

# *Digital Imaging in Education:*

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## **Introduction:**

Since 2003, digital cameras have outsold film-based cameras, and the gap is widening. This move toward digital formats is taking place for several reasons.

First, the cost of digital cameras is dropping, while the quality is improving. By the end of 2004, the retail price for a digital camera with optical zoom was running about \$75 per megapixel. Cameras with 2.1 megapixels that had sold for over \$300 the year before were starting to break the \$150 price barrier, and even high-resolution cameras (5 megapixel and above) seemed to follow the same rules. By November, 2004, the prices were continuing to drop.

A second factor driving camera sales was that, for the first time, image quality from digital cameras was starting to rival that of film, even for enthusiasts and semi-professional photographers.

A third factor driving sales was the continued drop of price for photo-quality printers, DVD-ROMs and other storage devices needed to hold libraries of digital images. For example, disk drives in September, 2004 were selling for under \$1 per gigabyte.

But price reduction (and quality improvement) alone are not enough to justify the overwhelming popularity of digital photography. Good film cameras remain less expensive than mid-range digital cameras and, even if the cost of film and processing for typical amateur use is factored in, the price of digital cameras exceeds that of typical film-based devices. Whatever is driving digital camera sales goes beyond the price and image quality issues alone.

In the days when film-based cameras reigned, most home camera users took photos of parties and family events. These pictures were then developed at the local drug store, and people were happy if half the pictures turned out well. Once the images were shown to the family, they generally ended up in an album, or a shoebox, where they were looked at infrequently, if at all. Once the picture was taken, it became a static

artifact to be looked at on special occasions. For most users of film cameras, photographs were nouns to be treasured and looked at on occasion.

People who use digital cameras, generally, operate differently. Instead of just printing the images as they are, digital photographers often crop and zoom their images before printing them, even if they don't own a computer. Many drug stores have printer kiosks where people can edit their pictures before printing them, providing opportunities for after-the-fact image composition. Those who have computers at home have even more capabilities through the use of popular image editing programs such as Photoshop Elements and other tools that allow users to turn their computer into a digital darkroom. Once edited, these images may not even be printed but, instead, e-mailed to friends, or posted on a web site, or burned to a CD as a slide show. For digital camera users (as for film users with their own darkrooms), images are verbs to be worked with, not static objects.

The shift from film to digital photography is significant in that it has moved images from the world of nouns to that of verbs. While hobbyists and professionals have always edited, manipulated and otherwise acted on their images, this capability is now being embraced by the public at large. This is a significant shift, and presents many new opportunities for images both in and outside of the classroom.

When viewed from this perspective, the shift from film to digital cameras by a large proportion of camera buyers is quite significant: they want to be actively engaged in the manipulation of their images.

While camera use in the classroom has never been very high, it is growing with the increased use of digital cameras. In this case, the absence of film and processing cost, plus the immediacy of images play important roles. Beyond this, we are poised for a revolution in the classroom use of digital imaging that can impact the exploration of numerous subjects at almost all grade levels. For this reason, it is important that educators move beyond the mechanics of camera use, and image editing, to the design and implementation of curriculum-based projects that take advantage of digital images to help students understand things in new ways.

Much has been made of today's digital generation and their reliance on images first, text second (Burmark, 2002). Whether the images in our students' lives come from television, the Web, or their own digital cameras, the rich image landscape in which they are immersed has increased the need for visual literacy among educators and learners alike. As students become proficient in developing their capacity to "see" the things they photograph, they develop the capacity to evaluate and understand the deluge of images they encounter on a daily basis. As Marshall McLuhan and other media commentators have observed, a picture is *not* worth a thousand words – it is a different form of communication altogether, and can not be compared with text. One

might as well say that an automobile is worth a thousand apples. The comparison is meaningless.

This brings another point into view: the power of digital images in the classroom comes not from its capacity to allow us to perform old tasks differently, but from its capacity to let us do things we could not have done before at all.

Take, for example, digital storytelling. A student might craft a narrative from a series of images that are assembled into a movie using pan and zoom effects to highlight various aspects of each image in conjunction with a narration track. By using both voice and image simultaneously, the emotional impact of a story can be magnified beyond that possible by most young writers using words alone.

