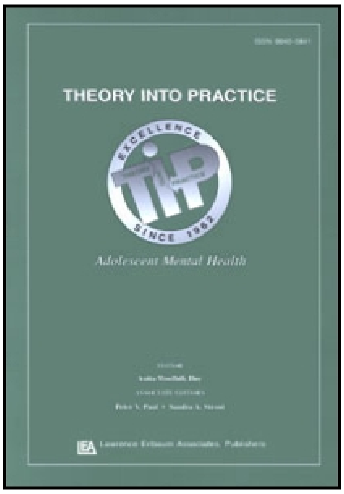

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Digital Visual Literacy

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Digital Visual Literacy

Like other literacies (textual literacy, numeracy), digital visual literacy (DVL) is the ability both to create and to understand certain types of information, in this case visual materials created with a computer. DVL is now essential in many daily life and workplace tasks, from looking critically at newspaper images or TV evening news to using a digital camera, making a Web site, creating presentations, and modeling and visualizing data in virtually all of the sciences. DVL is, of course, also now essential in all visually oriented disciplines. Defining the underlying principles of DVL and integrating it into established curricula presents many challenges. This article describes some of these and the authors' responses, using experiences from an innovative course at Brown University and a larger-scale community-college-based project, Digital Visual Literacy.

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THAT WE LIVE IN AN increasingly digital visual world is all too rarely reflected in K–12 education. With the arrival of inexpensive computer graphics, however, the visual aspects of academic and cultural discourse have become so important that educational institutions are finally being forced to assess the importance of visual literacy. Our culture's shift from print media and traditional film and video toward digital image creation and dissemination may do more for visual literacy efforts than any previous technology.

To give an idea of the degree to which the digital visual world has evolved, note that Kodak no longer makes film cameras or slide carousels, and Adobe Photoshop™ is now commonly used as a verb. We have traded in our bulky black dial phones from about 20 years ago for sleek cell phones that now work all over the globe. Some contain megapixel cameras whose pictures we can beam to family, friends, Web sites, or even, in New York City, to 911.

These technological changes are not restricted to the personal realm—most impact the workplace more than the home. Professionals in disciplines from communications and entertainment to most areas of science and technology rely increasingly on visual interaction. Our understanding of the universe has been deeply influenced by visual computing technology, from outer space images via the Hubble telescope to vivid views of our internal organs and images from the world of nanotechnology. You can now get a full body CT or MRI scan for under $1,000 at your local mall.

This substantial and relatively recent shift in methods of communication and ways of understanding the world is directly due to the rise of computer graphics—the ability to represent computer data visually and interact with that representation. Computer graphics was invented in the 1960s and in wide use in industry, and even some homes, by the 1980s, but it is only in the last 20 years or so that the general public and nonvisual professionals have been directly leveraging the impact of the visual power of the computer.

The other key factor creating a digital visual world (and thus the need for better visual education) is the World Wide Web. Like a printing press on steroids, the Web has brought freedom of the press to diverse authors who would never have published either text or images through traditional methods, from school children to adults and all manner of special interest groups. The Web has made it astonishingly easy to share images.

Ubiquitous computer graphics has done more than create convincing movie special effects; it has changed the role of the visual in our culture. The digital camera and the Web, for instance, have changed how we perceive events that used to be more fully mediated by major news networks, from the Abu Ghraib images that spread overnight to YouTube videos recorded by soldiers giving a different perspective on the evening news. The ease with which digital images can be altered to create *fauxtography* means that we must become much more critical interpreters of visual information.

Digital Visual Literacy

What specific knowledge and skills do we need to achieve meaningful digital visual literacy (DVL)? How can we get the most out of the visual computer-based materials in our lives? Young people may already seem proficient users of visual technologies, but most are unaware of the principles underlying the tools they so readily adopt and cannot make important connections between types of visual technology and its uses. Like the traditional literacies (textual literacy, numeracy), DVL is the ability both to create and understand certain types of information, in this case visual information created with a computer. Specifically, we define DVL as the ability to:

1. critically evaluate digital visual materials (two-dimensional, three-dimensional (3D), static, and moving);
2. make decisions on the basis of digital visual representations of data and ideas; and
3. use computers to create effective visual communications.

DVL is not the same as (although it obviously overlaps with) other recently advocated literacies such as *multimedia literacy* or *screen literacy*, because of its focus on the visual. Although the computer has influenced our use of other channels of communication, such as text and sound, the most revolutionary change has been, we believe, in the visual realm.

