The Importance of Using Visual Communication

in Classroom and Online Environments.

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There can be no words without images.
Aristotle

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Introduction

This paper will examine the need to incorporate more visual information into classroom and online learning environments. Students today are surrounded by technology that bombards them with visual information. Images flash across their televisions, computers, and smart phones every minute of every day. Despite this, many classroom instruction is limited to lectures, and many online learning environments are little more than digital textbooks filling screen after screen with only words. Educators need to take advantage of the *eye-minded* nature of today's students.

"We are becoming a visually mediated society," wrote Paul Martin Lester (1995). "For many, understanding of the world is being accomplished, not through words, but by reading images" (para 6).

Numerous studies have shown that materials that utilize visual communication are often more effective than materials that rely solely on text to communicate. This paper will examine some of arguments that have been made both for and against the increased use of visual information in the classroom and virtual world.

Given the power of visual information, this paper will also look at the work of Edward Tufte who has championed the use of graphics to communicate complex concepts. Tufte (2006) uses principals of analytical thinking and applies them to analytical *design* stressing that, "The purpose of an evidence presentation is to assist thinking" (p.137).

The paper will conclude by examining some strategies for using visuals in online environments. This examination with include looking at the work of Jakob Nielsen, a leading web usability expert. This paper is being done to explore how effective visual information can help instructional designers succeed in creating more effective learning environments.

The Pros and Cons of Visual Information

This section of the paper examines some of the arguments that have been made advocating both for and against the use of visual information in an education setting. Many studies have demonstrated that materials that use visuals are more effective than just using text. However, empirical research has not provided clear evidence on one side or the other. Some researchers have found that additional factors must be considered when looking at the visual vs. verbal argument.

Positive Effects

Some in education have advocated for the teaching of *visual literacy*. Visual literacy, broadly defined, is the ability to "communicate and understand through visual means" (Riesland, 2005, para. 4). This is seen as an essential skill for students who being asked to code and decode ever complex messages in a media-rich society (Riesland, 2005).

Phillip Yenawine (1997) wrote in "Thoughts on Visual Literacy" that visual literacy involves a set of skills ranging from simple recognition (*naming what one sees*) to complex understanding on "contextual, metaphoric and philosophical levels" (p. 845). These are skills that develop during childhood, but must be refined over time. These skills must then be redefined as new visual technology changes the way we all communicate.

"By educating students to understand and communicate through visual modes, teachers empower their students with the necessary tools to thrive in increasingly media-varied environments," wrote Riesland (2005). "The definition of literacy is outdated and that the new definition must account for the technologically evolving landscape" (para. 4). Students need to, "be prepared to communicate with a level of visual sophistication that will carry them through the multimedia-dependent environment of higher education and the modern work environment.

Moreover, visual literacy instruction will better prepare students for the dynamic and constantly changing online world they will inevitably be communicating through" (para. 10).

This *shift* toward the visual is also demonstrated by changes seen in science textbooks ((Kress *et al.*, 1998). An examination of science textbooks revealed a switch from visuals that supported text explanations; to text that supported visual explanations. This makes the argument that graphics now hold more meaning and are central to the meaning of modern texts and meaning-making systems (Kress *et al.*, 1998).

The importance of using visual information is also seen in the Dual Coding theory proposed by Allan Pavio (1979, 1990). He theorized that humans have one memory system for verbal information and another separate memory system for imaginal (visual) information. The verbal memory system includes language systems; both auditory and speech. The imaginal memory system includes visuals, graphics, and charts; along with sounds, tastes, smells, and nonverbal thoughts and reflections (Pavio, 1990). Since information in either system can trigger memory information in the other system, "the chance of learning is much greater when two, rather than one, memories are involved" (Lohr 2003, p. 37).

Paivio (1979) also stated that because of the differences in these memory systems that, "verbal behavior mediated by imagery is likely to be more flexible and creative than that mediated by the verbal symbolic system" (p. 435). This leads to the argument that mental imagery is viewed as holistic and creative ,while mental verbal processes are viewed as linear and analytical (Arnheim, 1993). Because of this dual coding, both the visual and verbal memory systems should be targeted by educators whenever possible.

The last argument championing visual learning comes from the learning style models formulated by Richard M. Felder and Linda K. Silverman. Felder and Silverman (1988)

theorized that the ways people receive information could be divided into three categories or

modalities. These three modalities include: visual (*sights, pictures, diagrams, and symbols*);

auditory (*sounds and words*); and kinesthetic (*taste, touch, and smell*). Felder and Silverman

(1988) wrote that, "An extensive body of research has established that most people learn most

effectively with one of the three modalities and tend to miss or ignore information presented in

either of the other two. There are thus visual, auditory, and kinesthetic learners" (p. 676).

