DESIGNING FOR ENCODING SPECIFICITY:
RESEARCH-BASED VISUAL DESIGN CRITERIA THAT ENHANCE
ENCODING IN EDUCATIONAL MATERIAL

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ABSTRACT

The effectiveness of educational material to visually transmit information is an important facet in the learning process. Poor visual design confuses learning objectives, frustrates the reader, and makes retention more difficult. Educational psychologists have written extensively on different aspects of improving the visual communications of educational material. Ironically, this research is predominately textual in format and has not penetrated the design community. Two levels in this visual communications exists; one aesthetic, the other cognitive. The former is closely related to traditional design and is most likely to be addressed. The deeper, more value-laden to encoding information, is the cognitive level. It, however, is seldom addressed by designers. Lacking knowledge in educational psychology, designers defer to editors, who conversely lack knowledge of design principles, for visual encoding suggestions. This collaborative process is often hampered by a general lack of communication. The result is a document that is educationally sound with a possibly high aesthetic design quality but poor visual capacity to help encode information.

The appropriate solution proposed was to increase designers' knowledge in cognitive aspects of visually communicating educational material. Educational courses related to encoding strategies and visual information processing were taken. Research was conducted in the fields of education, educational psychology, and design. Applying various research techniques, primary research was conducted into user needs of the main stakeholders: students, editors, designers, and teachers. Current textbook design critiques were explored to identify potential design flaws.

The results was a proposed set of research based visual design criteria. Detailed, visual examples, utilizing this criteria, were produced. These examples were accompanied with an annotated version clearly describing the applied principle and its use.

End user evaluations were then conducted to test the validity of the criteria. For this, a chapter from a current textbook was redesigned in accordance with the criteria. Following a comparative
analysis of the two designs, usability tests were conducted with 8th grade students. Design critiques were solicited from five individuals involved with aspects of textbook usage or design. This research is a practical guide offering possible solutions and creates a common resource for critiquing purposes between editors and designers. My research focuses on middle school print material.
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CHAPTER 1

ANALYSIS OF THE PROBLEM

In the late 1980s, a newly created design firm called Ligature Inc. proposed a shift in the visual/verbal architecture within textbooks. This was a rather radical departure from earlier textbooks for several reasons. First, editors have traditionally been the major driving force behind textbook design. Ligature suggested a greater parity and partnership between editorial and design, thereby elevating "visual information" to a more equal role with "text information" in the encoding process. Second, Ligature encouraged a more visual format: larger images, more color, smaller blocks of text placed in more interactive layouts. They felt that textbooks needed to be more visually-engaging and interactive with the learner.

According to The Visual Turn and the Transformation of Textbooks, this approach was well-received in field tests with teachers. A major milestone was when the State of California adopted Ligature's newly-designed social studies textbook series in 1989. The format spread to other publishers, and this visual style grew more prevalent.

Today, however, this approach appears to have gone too far. Textbook watchdog groups complain that textbooks are visually overwhelming. They argue that this increased visual emphasis has reduced the amount of text presented, oversimplified some information, incorrectly portraying other information, and has thereby "dumbed down" textbooks.

My argument is that while an increased verbal/visual mix can enhance the encoding process, many current textbooks are not designed efficiently to assist the encoding of information. Many images are more decorative than actually adding meaning. Linkages between the visual and the verbal is not always clear or strong, and many current professional practices do not encourage stronger links between the editor's "verbal content" and the designer's "visual encoding" of this information.

This chapter examines problems dealing with the visual encoding of information in textbooks. My focus is limited to visual aspects and does not address the editorial content of the
text. I entered this research process somewhat skeptical. I had read several reviews that were critical of textbooks and had heard that textbooks were poorly done. I surmised that there were some problems, but that this issue had been exaggerated out of proportion. I expected to find isolated instances. What I found, however, is an industry-wide issue that needs to be addressed. I found many textbooks visually overwhelming, teachers and parents that broadly agreed that many textbooks are poorly done, science content editors glad that some visual problems may finally be addressed, and identifiable problem areas that can be discussed.

My research looks at this problem from three perspectives. The first is related to design-specific problems: issues related to visual hierarchy, visual/graphic architecture, choice of images, and information design. The second perspective deals with the end-user, the student, and discusses their limited visual literacy skills. The third, and final, perspective encompasses the broader industry-based issues that impact visual learning. Topics include the impact of a market-driven production process, the influences of technological advances on design, the lack of usability research done by textbook designers, the pressures on the design process caused by the consolidation of textbook publishers, and the often-disconnected relationship between editors and designers in the developmental process.

1.1 DESIGN-SPECIFIC PROBLEMS

This section examined visual design-specific problems within textbooks. To research these problems, seven middle and high school textbooks were surveyed with subjects ranging between history, physics, and English literature. I read numerous critiques of textbooks to determine their criteria in judging educational quality. I interviewed editors, subject matter experts, textbook watchdog organizations, designers, and teachers. I read literature related to encoding information and took several courses related to educational psychology and the design of educational material. I provide visual demonstrations of the problem when possible. In some situations, I provide several examples for the same problem. This was done not to create redundancy, but to demonstrate that a particular problem goes beyond one book or one publisher.
Three problems were discussed: visual architecture that degrades encoding, the use of inaccurate and misleading visual information, and poor encoding between verbal and visual information.

1.1.1 Visual Architecture That Degrades Encoding.

Visual architecture is the structured organization of the verbal/visual mix on the page. The problem comes not with the amount of either text or visuals, but with its presentation. If a page is visually overwhelming, the reader has difficulty focusing on the text. They can become distracted, and even anxious about learning from the material. Conversely, pages that are "text heavy" do not engage the reader. They are usually less attractive and possibly even uninviting and intimidating. Poor visual architecture is the result of crowded, poorly organized visual layouts, the excessive use of test cues, sidebars, and color, and ineffective navigation. Each of these problems are discussed and demonstrated below.

1.1.1.1 Overwhelming Visual Presentation. Holt, Rinehart, and Winston's *Elements of Literature* has examples of crowded visual layouts. At times, the learner is confused and distracted with competing visual elements. One spread is packed with an advanced organizer containing five sub-topics, the title of the story article, text typeset in boxes, and an overall colored background treatment (See Figure 1.1).

Another example is taken from a recent review of Middle School textbooks. The study was conducted by Dr. John Hubisz, a physics professor at N.C. State University in Raleigh, N.C. He reviewed and critiqued the physical science in Middle School science textbooks. He reviewed for scientific accuracy, adherence to an accurate portrayal of the scientific approach, and the appropriateness and pedagogic effectiveness of the material presented for the particular grade level. He also noted such things as readability, attractiveness, and the quality of illustrations. He writes about the visual clutter in one book, Glencoe's *Science Interaction:* 2

There is a huge amount of clutter that detracts on every page from the learning of science. However it is not only this book, but all the books that fill up the pages with non-essential information (names, supposed threats to the environment, multicultural efforts, a multiplicity of things to do that are not relevant to the question at hand, topics well beyond what the student has no idea where one ends and another begins. 3
Figure 1.1 Overwhelming Visual Presentation. The crowded visual layout makes the visual scanning difficult and competes with the photo background. *Elements of Literature* (Austin, TX: Holt, Rinehart, and Winston, 2000) 420-421.
In Holt, Rinehart, and Winston's *Call to Freedom*, the visual architecture disrupts the learner's reading. Robert Hagopian, a teacher in California, is quoted as writing:

*Call to Freedom* breaks up the core text in unprecedented ways. Focus boxes, some of them running as much as six consecutive pages, deal with such matters as "Reading for Graphics," "Geography Skills," "Linking Past and Present," "Merry the Curriculum," "Science and Technology," "Cultural Diversity," "Skills Workshop," and "Building Your Portfolio." Lucidity and coherence disappear in a maze of exercises and learning activities.  

Another example containing overwhelming visual layouts is Prentice Hall's *World History: Connections to Today*. Historian Paul Gagnon of Boston University, reviewed this textbook, and is quoted as writing:

"Quite apart from the layered historical narratives, a deluge of boxes, sidebars, questions, exercises, analyses, chores for "research" and writing, and sundry "activities" is overwhelming...The average page resembles a garish and over-crowded website." 

Seeking further clarification, I emailed Dr. Gagnon. He replied back,

I have no claim to useful views on the verbal/visual mixture of texts. My lodiated opinion is that the endless array of visuals just makes the book heavier, more costly, and speaks its own gerness of attention deficit order, breaking up the adventurous narrative/series--dramas whether nice or dreadful--that texts ought to focus on but usually don't. Kids read paperbacks with no illustrations. A lot of them would read history, too, if it were alive.