In the creative domain, the power of unadorned images to evoke interesting questions is unparalleled. What may seem concrete to one viewer might seem quite abstract to another. Conversations around the message contained in an image can be quite insightful and help students develop their capacities for independent thought, along with their ability to express ideas with clarity and insight.

The effective use of digital photography in the classroom will not emerge overnight. First, the cameras and image editing software are new tools to be mastered. Second, the grammar of color and composition need to be explored. It is only after this grounding in practice (the equivalent of learning how to hold a pen and learn to write) that purposeful work starts to get done. The good news, though, is that many young people are quite adept at mastering the mechanics of cameras, and the fundamentals of composition are fairly easy to explore. Interesting projects are easy to create, and vast libraries of such projects are likely to emerge soon.

We are in the early stages of a new technological revolution in education, one that opens the door to amazingly creative projects that use computers, the Web, and digital cameras to explore academic subjects in ways we could scarcely imagine a decade ago.

## References

- Burmark, Lynell (2002). *Visual Literacy*, ASCD.
- Nikpour, Kaveh, et al. (2001). *The Language of Photography*, eight video set from Films for Humanities and Sciences.

## Activities:

The following pages demonstrate curriculum projects using digital imaging across grade levels and subject areas to show how powerful digital imaging can be in the hands of students. This part includes five subject-area examples (language arts, social studies, math, science and art) at three grade levels (primary, upper elementary, high school). Each project contains a description including a listing of tools that can be used to build the project. Examples of completed or partially completed projects are provided on the CD for later reference.

<b>Project Title:</b> Alphabet book
<b>Grade:</b> Primary
<b>Subject:</b> Language Arts
<b>Tools:</b> Digital Camera, Photoshop Elements, QTI2 or similar program
<b>Other Resources:</b> none
<b>Project description:</b> Students create an alphabet book using different examples than usually found in such books (e.g., abacus instead of apple). Students can use digital photos or hand drawn images that are then scanned for inclusion in the project.  An alternate project is to find letter shapes in common objects (e.g., the letter "A" in a stepladder) and make a book using images of these objects.

<b>Project Title:</b> My Community
<b>Grade:</b> Primary
<b>Subject:</b> Social Studies
<b>Tools:</b> Digital Camera, Photoshop Elements, QTI2, ACDSee or equivalent
<b>Other Resources:</b> Possible historical pictures of the community from the Web
<b>Project description:</b> Students take pictures of their community with the goal that a narrated slide show based on these pictures tells a story of some aspect of the area where the student lives. The focus could be on the social structure of families, the difference between residential and commercial areas, etc.

<b>Project Title:</b> Number Books
<b>Grade:</b> Primary
<b>Subject:</b> Math
<b>Tools:</b> Digital Camera, Photoshop Elements, QTI2
<b>Other Resources:</b> none
<b>Project description:</b> Students take photos of objects with different numbers associated with them (wheels on cars, petals on flower, etc.) and build a number book.

<b>Project Title:</b> What Am I?
<b>Grade:</b> Primary
<b>Subject:</b> Science
<b>Tools:</b> Flat bed scanner (2400 dpi), Photoshop Elements, ACDSee
<b>Other Resources:</b> none
<b>Project description:</b> This project uses a scanner as a low-power (40x) microscope. Students scan common objects (hair, cloth, paper, etc.) at the highest resolution and then create a slide show using a small sample (e.g., 640x480 pixel) of the scanned image which is then shown to the rest of the class to see if they can tell what the object is. Completed slide shows created by one class can be exchanged with those of another class to see if they can figure out what the images are.

<b>Project Title:</b> Smooth and Rough
<b>Grade:</b> Primary
<b>Subject:</b> Art
<b>Tools:</b> Digital Camera, Photoshop Elements, ACDSee
<b>Other Resources:</b> none
<b>Project description:</b> Students take pictures of textured objects (e.g., tree trunks, brick walls) with the view of capturing the essence of the texture. Collections of these images can be shared through a narrated slide show. The goal is for students to “see” the objects at which they are looking.