One cannot understand the digital visual world without grasping the great change that computer technology has brought to image making and sharing. It is not just abilities such as altering images in Photoshop or making a realistic-looking 3D dinosaur that make computer graphics revolutionary—it is the computer's ability to provide a discrete and abstract language for representing visual information. Now a photograph can be stored as 1s and 0s and the information can be reconstructed as necessary to view the image on a screen or printer. In a way, a computer image is like a musical score, with the notes stored in the computer and the performance qualities (such as color depth, resolution, etc.) changing with available software and hardware. Because visual information is represented mathematically in the computer, it can be replicated, altered, and shared in new ways. And, unlike most previous visual-technology breakthroughs—the

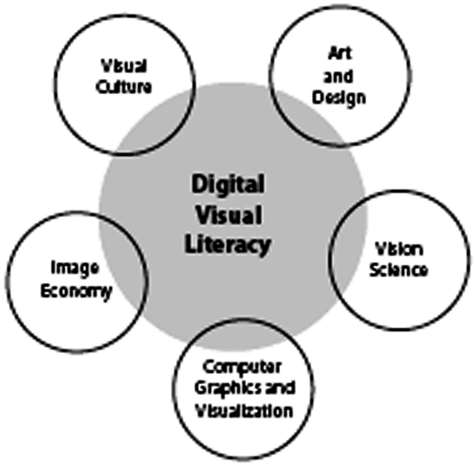


Figure 1. The interdisciplinary nature of DVL.

printing press, the telescope, or the microscope—computer graphics is readily available for everyday work by amateurs.

Our research has focused on determining underlying principles to guide the creation of DVL curricular materials. The following five general areas form the foundation for DVL (see Figure 1).

Visual Culture

Viewers today need to be both more appreciative and more critical of visual material than in the past. This goal requires exposure to ways of talking about visual material and methods of visual research (Kress & van Leeuwen, 1995; Mitchell, 1987; Rose, 2001; van Leeuwen & Jewitt, 2001), as well as practice in interpreting visual materials. Although students know they can edit photographs, the teaching of critical viewing is underdeveloped compared with the teaching of critical reading. When Reuters ran a photo by freelancer Adnan Hajj apparently showing damage caused by a bombardment of Beirut in August 2006 (Figure 2), few thought to question its authenticity. Johnson (2006) provided a detailed analysis of faked smoke (you can see the repeated areas where the Photoshop clone tool was clumsily used) and also demonstrated that some of the buildings

Figure 2. Altered photo run by Reuters.

were cloned. Reuters fired the freelancer and apologized.

Art and Design

The design bar has been raised and design skills are more and more prerequisite for today's students. The availability of powerful design tools to anyone with a personal computer cuts both ways: people can easily create materials at home that would once have required a graphic design firm, but now that so many people touch up their own photographs, design their own cards, and print correspondence on crisp high-resolution printers, work begins to look somehow amateurish and deficient when these tools are not used.

The education of today's nonprofessional designers (who are, increasingly, all of us) is mostly haphazard. Fortunately, a great deal of work has been done in visual literacy, including self-guided curricula such as that offered in Woolsey, Kim, and Curtis (2004) and Edwards (1999). In addition, through cultural osmosis, things like *font-itis* (using too many different type faces in a single document) are largely a thing of the past. Through example and informal networks, basic principles of design are becoming part of the common language. Widely accessible design books, from Tufte's (1990, 2001) famous works on information design to highly practical handbooks such as Williams' (2003) *Non-Designer's Design Book* have helped codify basic principles and bring them to amateurs.

Vision Science

Vision science can provide explicit guidelines for graphic design that are based on scientific knowledge of the visual system, rather than on vague rules that change from instructor to instructor. When elements on an informational poster, for instance, are properly grouped and aligned, there is scientific evidence to show why it is easier for the audience to understand the content. Vision science can also answer such questions as "Why is red text on a black ground a poor choice for a Web page?" (Those colors lack the necessary value contrast necessary to read type easily.) Students who understand basic relevant vision science concepts, such as those in Hoffman (2000) and Ware (2004), are more effective designers.

