few years ago. Fortunately, many solutions exist. One of the easiest solutions is the purchase of really big hard drives with hard drives into the hundreds of gigabytes not uncommon these days. The price of hard drives has been decreasing while the capacity has been increasing and there seems to be no end in sight for this trend. Archiving information for many years is easy as hard drives grow larger. And, while saving old data is important, the importance of having a good back up procedure for daily work should not be taken lightly. One lost term paper is all it takes to reinforce the importance of good backups. Many software solutions exist which can help to facilitate the automatic process of backing up daily work.

Beyond the hard drives there are several forms of removable storage that are available to teachers and students. One of the most prevalent is the compact disc (CD). With a CD-R (Recordable) or CD-RW (ReWritable) and the correct blank media you can store 700 megabytes (MB) of data, including text, audio, photos, and short movies.

DVD burners have come down in price in the last two years and are finally becoming an affordable storage solution. These allow students and teachers to store 4.5 GB of information including feature length movies. Care should be taken to ensure that the media being bought is compatible with your drive. The two most popular types of blank recordable DVDs are DVD-R and DVD+R.

One type of storage that is starting to make inroads to the educational institutions are called USB Flash drives. These are small USB memory devices, similar to what would be used in a digital camera. Flash drives are small, about the size of a dried apricot, with storage capacities from 32 MB to 1 GB. These drives easily store large quantities of information, and allow access to any of this information at any computer with a USB port. They are even cross platform so both Macintosh and Windows based PCs can read the drive. Students and teachers alike are starting to save important documents on these drives so that they can easily transport them attached to key chains or lanyards. This solution allows a person to easily save work on one machine and then continue work on a new computer in the school or even at home.

## ***Availability Solutions***

---

Probably the largest hurdle to pervasive technology usage in the schools is still the cost. Even with prices dropping the cost of a laptop is still prohibitive to get one for every student. Although desktops are quite a bit cheaper, most schools do not have the resources, both physical and financial, to create a one-to-one ratio of computers to students. Because of shrinking budgets, schools are forced to explore cheaper alternatives.



Handheld computing is just beginning to creep into the educational vocabulary. These devices are often referred to as PDAs, which is short for personal digital assistants. The two main types of handheld devices are Palm and Pocket PC. They largely do the same thing, but run two different operating systems (similar to Macs and PCs). Using Palm and Pocket PC devices, students and teachers can do many of the things that they used to need a full computer to do. They can keep track of their personal and school calendars, addresses and phone numbers. They can also develop databases, not to mention play solitaire and many other games (you have to watch for that). Teachers can obtain classroom management software to take quick attendance and to track student grades and on-task behaviors while monitoring and wondering around the classroom. With compact keyboards students can utilize a fairly powerful word processor that should be compatible with MS Word on your regular computer. With a wireless network and wireless card, students and teachers can surf the web and check e-mail. With expansion cards you can even have a US

atlas, dictionary and encyclopedias at your fingertips. These devices range in price from \$100 to \$500, with the more expensive having more features and capabilities. The more expensive devices will often offer better resolution on the small screen. They might also offer a color display and much more memory than the cheaper devices.

While a laptop computer may not be cost beneficial for many schools to buy in mass quantities, there are other options when the need is just a basic word processor. In fact, many products on the market meet this need. The most popular alternative to a laptop in education are devices like the under \$200.00 AlphaSmarts. This is a rugged device that looks similar to a laptop, but does not open. It has a full keyboard and a small LED screen that allows students to type, format, and save pages of text. Many also have limited database and spreadsheet capabilities. Students then are able to rework this text and print a final copy or transfer to a regular computer to save or further format. These devices are a welcome addition to any school building, allowing for word processing to happen in the classroom, and freeing up the computer labs for more computer intensive projects.



## SUMMARY

In looking into technology in the educational setting care should be taken to look both at the physical layout and the type of equipment available. While computers are an integral part to any educational technology setting there are many devices beyond the computer that can enhance the educational process.

Specialized input devices for special needs or young students are available, along with digital still cameras, video cameras, microscopes, and more. Certain output devices can greatly enhance the students experience during presentation. The basics include a large television monitor and a set of powered speakers, but data projectors, and interactive white boards can add to the power and value of the presentation.