<b>Project Title:</b> Digital Storytelling
<b>Grade:</b> Upper Elementary
<b>Subject:</b> Language Arts
<b>Tools:</b> Digital Camera, Scanner, Photoshop Elements, ImageMatics StillMotion Creator, Sound Forge, QTI2
<b>Other Resources:</b> Possible to incorporate some images from historical Web sites as needed (memory.loc.gov, www.archives.gov).
<b>Project description:</b> Using scanned family photographs and current pictures taken with the digital camera, students create a 90-second to three-minute “film” about an event or person in their life. The project involves the use of images, a narration audio track, and a background music track. This project is based on the digital storytelling workshops of Sara Armstrong.

<b>Project Title:</b> How it was, and how it is
<b>Grade:</b> Upper Elementary
<b>Subject:</b> Social Studies
<b>Tools:</b> Digital camera, Photoshop Elements, ACDSee
<b>Other Resources:</b> Historical image archives ( <a href="http://memory.loc.gov">memory.loc.gov</a> , <a href="http://www.archives.gov">www.archives.gov</a> ).
<p><b>Project description:</b>  Students explore their community's history through archived images and compare and contrast their observations with the present based on digital images of the same areas taken by the students. In exploring the changes, students are then invited to imagine how their community might appear in the future.</p>

<b>Project Title:</b> Roof Line Slope
<b>Grade:</b> Upper Elementary
<b>Subject:</b> Math
<b>Tools:</b> Digital camera, Photoshop Elements, Printer, Ruler
<b>Other Resources:</b> none
<p><b>Project description:</b>  Students photograph houses in their community and measure the slope of the roof for each house. This data is then put in a table and plotted on a graph. When hundreds of houses are photographed, a distribution of roof slopes is easy to see. Students then explore why houses have sloped roofs, and explore the advantages/disadvantages of this type of roof design.</p>

<b>Project Title:</b> Levers in Life
<b>Grade:</b> Upper Elementary
<b>Subject:</b> Science
<b>Tools:</b> Digital camera, Photoshop Elements, FantaMorph
<b>Other Resources:</b> none
<b>Project description:</b> Based on student study of simple machines, photos of levers found in everyday life (e.g., see-saw, claw hammer used to pull nails, etc.) are morphed into each other by students to show the common elements of each.

<b>Project Title:</b> Take a Picture, Tell a Story
<b>Grade:</b> Upper Elementary
<b>Subject:</b> Art
<b>Tools:</b> Digital Camera, Photoshop Elements
<b>Other Resources:</b> none
<b>Project description:</b> Students create digital images, each of which is designed to tell a story both through subject matter selection and composition.

<b>Project Title:</b> Gone in 30 Seconds
<b>Grade:</b> High School
<b>Subject:</b> Language Arts
<b>Tools:</b> Digital Camera, Photoshop Elements, ImageMatics StillMotion Creator, Sound Forge, Pinnacle Studio
<b>Other Resources:</b> none
<b>Project description:</b> Students create a video public service announcement using still images (with pan and zoom effects) and a narration track. The announcement needs to be compelling and can only take 30 seconds. (Note that completed projects might be submitted to local PBS television stations for broadcast.)

<b>Project Title:</b> Historical Documentary
<b>Grade:</b> High School
<b>Subject:</b> Social Studies
<b>Tools:</b> Digital Camera, Scanner, Photoshop Elements, ImageMatics StillMotion Creator, Sound Forge, QTI2
<b>Other Resources:</b> none
<b>Project description:</b> Students create a three- to five-minute documentary on an historical event or person using a combination of scanned and original images placed over a narration track in a computer-based movie.

<b>Project Title:</b> Tile Patterns
<b>Grade:</b> High School
<b>Subject:</b> Math
<b>Tools:</b> Digital camera, Photoshop Elements, ACDSee
<b>Other Resources:</b> Web sites on the artwork of M.C. Escher.
<p><b>Project description:</b>  Students explore their community for examples of intricate tile patterns (both simple and compound) which they then photograph. These images form a basis for exploring the mathematics of tiling and tessellation in general that can be expanded by exploring the artwork of M. C. Escher.</p>

<b>Project Title:</b> Flower Petal Study
<b>Grade:</b> High School
<b>Subject:</b> Science
<b>Tools:</b> Digital camera, Photoshop Elements, ACDSee
<b>Other Resources:</b> none
<p><b>Project description:</b>  Students photograph blooms from various flowers and create a table showing the number of petals found on each type of flower. When hundreds of flower types are photographed (e.g., at an arboretum), certain numbers may stand out. Students are then charged with exploring why these numbers are so commonplace in flowers. This project can be done jointly with a mathematics class.</p>