Holt, Rinehart and Winston's *Environment Science* is an example of visual overload. Max G. Rodel, a consulting environmental chemist affiliated with Environmental Science Associates in San Francisco wrote in a review for *The Textbook League*:

*The page...are lavish, confusing visual displays, loaded with images, headings, boxes, logos, tables, charts, and other distractions, and the main text is obscured by a barrage of sidebars, feature articles, section reviews, "Bio-Fact" notes, "Field Activity" notes and other items. Trying to find and follow the main text is a head spinning challenge...Because the pages are so heavily decorated with pictures, sidebars, and other ornaments, the presentation of scientific topics seldom achieve any depth."

Visual overload adversely impacts the learning process. Dr. Francis M. Dwyer, professor of education at Penn State University, has written extensively on the encoding of information. He writes about the impact on learning caused by visual overload: "Visually containing too much
information may tend to overwhelm the student and cause him to withdraw from rather than engage in the necessary kind of interaction with the visualization which will enhance the learning process." 8

I found Dr. Dwyer's comments true when I examined Glencoe's Civics Today. It is a brightly colored, illustration-filled textbook. At times, however, I was visually overwhelmed by the many competing activities, opportunities for online updates, reading assessment checkpoints, political cartoons with elaborative questions, foldable activities, and the list goes on. Looking at the book actually created anxiety because I didn't know what to look at first.9 (see image 1.2).

These views are also shared by science content editors. I conducted a round table interview with four science content specialists at the Eisenhower National Clearinghouse (ENC), Columbus, Ohio. They were Dr. Kimberly Boempler, Carol Damian, Carolee Barber, and Jennifer Gonya. Ms. Damian, a 25 year physics teacher veteran, stated that some textbooks were so visually stimulating, that she wouldn't want her students to use them. Both Carolee Barber and Jennifer Gonya, former teachers, agreed.10

An interesting complaint common to all of these critiques is that "the reading of the text" is broken, disrupted, or distracted by visual elements. This is an important issue because there are others who advocate a different, and almost opposing, stance on the learning of information. How this "verbal/visual mixture" is decided impacts the visual layout, and thus the learning style, of the textbook. Dan Rogers, a senior project editor at Ligature Inc., argues in favor of a more non-linear, visually-integrated approach:

"We were pushing the edge [of established convention] in terms of the presentation" with a non-linear approach. Mentioning the resistance by teachers who look at it solely with a linear "mindset," he said, "I read the text and then I look at the picture. And then I read some more and look at this picture. And I don't know what to look at first." Whereas, "kids generally respond very positively. This is the kind of presentation they're familiar with and very able to cope with."11

Ligature's argument was that the "visual" element should receive at least equal footing with the "verbal" elements. Andrea Larpina explains:
Figure 1.2 Compelling Visual Layout. This is an example of a page containing a lot of visual information. With so much competing visual information, the learner can become overwhelmed. Richard C. Reny et al., Civics Today: Citizenship, Economics, and You (Columbus, OH: Glencoe-McGraw-Hill, 2003) 20–21.
Though it is somewhat ironic to hear a graphic designer pontificate about the "destruction of narrative text" simply by images alone, nevertheless, their shared convention reinforces a widespread cultural assumption...and that is [that] visual information is inherently superior and deceptive, and images are without content. This antipathy toward the visual is also widespread in education and now more than ever it needs to be challenged.12

1.1.1.2 Excessive Use of Text Cues and Icons. Another problem noted with the visual architecture of textbooks is the excessive use of text cues that disrupt the reading flow. Text cues, sometimes in the form of icons, are meant to assist the learner with navigation. Some textbooks, however, have taken this to the extreme.

Holt, Rinehart, and Winston’s *Elements of Literature* is an example of excessive use of icons. The spread on pages 398 - 399 contained the following graphical elements: The “building your portfolio” section has an image of folders, the “writer’s notebook” has an icon reading “Work in progress,” “Creative writing” section has a clip art style illustration, and “making meanings” has another clip art illustration. The right page of the spread has a header illustration for “Elements of Literature,” in the lower portion of the page is a cartoon. There are six design elements in the two pages. Many other pages appeared to have new and different graphic elements (see Figure 1.3).13

Excessive use of color in text cues adversely impacts reading. In Glencoe’s *American Journey*, text cues are red, blue, green and yellow. Some are encased in brass-colored ovals. Some paragraphs start with a gold star in a red square. There is excessive use of labeling within the captions, such as “History and Art.” All this adds nothing to the overall comprehension. Quotations are set off with oversized green quotation marks. The reader is drawn to the large visual elements rather than to follow the text (see Figure 1.4).14

Vague navigation weakens the visual architecture. The navigation in *Elements of Literature* is extremely vague and confusing, and makes it difficult for the reader to determine where they are strategically in the book. Many pages leave the reader wondering to which story is the page related. Difficult to know when one article has stopped and a new topic is beginning. This confusion slows comprehension.
Figure 13 Excessive Use of Icons. Elements of Literature, 398-399.
Figure 1.4 Visuals overpower the text. Note the large quotation marks. They are probably meant to alert the reader that this is a quote, and they are used as a visual element with color. The overall visual hierarchy of the page is minimal. The eye is drawn to the large photos and the spot of color. Joyce Appleby, Alex Brinkley, and James M. McPherson, *The American Journey* (Columbus, OH: Glencoe McGraw-Hill, 2000) 376-377.
1.1.1.3 Distracting Visual Elements Weaken the Visual Architecture. Elements of Literature use an excessive amount of border treatments. While border treatments can add more visual meaning to the story, these borders were too visually stimulating and distract the learner when trying to read.  

In McDougal Littell's World History, text appears to have second importance to sidebars and maps. Every page has at least one image or map. Many of these images intrude into the text making the reader's eyes move around these obstacles. There is little white space, and many pages are packed with text and graphics (see image 1-5). In another spread, a quote is highlighted with "a voice from the past," creating yet another unnecessary and distracting highlight. The Marshall Plan chart disrupts reading, and asks its own questions. Beside the chart is an exercise entitled "Thinking through History." It leads the reader off into another direction. Skipping over the chart, the reader moves to the next page which begins with a photo and another exercise entitled "Thinking through History." Visual hierarchy is limited largely to changing text colors and the alternating between serif and sans serif.

While these particular examples may be problem cases, some educational development houses, such as Ligature Inc., see otherwise and encourage increased interaction between the visual and verbal elements. They stress visual language in which the layout visually orchestrated how and when the text was to be read." Joe Godlewski, a senior designer at Ligature, stated that their design approach was for a more visually diagrammatic format. "More a kind of guide book approach," Godlewski added, "rather than a read-about kind of book." Dan Rogers, a senior Ligature editor, explained the concept further:

The goal was to keep it in relatively small pieces [by having a regular A Head (lesson title) and b Head (subtitle) structure that has to repeat periodically, so we don't end up with pages that look like solid text]. "The decision was made to always wrap text around objects on the left side, because you had an uninterrupted flow of type, so [again it was easy for kids to read]." Text elements were intentionally designed to be more readily noticeable when scanned. Organizing text in this visible fashion seemed to go against the standing conventions of how books were meant to be read.
Figure 1.5 Distracting Visual Layout. Notice that the text is shifted and displaced to allow better placement of sidebars and photos. Within this spread, there are four photos, one sidebar with elaborative questions, and three elaborative questions in the margins. This is an example of visual architecture not orchestrating a balance between the verbal and visual information. Rather than work together in mutual support, the two compete for our attention. Roger B. Beck et al., *World History: Patterns of Interaction*, Evanston, IL: McDougal Littell, 1999) 530-531.
Defending Ligature's more visual layout, Ligature editor, Rob Wirtig argued that there is a definite "mythology about how books are read." He cited that while the traditional literary method was considered the "norm," there were other effective reading strategies. These strategies employed more of a cinematic approach. The layout could be read "in sequence." He cautioned, however, that some educators may consider these strategies as forms of skimming and thereby label them an "aberration."  

1.1.2 The Use of Inaccurate Illustrations, Diagrams, and Charts

These misleading illustrations can be the result of poor visualization or attempts to oversimplify otherwise complex objects. The visualization of some information, such as an atom, can be difficult and can create inaccurate misperceptions of the actual item.

Over simplified illustrations that create misperceptions. Carol Damian of ENC talked about simplistic pictures that confused students. She cites the example of "blue blood." Most illustrations show oxygenated blood colored red, while showing deoxygenated blood as blue. While this helps the student visualize the flow of the circulatory system, it also perpetuates a chronic misconception that deoxygenated blood is actually blue in color (see Figure 1-6).  

Prentice Hall's Biology: The Living Science has examples of misleading illustrations that impact visual learning. Lawrence Davis, a reviewer for the Textbook League, writes:

"Many of the colored drawings in The Living Science are too vague. The Prentice Hall artists have done such odd things as showing a leaf's mesophyll cells suspended in space, or omitting all of the external parts of the human female's reproductive system. The illustrations of human sensory organs are rather weak, though high quality medical illustrations of all these organs are readily available and could have served as models."