Discoveries in vision science also help answer a common sense question that has long impeded visual literacy efforts: Why study the visual when we all learn how to see with no apparent effort at all? Unlike learning to read and write, learning to see and work with many types of visual information seems to come effortlessly. A natural assumption is that recognizing objects is really quite easy and not worthy of academic study. Quite the opposite has turned out to be true, as fascinating and comprehensive texts such as Palmer (1999) can attest. The actual process by which we make sense of the jumbled, *noisy,* moving visual stimuli that reach the retina's 100+ million photoreceptors is nothing short of extraordinary and helps make the current confluence of visual communication and powerful computer graphics and communications networks an historically important combination of forces.

Computer Graphics and Visualization

The importance of the catalyzing combination of the visual and the digital cannot be understood without a basic knowledge of how images are worked with on a computer. This subfield of computer science is called computer graphics and is described in Foley, van Dam, Feiner, and Hughes (1995) and for nontechnical audiences in Spalter (1999). Confusingly, the same term is also used for graphical images made with computers. Thus, an artist might say she is producing computer graphics and mean that she's designing logos, whereas a computer science researcher might say she is doing computer graphics and mean something entirely different, usually involving writing a lot of computer code to implement mathematical algorithms. All too frequently, students take only application-based courses (on Photoshop, for instance) and think they have learned something about computer graphics—without encountering a single important technical concept. Computer graphics concepts help students choose the appropriate type of software for a given task, easily become power users, and perform more sophisticated analysis of computer based images made by others.

K–12 computer courses could greatly benefit by shifting away from lessons on specific applications and putting more emphasis on the underlying concepts that will help students use many different applications effectively for years to come.

Image Economy

In *A Whole New Mind*, Pink (2006), suggested that the Master of Fine Arts is the new MBA , as intuitive, creative thinking associated with visual art and design becomes at least as valued in the marketplace as the sequential left-brained-style analysis that had dominated in previous centuries. The need to develop a generation of design-savvy citizens requires a massive educational commitment.

Our definition of the image economy goes beyond the increasingly important role of design to encompass entire new types of business and business models, such as corporate and community-based photo sharing and printing sites. Opportunities abound in areas from mass customization (e.g., various services that produce customized U.S. postage or wine bottle labels) to interesting new visual dialogs with Amazon's image upload feature, for instance. Using this feature, customers can upload their own product images to augment or contrast with those of the manufacturers.

In addition, although images were routinely sold or licensed before computers, a greatly expanded marketplace has emerged and a much wider variety of people must become familiar with the rules of visual copyright.

Intellectual Challenges

Given the acknowledged power of images, the key role of the visual system in our understanding of the world, and the ubiquity of visual materials in today's computer-based business and personal worlds, it is surprising that visual thinking and communication lacks a coherent basis as a discipline and is not a required course of study at any level of schooling. Part of the cause, as is evident from some of the discussion above, is the interdisciplinary nature of studying the visual. Artists rarely talk with vision scientists; computer scientists do not, for the most part, read any media theory; and different disciplines (such as computer science, perceptual psychology, culture studies, media theory, art history, and design) have widely varying initial assumptions and methodologies. Some disciplines are scarcely aware that the others exist. Few authors approach visual literacy from a truly multidisciplinary standpoint; for a counterexample, see Elkins (2003), who assembles a truly interdisciplinary group of canonical images with which all educated people should be familiar.

The interdisciplinary nature of the visual is the first challenge in teaching DVL in academia; the second is an historical suspicion of images that prevents what is known from reaching a wider audience. From Plato onward, suspicion of images has been a recurrent theme in both Western and Eastern religions and philosophies. In iconoclastic movements, for instance, the image is often seen as a misleading or subversive entity—remember the Taliban's destruction of the giant Buddhas of Bamiyan in 2001. The conviction that visual perception may cloud, rather than reveal, the truth is echoed by many 20th-century thinkers who question whether images can show reality or whether they, like written texts, depend for their meaning on the context of specific times, cultures, and individual viewers (Jay, 1994; Mirzoeff, 1999; Stephens, 1998).

Although this suspicion of images, in part, simply confirms their power, there is also truth to the concern that they can manipulate us in ways we are not even aware of. History has shown repeatedly that humans often treat a picture as something more than colors on paper or phosphors on a screen, and can be moved to tears or rage by seeing a mere symbol. There is also truth to the concern that images are far more subjective and open to differing interpretations than a logical argument made with text or a mathematical proof. Thus, although one often hears that we are living a *visual culture*, this is often not seen as a positive thing.

The passage of time may alleviate some of this distrust. After all, it is less than 200 years since the camera was invented. Some of the suspicion of images can be allayed by a better understanding of how visual materials are made and interpreted. Some of the suspicion will remain, but may be less frightening if it is understood.