Problems arise when there is a mismatch between students with visual, auditory, or

kinesthetic learning styles and environments that do not fit that style of learning. Students who

have a strong preference for visual or verbal communication have real difficulty learning in an

environment which does not support that preference (Felder & Silverman, 1988). Problems also

occur when there is a mismatch, "between the preferred input modality of most students and the

preferred presentation mode of most professors" (Felder & Silverman, 1988. p. 677).

Felder & Silverman (1988) explained that educators should seek a balance of

instructional methods by using both visual and auditory modalities (and if possible kinesthetic)

to reinforce learning for *all* students. This means that classroom instructors who just lecture, and

online teachers who only use text, *have* to provide visual materials for their students. Pictures,

diagrams, and sketches work well for illustrating concrete concepts. Process flow charts, network

diagrams, and logic or information flow charts should be used to illustrate more abstract

processes. Mathematical functions should be illustrated by graphs; and videos or live

demonstrations are best to illustrate working processes (Felder & Silverman, 1988).

Negative Effects

Poorly designed visuals can actually hinder the learning process. Visuals must match

with text and the goals of the instruction to effectively improve learning. Visuals that are not

consistent, do not complement text, or the goals of the instruction inhibit learning (Clark &

Lyons, 2004). That is why designing effective visuals is an important part of designing effective

instruction.

Not all studies about using visual information have been positive. A 1984 research paper

disputed claims that the using graphics improved decision speed and quality over other methods

of data display like traditional tables (DeSanctis, 1984). The paper demonstrated that graphics

were not more effective in communicating information than traditional tables. More importantly,

the study showed evidence that features that make graphs visually attractive (*color, design*

complexity, realism) could be detractions from accurate comprehension (DeSanctis, 1984).

Visual information should not detract or confuse students. Visuals should serve to clear up

confusion and highlight important information.

Those designing visuals should also be careful to attract students' attention to the right

information with the right attitude. Visuals should not be used to direct students to just the

exciting or entertaining aspects of a presentation (Sherry, 1996). Effective visual information

should aim to do much more than entertain. Visuals that do not encourage thoughtful analysis of

the information may actually interfere with the intent of a lesson (Sherry, 1996).

Envisioning Information

Whether you agree or disagree with these arguments, most educators would concur that

there are certain types of information that using textual communication alone is just not the most

optimal solution (Kendler, J., n.d.). Some information calls for a combined presentation of visual

and verbal communication. The leader in this area is Edward Tufte, an expert in the presentation

of informational graphics such as charts and diagrams.

Tufte has written several books on the theory and practice of designing informational graphics including: *The Visual Display of Quantitative Information* (1983), *Envisioning Information* (1990), *Visual Explanations: Images and Quantities, Evidence and Narrative* (1997) and *Beautiful Evidence* (2006). Tufte (1990) wrote that the objective of any chart, graph or diagram is not just to communicate statistical information in a clear way. The real job of a good informational graphic is to tell a story that aids in decision-making (Tufte, 1990). Good design is clear thinking made visible. Tufte (2006) wrote, *"Beautiful Evidence* is about *how seeing turns into showing*, how empirical observations turn into explanations and evidence" (p. 9).

Tufte's Grand Principals

According to Tufte (2006), in order for an informational graphic to be truly effective it should adhere to his six *Grand Principals*. These principals are detailed in the book, *Beautiful Evidence* (2006) and state that all good informational graphics should: enforce visual comparisons, show causality, show multivariate data, integrate all visual elements (*words, numbers, and images*), be well documented and be content-driven. Tufte (2006) explained that, "The purpose of an evidence presentation is to assist thinking", and that the six principles of analytical design "are derived from the principles of analytical thinking." (p. 137). He wrote that these design principles were universal and, "not tied to any particular language, culture, style, century, gender, or technology of information display" (Tufte, 2006, p. 10).

A New Vocabulary

In addition to his "Grand Principals," Tufte (1983, 1990, 1997, 2006) also provided the information design field with a new vocabulary. This included new words to describe bad design, like *chartjunk* and the *lie factor*. Tufte also created his own words for good design, like *high data-ink ratio* and *high data density*. He advocated the *mapping* of pictures, which is his term

for visually annotating images with relevant comparisons, scales of measurement, labels, or

explanatory diagrams that are placed next to, or are overlaid on the pictures (Tufte, 2006). Tufte

also introduced the concept of *escaping flatland.* This is the need for designers to break away

from two-dimensional displays by showing multivariate data in three or more dimensions (Tufte,

2006).

Design Obstacles

One of the major obstacles to good visual information design is low resolution data

displays. Tufte explained that designers must to be aware of the limitations of projected images

and computer displays. These kinds of displays have too much noise to adequately show data

rich information. "Noise is costly," wrote Tufte (1990), "since computer displays are low-

resolution devices, working at extremely thin data densities, 1/1o to 1/1ooo of a map or book

page" (p. 89). In these cases of *low resolution* instructors must provide printed handouts that

supply enough resolution to display complex informational graphics.