Project 2061 is a national project, funded by the National Science Foundation. Its purpose is to evaluate and improve the quality and levels of math and science in the United States. In a three year study, in collaboration with more than 100 scientists, mathematicians, educators, and curriculum developers, they examined the quality of textbook instruction using criteria drawn from research about how students learn. Their comments stated, "While most of the books are lavishly illustrated, these representations are rarely helpful because they are too abstract, needlessly complicated, or inadequately explained."
Like a car engine, the heart depends on electrical energy to start it and keep it beating regularly. This energy is generated by the body’s own pacemaker, a tiny bundle of nerve fibers located in the upper chambers of the heart. When this area contracts, it sends an electrical wave to the lower chambers, the atria. They contract and then the blood into the larger lower chambers, the ventricles. The wave of electricity then moves to the ventricles. The atria then relax, and the ventricles contract and pump blood out of the heart. This process repeats itself over and over, at the rate of about 60 to 100 beats per minute.

Figure 1.6 Oversimplified Illustrations Create Misperceptions. “Electrocardiogram medical diagram,” Peter Wildbur and Michael Burke, Information Graphics: Innovation Solutions in Contemporary Design (New York: Thames and Hudson, 1998) 75.
Some inaccuracies in visualized material are the result of a lack of expertise. Dr. Hubisz explains:

"Listed editors are presumably experienced with the subject at hand and have basic general knowledge. Illustrators, artists, photo editors and image bank librarians may not perhaps have specific knowledge of the subject, but presumably have expert status in finding or creating appropriate images, and presumably have adequate supervision by knowledgeable editors or authors to assure the accuracy of the science involved... Several dozen people will be listed as "content reviewers", "classroom reviewers", "field evaluators", etc. Their credentials or affiliations allow the buyer to think they were qualified to have an active role in the review of the material. The buyer is led to conclude the whole book was carefully checked."\(^22\)

1.1.3 Poor Encoding Between Verbal and Visual Information.

The memorization of information can be enhanced by the effective association between the verbal and visual elements. This theory, called dual coding, argues that incoming information can be coded within either the verbal or visual coding systems. Although the nonverbal components are generally stronger, retention is greatest when information is coded in both systems.\(^23\)

Glencoe's *The American Journey* contains examples of poor encoding between text and map information. Pages 283 and 285 are devoted to the expeditions of Lewis and Clark and Zebulon Pike. The map, showing the selected routes, is on the previous spread to the detailed information. The reader sees the map before reading the narrative text and must continually shuffle back and forth to read the text and study the map. Neither article about Lewis and Clark or Pike mention the map in their text, which lowers the reinforcement value of the map. Details mentioned in the text are left off the map such as the beginning dates of the expeditions. From the map, it appears that Sacagawea joins the expedition on the final portion of the expedition, rather than at its beginning. From the map, the reader would think that Clark and Lewis reunited on the return trip, which did not occur. From the map, the final destination of Lewis and Clark's expedition is not apparent. Nor is the final destination of Pike's 1807 trip made clear. Fort Mandan is shown on the map, but not mentioned in the text. It is probably the winter camp mentioned in the text that the explorers used in 1804. Interestingly, on the following pages, a
map showing Lewis and Clark's route is repeated in a National Geographic's "Journeys: Lewis & Clark" spread. This map is not mentioned in the earlier text, and consists of one enlarged journal entry from Lewis's writings and five highlighted informational points on their map.24

In another spread from Glencoe's American Journey is an example of poor encoding between the text and photos. Page 22 contains two pictures: one is a Mayan pyramid, the other is a ceramic model of a Mayan city. The caption does not indicate where the pyramid shown is located. Nor does the caption tell us why this inserted model is included. What is the reader to glean from this model? What do the larger structures in the model indicate? Is there a relationship between the two photos? The reader has no map to help orient their learning. Only on page 26, under the activity of "Understanding the Parts of a Map" is there a map related to the text. This map, however, is not mentioned in the earlier text, and may not be noticed by the student.25

1.1.3.1 Inefficient Use of Captions. Captions assist the reader with understanding the image presented. It provides information that may otherwise be missed or not mentioned in the text.

The late Philip Megg was a professor of Visual Communications at the Virginia Commonwealth University. He explained that picture captions are "titles, explanations, or descriptions of images. (Their) proximity to the image and type size should unmistakably announce its function. Research has shown that picture captions have from two to four times the readership of the text, making their importance even greater than the traditional role."26

Dr. William Winn of the University of Washington wrote:

"Without direction to the learner from the designer, there is no guarantee that the picture will play the role that was intended. Indeed, when pictures are used with other message forms, such as text, as they usually are, there is no guarantee that the student will even look at the picture, without instruction to do so. Once the designer has determined which function the picture is to perform, directions on how to look at the picture can be written into the message. If the topic is oil refining, such directions for a descriptive picture might read, "Notice the large number of pipes and tanks that make up an oil refinery." For an organizational picture (possibly in a more schematic form) showing the refining process, "Notice that the lightest fraction (gasoline) is extracted first, and heavier fractions later." For an interpretative picture of the fractioning process, "Look carefully at the temperature graph in the corner of the picture. You will notice that the lighter fractions evaporate at lower boiling points and can therefore be separated through pipe A leaving the fractioning tower, from the other, heavier, fractions."27
On page 22 from Glencoe's *American Journey*, there is an explicit reference in the text to look at the Mayan pyramid photograph. The result is that the reader may look at the photo at any time—rather than when associated with the text. The caption reads, "In Tikal and other cities, the Maya built huge pyramids where people could gather for ceremonies honoring the deities. A model of a Mayan city is shown (top left). How were the Maya governed?" The answer to the caption's question is "by theocracy." This answer is mentioned in the text. The problem is that if the reader begins with the photo, they may begin searching the text for the answer. This disrupts the reading process and encourages a "grazing" style of reading.

The important role of captions is reinforced by Dr. David Sless, Senior Lecturer in Visual and Verbal Communication at the Flinders University of South Australia. He writes,

"Despite the endless production of pictures in our culture most of them are used in this superficial 'attention role.' It is therefore likely that unless the context in which they are to be used offers sufficient guidance in their use, most students will presume that they have an attentional role and will therefore treat them as only incidentally relevant to learning."\(^{28}\)

1.1.3.2 Poor Selection of Images Adversely Impacts the Verbal/Visual Mix. For example, Dr. Hubisz cites images that do not reflect the text in Glencoe's *Science Interactions*:

- *Safety: page 40* - The activity calls for protective clothing and safety glasses and the student in the picture has neither. On page 196 the student pictured does not have the required "protective clothing" on. Page 462 - The text calls for "eye protection," but the discussion does not. There does not seem to be any interaction among the graphic artists and the "author" to ensure that the pictures, drawings, or diagrams illustrate what is intended.\(^{30}\)

In *The Visual Turn*, we see the amount of work that Ligature had to perform in order to get the quality of work they wanted. Massive amounts of manpower, diligent searches for just the right images. This quality remained high while they designed the books. Textbook publishers later created style guides which their production staffs had to attempt to maintain this high standard.\(^{31}\) Time constraints, limited personnel and financial resources, and available talent can drain the process of this sustained quality.
1.2 USER-SPECIFIC PROBLEMS

If students are to use more visual information, then they must be better equipped to comprehend the increasingly visualized information. Carol Damian, a 25-year physics teacher and ENC science content editor, explains, "students don’t know how to utilize textbooks. They learn literacy reading, but do not learn how to read a textbook. They don’t understand how to comprehend graphs."52

Richard Lowe, an ENC science content editor, confirms this visual literacy concern. In an article entitled, "Visual Literacy and Learning in Science," he writes:

The easy pictures are used in everyday life can give the misleading impression that visual language is somehow generally much easier to understand and more universal than verbal or mathematical language. He adds, "the forms of visual information that scientists and technologists are far more complex and esoteric. The specialized nature of scientific visualizations means that people do not learn to deal with them as an incidental result of their normal interaction with the everyday environment. Rather, they must engage in specific learning activities that help them to develop the knowledge and skills required to interpret these very particular types of visual representations. However, there are also aspects of how content is depicted that makes these visualizations challenging for the uninitiated. Visual literacy is an essential component of science and technology education today. However, it is an aspect of learning that is relatively neglected by teachers. As a result, there is a great need for further work to develop practical teaching strategies and resources."53

This concern of students’ low ability in visual learning is further supported in an educational review by Leavie and Leite. They write:

Students are not in the habit of learning from pictures. This should not be surprising since, as Olson (1977) puts it, "schools remain predominantly literate enterprises, that is, the major aspirations of the schools are concerned with literacy, and the means of instruction are predominantly literate."54 Students may not regard pictures as serious sources of useful information. Although most students probably do look at text illustrations in most situations, they usually do not "study" the pictures unless prompted to do so. Much research has indicated that people normally notice only the global aspects of a picture. They fail to attend to and encode most of the detailed features (e.g., Friedman, 1979). It may be that students attend closely to the aspects of text illustrations that are mentioned in the text."54
Joe Godlewski countered this viewpoint,