Applications

Now that we have discussed the motivation for digital visual literacy, its multidisciplinary underpinnings, and some of the ongoing intellectual challenges, we consider concrete ways in which DVL curriculum can be developed and implemented in a K–12 setting.

A DVL Course

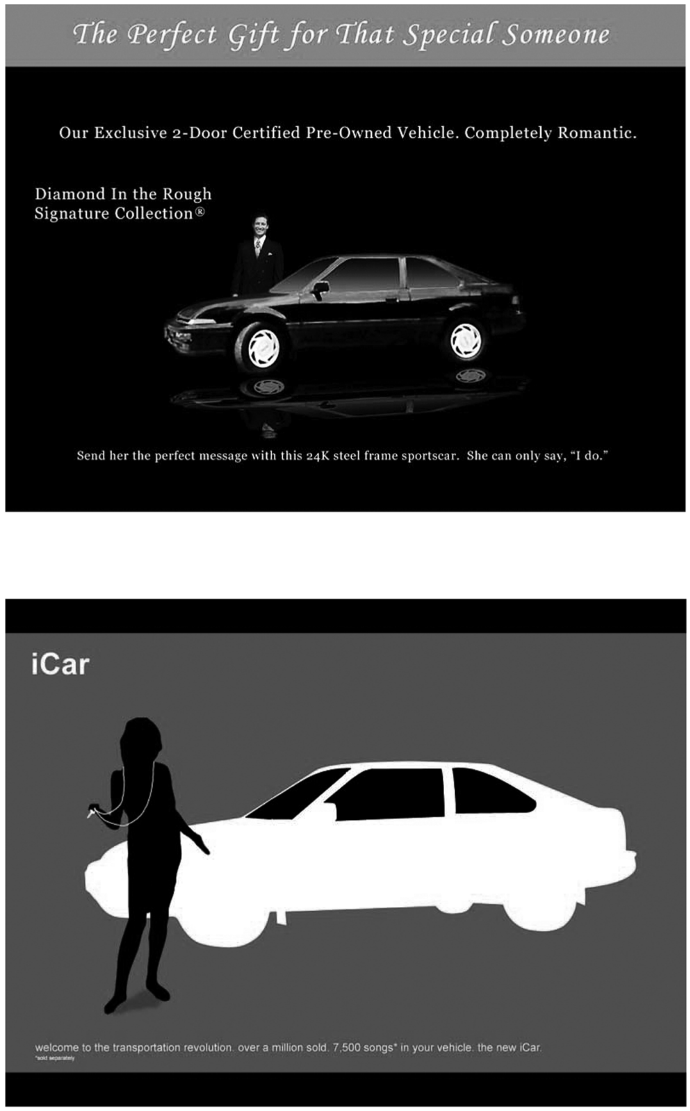
In the Spring of 2005, we taught an experimental DVL course, Brown University CS0024, the goal of which was to establish a basic level of visual literacy for today's computer-using students. A K–12 equivalent could have the same goal and use sections of many of the lectures, all online at Brown University, CS0024. The course was open to students at all levels and from all majors, and we chose final participants to ensure a heterogeneous mix of outlooks and backgrounds.

An upside of this approach was the ability to give students a sense of the entire discipline by introducing topics from the five areas discussed above and designing assignments that bridged them. For example, in one project students made advertisements for a single car that had to appeal to two completely different audiences (see Figure 3). Critiques of the results combined technical concepts in raster graphics (required for photo editing) with media theory concepts of signs and image rhetoric. We were originally wary of shifting rapidly among different disciplines but found that the students had no difficulty with this at all—the need to teach one subject at a time may exist mostly in the mind of an older generation.

Another benefit of the new course was the ability to combine not only disciplines but also pedagogical techniques. In addition to standard methods such as lecture and discussion, for example, we used some studio art approaches, such as the critique mentioned above. In a critique, the entire class sees and comments on each others' work. Although more difficult to manage than some other pedagogical approaches and also significantly more time consuming, exposing students to the critique methodology gave them a feeling for what the real-life design process is like. The process of explaining one's work in front of a group and receiving constructive criticism is much closer to the iterative real-life process of creating visual materials than the usual "turn in your homework and get back a grade and perhaps some commentary days later from the teacher."