This low-resolution situation creates the greatest obstacle for online instructors who are

limited by computer screens. These instructors also can provide downloadable graphics that can

be printed out at higher resolution, but the problem goes beyond that. Tufte (1990) wrote that

because computer monitors cannot show much in the typical eye span, information presented on

computer screens is often "stacked" in multiple layers. This causes computer users to frequently

get lost, asking the question, "Where am I?" (Tufte, 1990, p. 89).

"This reflects the essential dilemma of a computer display: at every screen are two

powerful information-processing capabilities, human and computer," wrote Tufte (1990). "Yet

all communication between the two must pass through the low resolution, narrow-band video

display terminal, which chokes off fast, precise, and complex communication" (p 89).

Presenting Complex Information

The challenge for online instructors is trying to use visuals in a low-resolution environment, limited by the conventions of the internet. These obstacles can be overcome with proper planning and good graphic design. William Horton (2006) wrote, "At its best, e-learning is as good as the best classroom learning. At its worst, it is as bad as the worst classroom learning. The difference is design" (p. 3).

The Need for Core Principals

Educators who are teaching online must have a strong understanding of basic graphic design principals. Ian Brown (2000) called visual and design principles the forgotten partner in multimedia and Web development. Basic, core design principles are often forgotten in the curriculum of educational multi-media courses. Teachers who are training to develop new media for the classroom should be provided with core visual, graphic and design skills necessary to produce quality products, wrote Brown (2000). In addition, educators need to understand how to design good information architecture. Many times a web page may look fine visually, but bad design and organization increases confusion in learners and causes students to "get lost" (Backer, 2004, p. 77).

Designing Web Usability

Jakob Nielsen is a leading web usability expert. Nielsen has popularized the issue of usability and the concept of usability testing, for designers, web developers and commercial clients building products on the Internet. His popular internet column, *AlertBox,* generates more than 5.5 million page views each year, and he has published a number of books including: *Designing Web Usability: The Practice of Simplicity* (1999).

According to Nielsen (n.d.), "Usability is a *quality attribute* that assesses how easy user interfaces are to use. The word 'usability' also refers to methods for improving ease-of-use during the design process" (para.3). Any successful online designer should understand this concept regardless if they are designing for the public *internet* or for a closed education *intranet*. On education intranets, usability is a matter of student productivity (Nielsen, n.d.). Time that students waste being lost in an online learning system (or pondering difficult instructions) can lead to frustration, poor productivity, poor grades, and poor student retention.

Usability is defined by five quality components including: learnability, efficiency, memorability, errors, and satisfaction (Nielsen, n.d.). Learnability refers to how easy it is for users to accomplish basic tasks the first time they encounter a new webpage design. Efficiency looks at how quickly users can perform tasks once they have learned the design. Memorability refers to the ability of users to reestablish proficiency when they return to a design after a period of time. Errors refers to how many errors users make, how severe are the errors, and how easily can users recover from the errors. Lastly, satisfaction looks at how pleasant is it to use the webpage design.

Understanding usability is important to online visual designers, because users do not *read* web pages, they *look* at them. According to Nielsen (1997), "People rarely read Web pages word by word; instead, they *scan* the page, picking out individual words and sentences. In research on how people read websites we found that 79 percent of our test users always scanned any new page they came across; only 16 percent read word-by-word" (para. 1).

Because of this tendency for people to scan, steps must be taken to simplify reading such as applying visual formatting that helps users detect document structure without difficulty. Educators, web designers and other content providers need to create *scannable* text. There are a number of visual ways to do this including: using headlines and subheads, using highlighted

keywords, typeface variations, colored text, and bulleted lists. There are also structural ways to help readers better scan pages including: writing in the inverted pyramid style, only using one idea per paragraph, and using half the word count (or less) of conventional writing (Nielsen, 1997).

Conclusion

This paper examined the need to incorporate visual information into classroom and online learning environments. Students today are surrounded by visual technology in the real world and virtual worlds that they live within. Classroom and online instruction needs to take advantage of the power of good visuals and informational graphics to communicate complex concepts.

This paper examined some of arguments that have been made both for and against the use of visual information and found that although many studies were positive, results were mixed and further empirical research is necessary. The use of visuals should be based on research-based theory about how students learn best with visual technology. Instructional development in this area should not be based on what computers can do, but rather what students can do (Mayer, 1997).

This paper also looked at the work of Edward Tufte. His *Grand Principals* should help guide the analytical *thinking* of designers who apply these principals to analytical *design.*

The paper concluded by examining some strategies for using visuals in online environments. This examination included looking at the work of Jakob Nielsen, a leading web usability expert. This paper was produced to explore how effective visual information can help instructional designers succeed in creating more effective learning environments.

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