Our premise was that students can and do read visuals, and that literacy is tied to both presentational and discursive processing of information. The visual stimulus was meant to "engage and attract" students, not "distract them. The more that text represents context and [shows them] a step and place giving them a [visual] reference, the more we felt they would be able to process what the text was telling them."33

Rob Wittig downplayed the concern over visual literacy, arguing that "terms like visual literacy are going to have to be considered transitional terms." He stressed that it is "not another kind of reading," and preferred the term "visual learning" instead of visual literacy. Andrew Laszina adds, "the whole notion of visual learning in instruction is not so much new as just relatively underdeveloped."36

This concern over the lack of visual literacy is influenced by a student's reading abilities. Each year, the DOE gathers statistics about student learning. According to its year 2000 National Report Card, a national educational statistics document, 63 percent of fourth-grade students perform at or above the basic level of reading achievement. Only 32 percent of fourth-graders read at the proficient level, and only 8 percent read at the advanced level.37

As explained in the report, "Basic Level (63 percent) should be able to make relatively obvious connections between the text and their own experiences and extend the ideas in the text by making simple inferences." 32 percent, proficient level, can "extend the ideas in the text by making inferences, drawing conclusions, and making connections to their own experiences. It adds, however, "The connection between the text and what the student infers should be clear." Only 8 percent of readers (advanced level) can "when reading text appropriate to fourth grade, should be able to judge text critically and, in general, to give thorough answers that indicate careful thought."38

1.3 INDUSTRY-SPECIFIC PROBLEMS

The last problem area is related to the textbook publishing industry and its impact on visual design problems. There are three major problem areas: the effects of a market-driven production on the design process, the minimal formal usability testing of the user audience, and inefficient coordination between editorial and design.
1.3.1 The Impact of Market-Driven Production Process on Design

Textbook publishing is a business that must meet State adoption deadlines, monitor and possibly match the competitive design edge of rival publishers, and are constantly driven by profits and loss. Betsy Van Don, adds,

*When publishers scramble to meet state-adoption deadlines, the potential for error escalates. “It’s the amount of material we have to provide in a relatively short period of time,” explained The president of Holt, Rinehart & Winston’s school division. “Time really is the enemy here.”*

An example of this competition is seen in the use of affiliations. Visual information, gained from graphics from these affiliations may (or may not) be integrated into the overall visual architecture. For example, Glencoe’s *American Journey* has National Geographic Society’s Yellow logo on the cover, yet has only 20 pages of content within the 1000 page volume. These pages are designed separately, and at times, repeat material discussed in the text. Holt, Rinehart, and Winston’s *Physics* has the logos of CNN’s Turner Learning and the Smithsonian Institution on its back covers yet have no references inside. Glencoe’s *Civics Today: Citizenship, Economics, & You* has maps from National Geographic. It also has political cartoons and special informational spreads from TIME Inc. These appear better integrated into the overall curriculum.

Consolidation, a result of the market-driven process, has had a tremendous impact of the design process. The number of publishers has shrunk. Table 1.1 shows a timeline showing textbook consolidation with the publishing industry (see Table 1.1). Many editors, designers, and illustrators have been laid off. Some publishers are simply acquired for their intellectual property and then dismantled. Ironically, remaining staff must continue to produce a similar workload as before. Large publishers may use traffic coordinators that manage the flow of materials from editors and designers.

1.3.2 Questions Concerning Quality Assurance

Some problems are the result of designers lacking subject-matter knowledge. Dr. Hubisz writes,
Realize that the editorial/illustrational staff and the content-reviewing staff are not necessarily trained in the subject. About ten of the listed content reviewers in Exploring Physical Science were biology teachers in Biology, but became "science instructors" in the title pages of EPS (Exploring Physical Science). (1995, 1997, and 1999) ... Unfortunately, most State and School District committees are not aware that the publisher(s) may take the short cut of not using real experts to prepare the book. They look for curriculum fit, for gender equity, for racial balance, and assume the content matter itself will be accurate. That assumption gets our children and us into trouble.  

1.3.3 Minimal Formal User Testing Done by Publishers

It is unknown if textbook publishers are doing formal usability studies. If testing is done, this information appears to be propriety and not available to the public. Due to work load and job responsibilities, graphic designers would probably not be involved with the usability testing. Problems with accuracy is also worsened by the lack of testing by designers. Paul Nini, professor of Visual Communications, writes,

My experiences in, and observation of, the field seems to suggest that graphic designers are quite adept at designing, producing, and introducing solutions (as designed messages), but that these are based on little if any information gathering and analysis. Likewise, it is rare to find graphic designers who solicit end-user evaluation of their efforts, whether in prototypical or final form. Most Graphic designers have no system in place to measure the effect of their work on an intended audience. Professional recognition currently consists of peer approval through a variety of publications and competitions, where emphasis is almost exclusively on the development of sophisticated graphic form.  

According to The Visual Turn, testing of Ligature's designs of the Houghton Mifflin's social studies textbook series were more market-oriented rather than formal usability tested. The importance in the difference is that usability testing deals with how well the reader is able to perform tasks with the product. Focus groups deal more with talking about a product, rather than its pragmatic functions. Also, Ligature's focus groups dealt with teachers, not with students. The end result is designers, having minimal training in designing educational product, are designing textbooks, without the benefit of any end-user evaluation information.
1.3.4 Inefficient Coordination Between Editorial and Design

Textbook development has traditionally been an editorially-driven machine. Stanley Rice, an author known for his publishing experience, writes,

"Only occasionally...is the designer required to decide what is to go in the book...[Instead it is] the publisher [i.e., editor] who produces the manuscript with its accompanying visual material...The central relationship determining book form has always been between the author and editor, not designer and editor. "Words are, after all, the very stuff of the design of books.""42

1.3.5 Advances in Technology and Printing

The introduction of the Macintosh computer in 1983 changed the face of publishing. Designers were able to make changes that traditionally were expensive and difficult to make. With this technology, page layouts were quicker to create. Designers could better integrate the verbal and visual elements. In 1960s, four-color process became more commonly available. With this new technology, many publishers, wanting to remain competitive in a market-driven environment adopted more colorful pages.

As computers became more integrated with the designer, the need for typesetters ceased. Typesetters had traditionally been well-versed in type specifications, copyfitting, and pica widths. Written instructions about grids, font sizes, type matrices were neglected and quickly forgotten. The quality of the design is more dependent now on the designer's knowledge of these topics.

Along with technology changes, new ideas about how to visually present information were being discussed. Richard Saul Wurman wrote Information Anxiety which spoke about how information needed to be visually organized in order to aid comprehension. In 1983, Edward Tufte, a Yale professor, wrote The Visual Display of Quantitative Information. This book stressed how information, especially quantifiable numbers, could be visually presented to provide deeper understanding. Tufte's book was an inspiration to the Ligature development team. Andrew Lasinski writes, "Joe Godlewski [Ligature art director] felt that Tufte's work had tremendous influence because it provided theoretical common ground, confirming mutual insights about the design of information. Rob Wittig [Ligature senior editor] saw Tufte as a general mentor who
provided "aesthetic influence expressed through simply his taste." As a result, Ligature proposed increasing the active role of the visual to a greater parity with the verbal.43

This notion of an increased visual role was supported by others. Robert Horn, professor at Stanford University, wrote, "The modern world of high technology, global business, and telecommunications has brought together a group of influences that is driving the increased use of visual language." Some of the influences that Horn cites are the enormous growth of the internet, television, and the increasing use of graphic computer tools and personal computers. In Horn's perspective, the use of visuals should be pushed even further.44

IN CONCLUSION

Research has shown that visual design problems do exist within textbook designs. These problems exist within three separate spheres: design-specific, user-specific, and industry-based problems.

Design specific problems are cluttered and visually overwhelming architecture. Poor encoding between the text and its visuals distracts the learning process.

Research has found that many students are not equipped to comprehend visual information. In some cases, the visual architecture is not oblivious nor self-explanatory to help the untrained reader. In other cases, the layout is visually disorganized. Slower students may become frustrated and withdraw from the material.

Finally, these problems are compounded by an market-driven industry process that publishes textbooks. Minimal, if any, usability testing is done to evaluate effectiveness. Design decisions are hampered by poor coordination between design and editorial departments.