Some of the drawbacks of preparing an entire course are obvious: A great deal of work is entailed and one has to introduce such a course into already crowded student schedules. Less obvious problems arose from the desire to teach different disciplinary topics in different ways: A room set up for a lecture is not necessarily good for group discussion; a room designed for computer lab sessions is a big challenge to lecture in, with students' heads hidden behind monitors. The typical computer science classroom does not afford the types of space needed for hands-on image making and critique. We had to bring in tables to provide a drawing surface and project work, rather than thumbtack it up (as one does in an art course) on freshly painted walls.

The major difficulty, still unresolved, was discovering how to introduce many topics and yet give students the sense that they learned something with coherence and depth. Presenting and integrating ideas from studio art, computer science, vision science, and media theory is probably at least a two-semester undertaking. Alternatively, one could restrict such a course to students already proficient in one or more of the basic disciplines, or focus on one or



(a)

(b)

Figure 3. DVL course student work: Make the same car to appeal to two different audiences (Gwendolyn Fuertes).

two chief areas and present the others more tangentially.

DVL Curricular Modules

Encouraged by the feedback from the full course, we sought a way to leverage our efforts and reach more students with fewer demands on the instructor. An opportunity arose in the form of a National Science Foundation Advanced Technology Education grant with Mesa Community College in Mesa, AZ (NSF ATE grant for DVL, 2005). In this project, we worked with teachers from several of the Maricopa Community College schools to develop DVL modules for introductory information technology literacy courses. Modules were developed to teach basic design in the context of programs like Microsoft Word, PowerPoint, and Excel, to introduce students to visual copyright issues, to experiment with ideas about the image economy, and to communicate using images in blogs. All the modules drew on principles from the five chief DVL areas discussed earlier and are available at the Web site for the NSF ATE grant for DVL (2005).

The advantage of this approach was that we could reach many more students (hundreds vs. 25 per year) and, with modules that include background information, PowerPoint slides, learning objectives, and assessments, we could alleviate most of the burden of material preparation for the instructor. The small scope of each module made them require less commitment to prepare (and revise) than a full course and could therefore involve more people on the development side.

Each module is designed, in general, to take one to two class periods—a much lower threshold to implementation than squeezing a whole new course into a student's schedule. In addition, although the modules span several disciplines, each primarily uses a single pedagogical approach, relieving the instructor of converting a teaching space from one physical layout to another.

The drawback of the module approach was the difficulty of putting the smaller nuggets of information in a larger context. To address this, we created an *Introduction to DVL* module that each teacher would present before individual topic modules. Also, because we felt that some groups of modules made more sense together than others, we began developing a map to help instructors choose complementary modules. As with the full course, however, there were still scheduling difficulties, because for every module introduced in a course, something else had to be omitted.

All in all, however, we found the module approach beneficial. Ideally, we envision a set of modules that could either comprise a full course or could be used piecemeal in existing art, design, computer science, media theory, vision science, and business courses.

Who Studies What?

A third DVL project helped us conceive of a wider range of modules and ways to attract new students into computer science courses (NSF BPC grant, 2006). It is no secret that participation in computer science by women and minorities has not only failed to reach any kind of parity with male participation, but has actually fallen precipitously in recent years, not only in absolute numbers, but in the percentage of students. A recent *New York Times* article provided some statistics and commentary, including interesting online responses from readers (Dean, 2007). Although no one disputes the lack of women in computer science, there is a lack of broad consensus on the causes.

Because the arts have plenty of female students, we developed a program to bring some of those creative participants into the computer science department by enlisting their design services. Our program, called Design for Science, recruits design-savvy students and pairs them with faculty members wanting help with visual aspects of communicating their work (or, in the case of areas like scientific visualization, actually helping with the research). We have found that simply being exposed to the people and concepts in computer science has helped change these students' perception of what computer science is and the role it might play in their lives. We are confident that introducing some DVL courses and modules into technical departments could similarly help attract more diverse and creative students, a win–win scenario for everyone. More details and projects examples can be found at NSF BPC grant (2006) Web site.

Conclusion

The emerging discipline of DVL differs from previous visual literacy efforts because of the ubiquitous role of computer graphics in our personal and work lives. We believe that the time has come to add DVL to the traditional textual and mathematical literacies as a basic skill required for educated citizens and productive participants in the knowledge economy of the 21st century. As K–12 institutions begin to integrate more computer-based visual literacy skills, successful models will be valuable jumping-off places. We hope that our framework of disciplinary areas and experiences with different instructional approaches, as well as materials provided online, will aid those of you undertaking this vital work.

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