Ease of data access is one of the most important changes that the computer has brought to the educational setting. With use of wireless networking, more computers can access the data from more places. Broadband Internet has allowed for educational video streaming, easing delivery and use of video in the classroom. Further, digital science equipment like weather stations and temperature probes allow students to more readily access and record live data. School web pages and e-mail allow for greater communication between parents and educators. With this increase of available data, storage solutions become an integral part of any educational technology routine. Large hard drives with good backup software are the most common and necessary solutions for long term storage, but CD and DVD burners are also fairly common for archiving of data. And, flash drives are replacing floppy disks as the most prevalent type of portable storage.

Finally, financial and physical limitations must be addressed in order to increase student access to computing. Devices like handheld computing devices and AlphaSmarts may help to fill the gap. Many hardware solutions exists and the list continues to grow.



## DISCUSSION QUESTIONS

1. What are the major considerations that a teacher must keep in mind when making decisions on utilizing educational computing?



2. Of the input devices mentioned, which one should every classroom have? Why?
3. What are the major uses at this time for the Palm and Pocket PC palm top computers?
4. What are some uses for a limited use computer, like the AlphaSmarts?



## KEY TERMS

Author:  
Need  
Definition?



**3D rendering:** A process where a computer with the help of software creates models from data and displays them in three dimensions so that they may be manipulated and observed from multiple perspectives.

**broadband:**

**CD/DVD burners:** A device that allows for the creation of Audio CDs, Multimedia CDs and DVDs. With this product original content can be saved, copied, and distributed to parents and students.

**Expansion cards:** A card or board that fits into slots on the motherboard of a computer to add extra functionality to a computer. Popular expansion cards include modems, ethernet, USB, firewire, and video.

**GPS devices:** GPS Stands for Global Positioning Satellite. These devices receive information from these satellites and give details about the user's location. Many of these include electronic maps to make a very powerful navigation tool.

**Hard drive:** A mechanical device that resides in a computer or in an external case connected to the computer that allows users to save and retrieve large amounts of information.

**Input devices:** Any device, connected to a computer, that allows the users to enter information into the computer. These include but are not limited to keyboards, mice, and microphones.

**LED:** LED stands for Light Emitting Diode. This is one of the technologies that allow for flat screen monitors.

**Multimedia computing:** Computer programs or presentations that include more than one format of content. These can include text, sound, graphics, and movies.

**Output devices:** Any device, connected to a computer, that allows the users to retrieve information from the computer. These include but are not limited to monitors, speakers, and printers.

**Handheld computing (PDAs):** Utilizing a computer that fits in the palm of your hands. These devices include, but are not limited to Palm and Pocket PC devices.

**USB:** USB stands for Universal Serial Bus. This is a type of transfer technology that allows users to connect peripherals such as printers, mice, etc., to their computer.

**USB flash drives:** These are small drives, similar to the memory in a digital camera, that allows for storage of a fairly large quantity of information on a very small and portable device.



## EXTENSION

1. Design the perfect classroom. Money is no object. Give an explanation of what technology would be present.
2. Create a technology wish list for a school. Money is no object. Give an explanation of what would be present. What technology will not be present in all classrooms? Why?
3. As computing becomes more pervasive in the classroom, and wireless networking brings the Internet to everyone who is in range, how will education be improved? What are the stumbling blocks for this change?



## WEBSITES

Technology & Learning Online

[http://techlearning.com/resources/product\\_guide.jhtml](http://techlearning.com/resources/product_guide.jhtml)

Author:

OK?

.jhtml

Apple Learning Interchange

<http://ali.apple.com/>

Smartboards

<http://www.smarttech.com/>

Mimeo

<http://www.mimeo.com/>

Powerschool

<http://www.apple.com/education/powerschool/>

AlphaSmart

<http://www.alphasmart.com/>

Weather stations

<http://www.ambientweather.com/>

Wireless networking

<http://computer.howstuffworks.com/wireless-network.htm>

The Center for Highly Interactive Computing in Education Handhelds page:

<http://hi-ce.org/www.handheld.hice-dev.org>



## REFERENCES

- Apple Learning Interchange. Retrieved 12/27/04 from <http://ali.apple.com/>
- Jonassen, D. (1996). *Computers in the Classroom: Mindtools for Critical Thinking*. Englewood Cliffs, NJ: Prentice Hall.
- Michigan Association of Computer Users in Learning. Retrieved 04/08/04 from <http://www.macul.org>
- Morrison, G. & Others (1999). *Integrating Computer Technology Into the Classroom*. Upper Saddle River, NJ: Prentice Hall.
- Warlick, D. (1999). *Raw Materials for the Mind: Teaching & Learning in Information & Technology Rich Schools*. Raleigh, NC: The Landmark Project.