In the next chapter, I will outline an approach to addressing a solution to this design problem.
1867  Ginn & Co. founded in Boston.
1868  Allyn & Bacon Inc. founded in Boston
1873  Wilcox & Follett Publishing Co. founded in Chicago
1885  Silver & Co. is formed
1885  D.C. Heath & Co. founded
1888  Silver, Burdett & Co. is formed when Frank W. Burdett buys M. Thatcher Rogers's interests in the company.
1896  Scott, Foresman & Co., formed in Chicago. They become the largest textbook publisher outside of New York.
1911  Scott, Foresman & Co. publishes the first math text for primary grades, *First Journeys in Numberland*. Scott Foresman is the first publisher to use four-color printing, which revolutionized textbooks.
1913  Prentice Hall is formed by NYU Professor Charles Gerstenberg and student Richard Ettinger, naming the company in honor of their mothers' maiden names.
1920  Scholastic founded
1924  Simon & Schuster is created by Richard Simon and Max Schuster. They publish a crossword puzzle book.
1930  Scott, Foresman & Co. publishes the first *Dick and Jane* stories in the Elson-Gray Basic Readers.

Continued

Table 1.1: Timeline of Textbook Publishing Consolidation from 1867 to 2000. This chart shows how the textbook publishing industry has consolidated from a large number of small textbook publishers in the mid 1800s to a smaller number of larger, often internationally owned, corporations in the year 2001. This consolidation process puts pressure on publishers to keep competitive and profitable.
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>Addison-Wesley Press is incorporated in Cambridge Mass. by Melbourne Wesley Cummings and Lew Addison Cummings (no relation). They choose their middle names to identify the new company.</td>
</tr>
<tr>
<td>1956</td>
<td>Addison-Wesley Publishing Co. moves from Cambridge, MA. to Reading, MA.</td>
</tr>
<tr>
<td>1960</td>
<td>D.C. Heath is one of the two largest publishers of high school mathematics textbooks in the US</td>
</tr>
<tr>
<td>1962</td>
<td>Time Inc. acquires Silver, Burdett &amp; Co.</td>
</tr>
<tr>
<td>1965</td>
<td>Silver, Burdett &amp; Co., along with its parent organization TIME Inc., and General Electric put up $18 million to jointly form the General Learning Corporation. Silver Burdett is a division of this new organization.</td>
</tr>
<tr>
<td>1966</td>
<td>Scott Foresman &amp; Co. relocate to new headquarters in Glenview, IL.</td>
</tr>
<tr>
<td>1967</td>
<td>Addison-Wesley establishes new corporate headquarters in Reading, MA, a new distribution center in Indianapolis, IN, and a new School Division building in Menlo Park, CA.</td>
</tr>
<tr>
<td>1968</td>
<td>Longman is acquired by Pearson plc, a London-based international media company</td>
</tr>
<tr>
<td>1970s</td>
<td>Scott, Foresman and Co. acquires Silver, Burdett from TIME.</td>
</tr>
<tr>
<td>1972</td>
<td>School Zone Learning Center founded</td>
</tr>
<tr>
<td>1974</td>
<td>Scott Foresman &amp; Co. acquires the General Learning Corporation from TIME Inc. and General Electric.</td>
</tr>
<tr>
<td>1974</td>
<td>Dorling Kindersley founded by Peter Kindersley and Christopher Dorling.</td>
</tr>
<tr>
<td>1974</td>
<td>Xerox Education Group buys Ginn &amp; Co. They are the second largest publisher of elementary and high school textbooks in the nation.</td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>School Zone Publishing Company incorporated from School Zone Learning Center</td>
</tr>
<tr>
<td>1984</td>
<td>Simon &amp; Schuster (S&amp;S) acquires Prentice Hall. S&amp;S expands from consumer publishing into the educational publishing market.</td>
</tr>
<tr>
<td>1985-86</td>
<td>Simon &amp; Schuster acquires Ginn &amp; Company, a leading elementary and high school publisher, and Silver Burdett Company, an elementary school publisher. The merged company is called Silver Burdett Ginn, a publisher of educational materials from pre-school through grade twelve.</td>
</tr>
<tr>
<td>1985</td>
<td>TIME Inc. acquires Scott Foresman &amp; Co.</td>
</tr>
<tr>
<td>1988</td>
<td>Pearson plc acquires Addison-Wesley.</td>
</tr>
<tr>
<td>1989</td>
<td>Addison-Wesley acquires Dale Seymour Co., a school supplemental publisher.</td>
</tr>
<tr>
<td>1991</td>
<td>Reed Elsevier acquires Rigby, an educational development house.</td>
</tr>
<tr>
<td>1993</td>
<td>Merger of Elsevier NV and Reed International plc to become Reed Elsevier plc</td>
</tr>
<tr>
<td>1994</td>
<td>Addison-Wesley acquires Peachpit Press, a computer trade publisher.</td>
</tr>
</tbody>
</table>

Continued
Table 1.1 continued


1994  Simon & Schuster’s Education Group moves to new state-of-the-art facilities in Upper Saddle River, NJ.

1995  Addison-Wesley merges with Longman Publishing to create Addison Wesley Longman.

1995  Scott Foresman & Co. establishes Celtication Press, a supplementary imprint.


1995  Simon & Schuster acquires Ziff-Davis Press, the book-publishing arm of Ziff-Davis Publishing. Ziff-Davis includes a list of seventy five books covering technology, science, and health topics. S&S also enters into a strategic alliance with Ziff-Davis Publishing to develop new computer books bearing Ziff-Davis magazine brand names such as PC Magazine, PC Computing, MacUser and MacWEEK.

1996  Addison Wesley Longman acquires HarperCollins Educational Publishers

1996  Scott Foresman-Addison Wesley School Publishing Group is forased.


1998  Simon & Schuster’s parent company, Viacom, announces plans to sell all of the Simon & Schuster educational operations, including Prentice Hall, Allyn & Bacon, and Macmillan Publishing USA.

Continued
1998  Pearson plc makes the successful bid to buy S&S’s educational operations and creates Pearson Education.

1999  Pearson plc, in order to purchase Simon & Schuster’s educational operations, must agree to U.S. Department of Justice consent decree. Pearson must sell titles in biology, anatomy, physiology, engineering, computer science, mathematics, economics/finance, social science, and teacher education.


2000  Pearson Education announces the creation of a K-12 Education Technology Group. This group provides computer-based delivery of elementary and secondary instruction.

2000  Pearson plc acquires Dorling Kindersley.

2000  Scholastics acquires Grolier Inc., the leading on-line and print publisher of reference products and the leading operator of direct-to-home book clubs, bringing together two of the most popular names in publishing and online media for children.

2001  Reed Elsevier acquires Harcourt General

28
ENDNOTES FOR CHAPTER ONE

1 Holt, Rinehart, and Winston's Elements of Literature (Austin, TX: Holt, Rinehart, and Winston, 2000). The author reviewed this textbook.


3 Hubisz 4.


5 Sewall 19.

6 Paul Gagnon, email to the author, 7 Dec 2002.


10 Dr. Kimberly S. Roemper, Carol Damian, Carolle Barber, and Jennifer Gonya, personal interview, 07 Nov. 2002.


12 Lasagna 3.

13 Elements 398-399


15 Elements 328-329
16 McDougal Littell's World History. (Evanston, IL: McDougal Littell, 1999)
17 Laspina, 69.
18 Laspina, 69.
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20 Lawrence Davis, "This New Prentice Hall Book Appears to Rely on Mimicry," The Textbook
21 Jo Ellen Roseman, Gerald Kulm, and Susan Shuttleworth, "Putting Textbooks to the Test,"
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35 Laspina 128
36 Laspina 153
ushistory/results/hatacheive-g12.asp
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42 Laspina, 20.
43 Laspina, 55.
CHAPTER 2

RESEARCH METHOD AND APPROACH

My argument is that many of the current textbooks are designed so poorly that their visual design actually distracts, rather than aids and reinforces, the learning process.

My approach was to first investigate these allegations. To understand the possible extent of its seriousness, I interviewed many stakeholders, including teachers in the public school system, textbook writers, art directors, science content specialists at the Eisenhower National Clearinghouse, and others who have critiqued the visual design of textbooks.

I also applied my personal experience as an illustrate/designer in the educational design field. I had worked at Landoll, a children’s educational publisher, for four years. The company produced ancillary mass-market educational products.

Once I determined that a visual design problem did exist, I then began a systematic method to learn what constitutes positive educational visual design. What are the visual design considerations that aid, rather than detract, from the learning process? I then aggregated and synthesized this research into visual design criteria. Part of this generative research consisted of taking classes in the fields of visual communications, education, art, art education, and educational psychology.

Once this criteria was developed, I then conceptualized visual demonstrations to further clarify this information. This step will be extremely important because designers of educational material currently have limited resources to help advance their design knowledge in this area. Currently, there is no common reference to work as a liaison between designers and editors.