<b>Project Title:</b> If Vincent Used a Camera
<b>Grade:</b> High School
<b>Subject:</b> Art
<b>Tools:</b> Digital camera, Photoshop Elements, Virtual Painter
<b>Other Resources:</b> Web Museum ( <a href="http://www.ibiblio.com/wm">www.ibiblio.com/wm</a> )
<b>Project description:</b> Students study the styles of famous painters (e.g., O'Keefe, van Gogh, Rousseau, etc) and then take digital photographs that capture some stylistic aspects of their chosen artist. For example, a student exploring Georgia O'Keefe might photograph the interior of flowers.

## Digital Camera information:

When you select a camera there are a few things to look for.

First, you want to choose a camera with optical, not just digital zoom. Optical zoom retains all the resolution of the camera's photoreceptor, and digital zoom trades off resolution for magnification. If you need to zoom digitally, it is better to do this after the picture is taken using tools like Photoshop Elements, rather than using the camera's built-in zooming software. Also, the optical zoom needs to be used sparingly if the camera is not mounted on a tripod. A hand-held camera can produce blurred images unless it is held very still when zoom is being used. This brings us to the second factor to consider:

Second, make sure the camera is easy to hold and is comfortable in the hands of students. Controls (shutter, zoom) should be easy to reach, and it should be hard for students to block the flash or lens with their fingers.

The third thing to consider is resolution (measured in megapixels). Digital cameras with optical zoom cost between \$50 and \$75 per megapixel as this is being written, and the price will continue to drop over time. At first glance, you might think that the cameras with the most megapixels are the best. It turns out that the physical size of the photoreceptor is also important, as a larger photoreceptor will provide more subtlety and depth in the richness of colors captured in each picture. You might want to read online reviews of any camera you are thinking about to see how professional photographers evaluate your camera with others in its price range.

As for the resolution, any camera with 3.1 megapixels or higher will probably be adequate for student use. Even some of the older 2.1 megapixel cameras produce great images, provided you are not primarily interested in printing images using large formats. The following table shows a guide to printed image size correlated to camera resolution.

Megapixels	Good printed image size (inches)
2.1	5" x 7"
3.2	8" x 10"
6.1	11" x 14" (35mm film resolution)
10.1	16" x 20"

**Image formats:**

When you take your pictures, they are stored on a memory card inside the camera. Every digital camera provides settings that let you choose the resolution and quality (and usually the format) of your saved images. The lower resolution and quality settings let you capture more images on a single memory card, but you may pay the price for these setting later. For example, an image resolution of 640 x 480 pixels may be useful for posting on a web site, but is too small to crop for use in a multimedia presentation. While you can zoom in on the picture to make it larger, you will see a loss in resolution and image sharpness. Highly compressed images may take little space on your memory card, but they lose details when edited, and also display visible artifacts that reduce the quality of the image.

The most common image format for digital cameras is JPEG. These images are compressed in a way that saves storage space, but retains as much of the quality of the original image as possible. If you are saving your images in JPEG format, be sure to choose the highest quality settings available. Other formats are sometimes available, such as TIFF or BMP. These are uncompressed formats that take up a lot of storage space, but have the advantage of avoiding compression artifacts in the stored image. When capturing images in this format, the camera does very little to the original image, only providing white balance and other color corrections prior to saving the picture.

Some high-end digital cameras provide the option of saving the image in the RAW format, in which the original image is saved just as it was detected by the photoreceptor. These images can only be opened in certain image editing programs (such as Photoshop) and are designed to be used by people who want total control over their images. JPEG and other formats are similar to having your film processed at a color lab, and the RAW format is similar to you processing your film in your own darkroom. For student use, high-quality JPEG images are generally adequate. Once you get your camera, set up a tripod and take the same picture several times using different settings for image format and quality so you can see which setting make the most sense for your applications.