I validated my possible solution through usability testing. To conduct the test, I took an existing chapter from an 8th grade social studies textbook, and redesigned its visual format in accordance with my research. I conducted a comparative analysis of the two chapters, addressing the visual design of both.
I then conducted usability tests using both the original textbook sample and my redesigned sample with a test group of 8th grade students. The test was conducted in accordance with the Ohio State University's Behavioral and Social Sciences Institutional Review Board. I submitted my redesigned sample to several authorities for review. One was be a professor of psychology who has written a book about the design of instructional text, a reading specialist who teaches in the Chicago-area public school system, a high school social studies teacher in the Columbus, Ohio public school system, the former president of Ligature Inc., and the president of a California-based textbook watchdog organization.

Following the completion of the usability tests and peer-reviews, I analyzed the results. I determined through my findings that my research did provide informational guidance that aids, rather than detracts, from the learning process.

Lastly, I will completed my research with some final conclusions and suggested areas for further research.
CHAPTER 3

RESEARCH-BASED VISUAL DESIGN CRITERIA

For educational material to be effective, its visual design must work with, not against, the learning process. In Chapter One, numerous complaints were examined concerning the visual design of textbooks. This design problem was refined into three areas of concern: design specific problems, user specific problems, and industry related problems. Through my research, I have developed five criteria that I feel can address many of these issues.

These criteria are only guidelines and are not meant to be “the” solution. Nor is this chapter meant to be a “how to” instructional guide; rather, my intention is to share educational considerations that need to be incorporated. Each design should be based on the specific needs of that project. Some information, because of the encoding specificity focus, may need to be tailored to emphasize one criterion while downplaying another. Restrictions, such as budget constraints, short deadlines, and limited human resources may degrade a project’s quality of design; however, if the designer reviews these criteria and takes this information into consideration -- the design will more likely aid the learning process.

The five criteria are: the use of a visual organization that aids the learning process, the use of images that reinforce text understanding, the use of caption that enhances comprehension, the educational considerations of typography, and the effective use of color.

Main criteria are labeled 3.1, 3.2, 3.3, on so. Each criterion is then broken down into subcategories. They are labeled as 3.1.1, 3.1.2, and so on. Finally, these subcategories can be broken down further into individual points, and labeled as 3.1.1.1, 3.1.1.2, 3.1.1.3, and so.

3.1 THE USE OF VISUAL ORGANIZATION THAT AIDS THE LEARNING PROCESS

The visual organization of an educational piece is extremely important to the learning process. For the most part, however, design is invisible and the reader isn’t even consciously aware of this criterion. Ironically, it is when this criterion is done ineffectively that the reader is
most aware of its value. When done poorly, the reader seems unable to focus on the material, his or her mind tends to wander about the page, the material seems confusing and disjointed, and the reader may even perceive the material as being "too difficult to learn."

The first criterion, visual organization, is divided into three topical areas: choosing a grid that supports encoding specificity, the use of a global navigational system to guide the reader, and making the initial design perception positive for learning.

3.1.1 Choose a Grid That Aids the Learning Process

3.1.1.1 Choose a Grid that Reinforces the Encoding Strategy. Depending on what information is to be learned has a direct impact on how the information should be visually presented. For designers, this is the concept of "form follows function." For example, students may be studying the solar system and are required to interact with specific data about each planet. This information needs to be available in a reference-style format, while the student reads the main text. Figure 1.1 is an example of a grid that could aid this type of learning (see Figure 3.1).

3.1.1.2 Use Visual Organization to Activate the Preattentive Process. An item must first be detected before it can be selected for further processing. This can happen subconsciously and without our awareness.

3.1.1.3 Use Sufficiently Wide Gutters to aid Readability. In large page-count textbooks, large gutters are essential to keep information clear of the gutter. Narrow gutters cause the reader to adjust their scanning in order to flow the text into the gutter. This slows the reading process and makes the reader consciously follow the text's path. The reader becomes aware of the design flaw and is forced to adjust, rather than focus all cognitive attention exclusively on the information.

3.1.1.4 Use Sufficiently Wide Columns to aid Readability. Too wide of a column lowers readability. The eye has difficulty following the line of type. Too short and constant eye movement also lowers readability. For details on readability, go to paragraph 3.4 Educational Considerations when using Typography.
This grid uses a scholar's margin for additional sidebar information

For this material, there was a lot of facts about planets. They needed to be visually available for reference and review.

Figure 3.1 Using a grid that reinforces the encoding specificity. The purpose of this product was to present planetary facts about our solar system. While there was a great deal of text, the user also needed to be able to access facts about individual planets quickly. Also, providing visuals made the material more dynamic and interesting. For this example, a one and two column grid was used. Also a large side margin was incorporated into the grid to place the many facts and images. Carl Nestor, Page Spread Example.
3.1.2 Use a Global Navigation System to Guide the Reader

Few readers are even aware of the term "global navigation," yet its presence is essential. The word "global navigation" is often thought in conjunction with website development. It deals with the ability to move throughout a piece aided by clearly marked visual guides. These guides inform the reader as to where they are at any given moment within the site (or document).

3.1.2.1 Use Visual Navigational Guides to Direct the Reader. The best analogy for understanding global navigation is a "navigating" through a college campus for the first time. This involves finding street names, building names or numbers, and then finally a specific classroom. When the navigation is clearly marked, the reader gets to class without difficulty. They may even remark about how easy it was to find the classroom and possibly begin the class with a pleasant, positive attitude. If the navigation is improperly marked however, the traveler becomes confused, delayed, and even possibly lost. Their difficulties could turn into frustrations. This could even lead to negative comments and feelings about the difficulties of finding a classroom, and even negatively shape their attitudes and opinions about the entire campus. The same is true of navigation within a textbook.

A list of visual navigation guides include page numbers (or folios), chapter identifiers, special callout identifiers, or any other visual element that aids the reader's movement on the page. Other types of navigational guides for a textbook include the table of contents, the index, and glossary. These should be clearly marked and visible, just as street signs prevent a traveler from becoming lost.

3.1.2.2 Use Visual Identifiers to aid Navigation. These elements help to distinguish and highlight pieces of information. They include the use of boxes, separating information with lines, and using color to offer information. Icons are also a means to create visual identification.

3.1.2.3 Make the Navigational System Obvious and Self-Explanatory. Steve Krug, a web usability expert, aptly coined the phrase, "Don't make me think!" Readers having difficulty navigating to pages quickly are likely to become frustrated. These frustrations could compound an
existing dislike for a subject, and could lead to an aversion of the topic altogether. Students with learned failures could attribute their reading difficulties to themselves, rather than the book’s ineffective navigation, and quickly give up. “Making pages self-evident,” writes Krug, “is like having good lighting in a store: it makes everything feel effortless, whereas puzzling over things that don’t matter to us tends to sap our energy and enthusiasm—and time.”

3.1.3.4 Explain the Navigational System to the Reader in the Beginning of the Material.
Many students have had no formal instruction on how to navigate through a textbook. Combine this with low motivation or poor reading skills, and learning is effected immediately.

Global navigation is a seemingly invisible guide. Its importance is ironically felt more often in its absence rather than its presence. When readers have to overly think about their reading location or search for a page number and an indication of where they are, frustrations rise. When handled properly, the reader is more likely to remark about how much they learned from a book or about how much more efficiently they are able to work or study.

3.1.3 Make the Initial Perceptions Positive for the Reader
3.1.3.1 Make the Design’s Initial Perception seem Easy, Rather than Difficult, to read.
This helps to maintain the reader’s attention and build their confidence with the material. ²

3.1.3.2 Choose a Soft Cover, if possible, to lessen Initial Apprehension.

3.1.3.3 Choose Smaller Page Counts, if possible, to Appear Less Formidable.
Textbooks with large page counts tend to overwhelm some readers. Presenting information in shorter page counts makes the material appear less formidable. ³

3.1.3.4 Use an Open Text Design to Make the Layout Inviting.
Pages filled with text and little visual interest or relief are not appealing. “Typical learners who lack confidence in their learning skills,” writes Kolber and Barkman, “often associate long books and books with lengthy chapters or segments with difficult reading.” ⁴
3.1.4 Use Visual Hierarchy to Organize Information

3.1.4.1 Create Visual Hierarchy to Direct the Learning Process. By visually organizing information, the designer directs what the reader attends to first, then second, and so on. In this way, the design acts as a guide to "navigate" the reader through the material. If the visual layout is handled improperly, the eye is confused and may miss important information. The reader could also read information out of order or cause mild confusion. This distraction causes the reader to consciously focus on overcoming the design flaw to maintain the learning process. Figure 3.2 is a demonstration of visual hierarchy (see Figure 3.2).

3.1.4.2 Use Differences in Size to Create Visual Hierarchy. All things being visually equal, the eye is drawn to the largest elements first. Figure 3.3 is a study in eye movement (see Figure 3.3). The eye is initially drawn to the large face. Notice how the face is scanned repeated before moving to the next visual element.

3.1.4.3 Use Placement on the Page to Create Visual Hierarchy.

3.1.4.4 Use an Engaging Visual to Generate Interest. Keller writes, 

"It is important that users become engaged and successful from the start. A high-interest activity often involves confronting learners with some dramatic or unexpected event...Sometimes, sequence considerations force a designer to open with uninteresting content. When that happens, print content designers should make a special effort to creatively use images, type, graphics, and page layouts to generate interest."

3.1.4.5 "Chunk" Information to Organize it Visually. This means presenting information in small digestible units. Research has shown that humans can remember best when "chunking" is limited to seven items of information at one time.

3.1.4.6 Use Text Signals to Visually Organize Information. Well-organized text aids the reading process.

3.1.4.7 Avoid Irrelevant Information. The reader needs to focus on what is essential to learn and unnecessary words (and images) should be deleted.

3.1.4.8 Use Contrast to Draw Attention to Certain Parts of the Message. In visual messages, attention can be directed by the use of contrasting brightness, color, size, shape, type style, and motion.
Figure 3.2 Visual hierarchy. In this study, we follow the eye movement influence by visual hierarchy. Notice in Figure 3.2A, the initial focus area is shown with a large black dot. The eye is then attracted to the large human figure (see Figure 3.2B). The movements of the female's arms direct the reader's attention to the boxes along the top of the spread (see Figure 3.2C). Next, the eye scans through the remainder of the spread (see Figure 3.2D). Understanding this is important to visually organizing information to aid in the learning process. Herman Brandt, *The Psychology of Seeing* (New York: The Philosophical Library, 1945) 36-37.
Figure 3.3 Size influences visual hierarchy. This is a study that tracked eye movement. Notice that the larger elements are given the most attention. Interestingly, the visual emphasis is on people, and primarily to their eyes first, followed by the mouth. *The Psychology of Seeing*, 69.
3.1.4.9 Pictures are Usually More Memorable than Words, and are thus Useful When Information has to be Remembered. 10

3.1.4.10 Eye Movement Follows the Direction of Images. In Figure 3.4, we observe that the reader's eye movement follows the general direction of the image (see Figure 3.4).

3.1.4.11 Visual Emphasis Looks at People First. When scanning, our eyes are attracted to the human form. As we scan the face, our eyes go to the eyes first, followed by the mouth. In Figure 3.5, we observe a reader who reads information in the woman's face and then reads the advertisement's text (see Figure 3.5). Eye fixation searches the eyes and mouth for recognition (see Figure 3.6). 11

3.2 THE USE OF IMAGES TO STRENGTHEN THE LEARNING PROCESS

Readers learn approximately 25 percent more from illustrated texts than from non-illustrated texts. 12 Therefore, images play an important role in aiding the learning process. It is, however, also one of the larger problem areas. Balance must be maintained between the visual and the verbal elements. Care must be taken in choosing the appropriate number of images and placing them strategically for maximum impact on the learning process. It is therefore necessary to know precisely what a picture's function is intended to be before it is selected.

3.2.1 There are Four Functional Approaches to Using Images.

a. Attentional function. Some pictures are used to attract attention and build interest.

   Textbooks often use this function to grab the reader's attention.

b. Affective function. For some pictures, their purpose is to create a mood, create an emotional response, or enhance the reader's enjoyment. In educational value is that it can help the user process the information more deeply.

c. Cognitive Function. Some images are used to help visualize information in the text. This should be the most common function of an image.

d. Compensatory. Pictures can also help comprehension for students learning to read, or those with reading difficulties. These images help the reader find clues to increase understanding. 13
Figure 3.4 Eye Movement Follows the General Direction of Image. When scanning, the eye follows the direction of the principal lines in a picture. If the principle lines extend in a vertical direction, the eye movements are mostly vertical. If the picture emphasizes horizontal lines, the eye movements are horizontal as well. This principle needs to be considered when arranging visual elements so that the most important images are seen first. Guy Thomas Buswell, *How People Look at Pictures: A Study of Psychology of Perception in Art* (Chicago: University of Chicago, 1935) 79.
Figure 3.5. Centers of interest during eye scanning. The picture above is a car advertisement. Image A is the original advertisement; Image B shows the eye scanning movement. Notice that the majority of the eye movement is centered on the woman's face, and her lips specifically. The words were secondary. This chart is taken from How People Look at Pictures, 140.
Figure 3.6 Focus of attention. This chart shows the reader's eye movement when looking at these images. The reader's eye search primarily in the eyes and then mouth for recognition. Evelyn Goldsmith, Research into Illustration: An Approach and a Review (Cambridge, UK: Cambridge University Press, 1984) 281.
3.2.1 Consider Varying Image Type. Typical images appearing in textbooks, include:
   a. Color photograph
   b. Black & white photographs
   c. Detailed line drawing
   d. Simple line drawing
   e. Labeled diagram
   f. Cartoon

3.2.3 Select Images that Strengthen Encoding

Retention of information is improved when the reader can process information using both
the visual and verbal coding systems. Care must be taken, however, to select images that aid the
learning process.

3.2.3.1 Use Interesting Pictures to Gain and Maintain Learner Attention. This could
include images with dynamic angles or close-ups of unusual images. In Figure 3.7, the reader is
drawn into the excitement of the battle (see Figure 3.7).

3.2.3.2 Choose Pictures that Include Novelty and Drama to Maintain Learner Attention.
Figure 3.8 is an illustrated biography of John Smith. The comic-book format is not only interest-
ing, it provides the reader with visual information about clothing and environments that may
not be included in the text (see Figure 3.8).

3.2.3.3 Choose Images that Help Visualize Abstract Concepts. In Figure 3.9, the concept
of relative sizes between planets and the sun is linked to familiar objects (see Figure 3.9).

3.2.3.4 Choose Images that Contain Strong Visual Message. The stronger the emotional
appeal or impact of an image, the more likely it will affect the reader and likely to be remem-
bered. In Figure 3.10, two images are shown of the same event. Figure 3.10B is more emotional-
ly charged and more likely to be remembered. (see Figure 3.10).

3.2.3.5 Select Pictures that Include People to Gain and Maintain Learner Attention.

3.2.3.6 Whenever Possible, Select Pictures that Show People of the Same Age Range
as the Reader.
Figure 3.7 Dynamic angles create visual excitement and draw the reader in. As interest increases, so does the potential for deeper encoding of information. Howard B. Wilder, Robert P. Ludlum, and Harriett McCune Brown, *This is America's Story*, 3rd ed. (New York: Houghton Mifflin, 1970) 593.
John Smith went looking for adventure as a soldier in Europe before turning west to help colonize America.

Figure 3.8 Choose images that include novelty and drama. Here information is presented in a comic book style format. The reader receives information in dual modality: The visual is dominant on page, and provides vivid imagery to help maintain the reader's interest. This is America's Story, 89.
Figure 3.9 Linking schemata through imagery: New information can be more easily encoded (learned) when it can be related to what is already familiar. In this example, the user learns about the size comparisons of planets by relating their relative sizes to common objects. Carl Nestor, digital illustration.
Figure 3.10 Selecting images with affective impact. These two photos show the difference in affective intensity. Image A has less emotional impact than B. This is because the eye contact is between the two rescuers and not the child. The event seems like a handoff. In Image B, the eye contact is between the firefighter and the dead child. It draws the reader into the scene and creates a powerfully, emotional image. Such power will not be easily forgotten by the learner.
Figure 3.11 Cartoon illustration. This cartoon provides visual interest and attracts attention. It also provides clear visualizations of the information in a fun format. *This is America's Story*, 150-151.
Chapter 7
Astronomy

In this chapter, we will examine the importance of astronomy. We will look at our Solar System and a historical review of astronomy.

Imagine...

- Imaging a 15 billion mile
  precision telescope from your
  kitchen window: 8 months on
  13 tons and 150 feet long.
- Oh yes, you’ll be looking at 13,000
  miles per hour 300 miles
  above the Earth.

Figure 3.12 Visually communicating size. Notice how the visual captures the size of the event.
Image from NASA. Carl Nestor, page design.

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3.2.3.7 Colored Images Tend to be More Interesting to Most Readers.

3.2.3.8 Avoid Using Purely Decorative Images. Not only do they produce visual clutter, but readers may characterize all the images as decorative and pay less attention them collectively. They also distract from the learning process by taking cognitive workload away from the learning process.\textsuperscript{17}

3.2.3.9 Cartoons can Increase Interest and Enjoyment. Their use must be balanced between the type and amount of information being present and space used to display them. The cartoon should be related to the topic and provide some type of learning reinforcement.\textsuperscript{13} For example, Figure 3.11 is a fun illustration that teaches about the way the British closed the frontier (see Figure 3.11).

3.2.3.10 Size Images Accordingly to Fully Communicate its Visual Information. Images that are full of visual details should be sized so that this information can be processed. Size can also communicate the power of an image (see Figure 3.12).