You can never recover lost information, so you should always capture images at the highest resolution and quality you can. This reduces the number of images you can put on a single memory card, but now that memory cards with 512 megabytes of storage are available for under \$40, this is less of a problem than it used to be. Once a card is filled, the images should be transferred to your computer's hard drive, and backed up on CD-ROMs.

In a classroom setting, the number of captured images is likely to be quite large and to grow rapidly. You may wish to budget for an external hard drive that is dedicated just to images taken by you and your students. Now that hard drive prices have dropped

below one dollar per gigabyte, this investment makes a lot of sense.

## Other sources of images

While student projects using their own images are quite powerful, there are many times when these images can (and should) be supplemented by other images obtained from other sources. Images of artwork (paintings, etc.), historical pictures, contemporary news photos and other images all have a place in student work. It is essential, of course, that students learn how to reference these images and, in some cases, to secure permissions for their use in their projects. Concern for plagiarism is easier to develop once students have taken pictures of their own for which they feel an attachment.

The whole topic of copyright becomes an important subject at this point, and the subtleties of “fair use” and various forms of public domain need to be explored in an age-appropriate fashion when students use pictures or other materials created by others.

It comes as no surprise that the Web is a tremendous source of quality images appropriate for student work, many of which can be obtained for free or for a modest annual site license. The following sources are but the tip of a growing iceberg of quality images appropriate for use in school projects. Again, please note that “free” images are still likely to be copyrighted, and that all image sources should be referenced by those who use them.

### Free Images:

Weather	NOAA	<a href="http://www.noaa.gov">www.noaa.gov</a>
Space	NASA	<a href="http://www.nasa.gov">www.nasa.gov</a>
History, misc.	American Memory Project	<a href="http://memory.loc.gov/ammem">memory.loc.gov/ammem</a>
Misc.	FREE Site	<a href="http://www.ed.gov/free">www.ed.gov/free</a>
History	National archives	<a href="http://www.nara.gov">www.nara.gov</a>
Fine art	Web Museum	<a href="http://www.ibiblio.com/wm">www.ibiblio.com/wm</a>
Global Community	UNICEF	<a href="http://www.unicef.org/voy/">www.unicef.org/voy/</a>
Space Science	Windows to the Universe	<a href="http://www.windows.ucar.edu/">www.windows.ucar.edu/</a>

### Subscription Image Databases:

News	Associated Press	<a href="http://ap.accuweather.com">ap.accuweather.com</a>
History	Safari	eDireq content server

## Technology resources:

### **Video content (available from Safari eDireq - [www.safaripathways.com](http://www.safaripathways.com))**

Films for Humanities and Sciences

Visual Encyclopedia of the Twentieth Century

### **Web sites for images:**

American Memory Project ([memory.loc.gov/ammem](http://memory.loc.gov/ammem))

Associated Press archives (subscription) ([ap.accuweather.com](http://ap.accuweather.com))

NARA ([www.archives.gov](http://www.archives.gov))

NASA ([www.nasa.gov](http://www.nasa.gov))

NOAA ([www.noaa.gov](http://www.noaa.gov))

Web Museum ([www.ibiblio.com/wm](http://www.ibiblio.com/wm))

### **Web assist tools:**

Download Studio ([www.conceiva.com](http://www.conceiva.com))

Grokker ([www.groxis.com](http://www.groxis.com))

### **Media editing software:**

ACDSee image browsing software ([www.acdsee.com](http://www.acdsee.com))

Acoustica MP3 Audio Mixer ([www.acoustica.com](http://www.acoustica.com))

eZedia QTI2 ([www.ezedia.com](http://www.ezedia.com))

FantaMorph ([www.fantamorph.com](http://www.fantamorph.com))

ProShow Gold ([www.photodex.com](http://www.photodex.com))

MrSID Viewer for Library of Congress maps ([www.lizardtech.com](http://www.lizardtech.com))

Photoshop Elements ([www.adobe.com](http://www.adobe.com))

Pinnacle Studio 9 movie editor ([www.pinnacle.com](http://www.pinnacle.com))

Quicktime 6 (essential) ([www.apple.com](http://www.apple.com))

ReaConverter Pro batch image processor and converter ([www.reasoft.com](http://www.reasoft.com))

Sound Forge ([www.sony.com](http://www.sony.com))

Virtual Painter 4 ([www.livecraft.com](http://www.livecraft.com))