3.2.3.11 Choose the Complexity of Image Based on the Informational Need and Space Available. Some realistic images, such as photography, may contain more visual information than needed. As a result, the reader has difficulty in distinguishing the essential visual information from the surrounding visual stimuli. The student may begin a "scanning syndrome"—a constant surveillance of the entire perceptual field while not focusing or interacting with any specific stimuli. Choosing images with too little visual information can also adversely impact learning. There may be insufficient information to aid the learning, or the reader may become bored or disinterested.\textsuperscript{14}

3.2.4 Learning Value of Images

3.2.4.1 Pictures are Usually More Memorable than Words.

3.2.4.2 Give Students Specific Instructions on What to Look for Within an Image. Picture utilization skills are developmental, and students may only glance half-interestedly at an image. It is important to direct the student's attention to the correct image at the appropriate time for learning.
3.2.5 Images and Text

In textbook design, pictures are often thought of as "adjuncts, whose function is to illustrate the printed word." In some instances, however, the visual may be more effective in presenting information.

3.2.5.1 Use Illustrations that are Closely Related to the Text. Using unrelated imagery may distract the reader or cause him or her to concentrate on unimportant information.

3.2.5.2 Direct Attention to an Image at the Appropriate Time and Context to Reduce Misinterpretations. Philip Brody, a professor of Curriculum at the University of Kansas, writes,

"The primary instructional function of directing attention to a picture at a particular moment is to place the picture in an appropriate context, thus reducing the number of possible interpretations. Viewing a picture of a third-world family, will certainly result in a different set of interpretations than viewing the same picture during a section concerned with the economies of developing nations. In spite of its obvious instructional value, directing attention to a particular picture is a necessary, but not sufficient condition for the proper integration and utilization of pictorial information; its success is dependent on the extent that viewers possess similar processing strategies as well as shared common experiences with the content being represented. Since individuals typically vary greatly in regard to these conditions, all that can be expected is for the pictures to be examined at the same moments of instruction, but with interpretations differing between learners."

Brody later adds,

"One of the most important, yet least studied, issues related to the use of pictures to improve instructional textbooks is the placement of the pictures relative to the written text."

3.3 THE USE OF CAPTIONS TO STRENGTHEN THE LEARNING PROCESS

The third criterion deals with the use of captions. Research has shown that dual processing, or learning through both visual and verbal means, produces deeper encoding and greater memory retention.

3.3.1 Use Captions to Assist the Learner with Understanding the Image Presented.

Captions provide information that may otherwise be missed or not mentioned in the text. For example, the caption may direct the reader to observe or question visual information about an image. This interaction with the visual increases interest and strengthens memory retention.
3.3.2 Use Captions to Reduce Misinterpretation. Dr. Brody writes that picture interpretation is "closely tied to individual experiences and expectations; even students with similar backgrounds and abilities do not always interpret a picture in the same manner." Figure 3.13 gives a humorous demonstration of this point (see Figure 3.13). Brody continues,

When viewing the Victorian mansion, one may focus on the interesting architecture, while another may focus on the windows or entryway. Similarly, even when examining the same component of a picture, individuals will vary on the values attached to that component. The mansion may be viewed by some as an instance of the "good old days" while others may view it as a symbol of the power and wealth of a privileged few.

Brody's thoughts are visualized in Figure 3.14 (see Figure 3.14).

Dr. Francis M. Dwyer was a professor and Head of the Department of Adult Education, Instructional Systems, and Vocational and Industrial Education at the Pennsylvania State University. He wrote that educational material is often written with the assumption that "when students view visual illustrations, they will all see the same thing and learn in the same way and at the same rate." 23

3.3.3 Use Captions to Tell the Reader: What to Focus on in the Image. In a research review by Dr. Levie, a Professor of Instructional Systems Technology, Indiana University and graduate student, Richard Lentz, they write:

Students are not in the habit of learning from pictures. This should not be surprising since, as Olson (1977) puts it, "schools remain predominantly literate enterprises. That is, the major aspirations of the schools are concerned with literacy, and the means of instruction are predominantly literate" (p.66). Students may not regard pictures as serious sources of useful information. Although most students probably do look at text illustrations in most situations, they usually do not "study" the pictures unless prompted to do so. Much research has indicated that people normally notice only the global aspects of a picture. They fail to attend to and encode most of the detailed features (e.g. Friedman, 1979). It may be that students attend closely on to the aspects of text illustrations that are mentioned in the text. 25
Figure 3.13 Misinterpretation. The girl is expressing herself as a flower. Her viewers, however, have their own interpretation. This problem of misinterpretation can be reduced through the use of captions. CEM, The New Yorker in E.H. Gombrich, "The Visual Image," Scientific American, Sep. 1972: 96.
The killer waited for them in the darkened house. Look at the windows for any signs of life or suspicious activity.

After wandering for five years, the weary traveler was finally home again. He gazed ahead searching for any sign of life.

This house was built in 1895 and is an excellent example of Victorian architecture. Notice the unique shape of the roof. See Victorian Features in the text.

Figure 3.14 Captions can influence interpretations. In this example, the perception of the same image is altered by three different captions. This example is an extension of the original illustration. David H. Jonassen, ed., Technology of Text: Principles of Structuring, Designing, and Displaying Text (Englewood Cliffs, N.J.: Educational Technology Publications, 1982) 306.
3.3.4 Use Captions to Explain the Learning Value of an Image Not Referenced in the Text.

If an image is not directly referenced in the text, the reader may not understand its relationship to the text. Dr. Brody warns,

An examination of current instructional textbooks reveals somewhat systematic, discipline-based biases towards making direct reference to a picture in the narrative; science texts, for example, seem to make reference to specific pictures more often than social science texts. Even within a specific discipline, practices vary considerably between publishers. Some science texts, for example, directly refer to 30 or 40 percent of the pictures, while others refer to less than ten percent.28

3.4 EDUCATIONAL CONSIDERATIONS WHEN USING TYPOGRAPHY

This fourth criterion deals with educational considerations associated with type. As with other criteria, it is when type is handled poorly that its impact is felt most. This includes issues of readability and font selection.

3.4.1 Good Readability Enhances Encoding

3.4.1.1 Use Black Type on a White Background for Optimal Reading of Print Material.29

3.4.1.2 Avoid Poor Contrast Between the Color of Type and its Background. White type on a black background slows readability by nearly 20 percent.30

3.4.1.3 Set Type in Upper and Lower Case Letters for Easier Readability. Setting type in all capitals lowers readability.31

3.4.1.4 Use a Readable Typeface. Some typefaces are better equipped to handle large bodies of text. These fonts include Times Roman and Adobe Caslon (see Figure 5.15).

3.4.1.5 Use a Readable Point Size of Type. At normal reading distances of 15 inches, 10 to 22 point type makes for optimal legibility. Use two to four points of leading with a line length of roughly 19 pica wide.32

3.4.1.6 Use a Readable Line Length. Studies have shown that to aid legibility make each line around eight to ten words and 10- to 12 point type to make text easier to read, maintain learner attention, and increase confidence.33 The late Josef Müller-Brockman wrote, "According to a well-known empirical rule, there should be 7 words per line for a text of any length. If you want to have 7 - 10 words per line, the length of the line can be readily calculated." 34
Use a readable point size of type. At normal reading distances of 15 inches, 10 to 12 point type makes for optimal legibility. Two to four points of leading, 19 pica lines set with 2 to 4 point leading produces optimal legibility.

Adolfe Caslon
11/20

Use a readable point size of type. At normal reading distances of 15 inches, 10 to 12 point type makes for optimal legibility. Two to four points of leading, 15 pica lines set with 2 to 4 point leading produces optimal legibility.

Times New Roman
11/20

Use a readable point size of type. At normal reading distances of 15 inches, 10 to 12 point type makes for optimal legibility. Two to four points of leading, 19 pica lines set with 2 to 4 point leading produces optimal legibility.

Adolfe Garamond
11/20

Figure 3.15 Different typefaces influence readability. Some fonts are fuller bodies and make for more readable fonts in large bodies of text. Notice how the typeface changes the text density of the page. Typefaces with fuller bodies naturally darken the page's overall visual presentation.
3.4.2 Font Selection

3.4.2.1 Use More Standardized Fonts that are Easily Recognized.

3.4.2.2 Using Serif, rather than Sans Serif, Typeface. Studies have shown that serif fonts are easier for long passages of text.

3.4.2.3 Use Fonts that have Easily Identifiable Characters, Especially the Letters Q, A, and G. This recognition feature is important for students in the beginning stages of reading.

3.4.3 Considerations for Reading Disabled

This topic was beyond the focus of my research area. It is, however, an important area that needs further exploration.

3.5 THE USE OF COLOR IN BUILDING DEEPER ENCODING

Color is an effective tool to provide emphasis and organization to information; however, if handled improperly, color can cause distractions and confusion.

3.5.1 Use Color to Attract Attention. Color has a strong attraction effect, but it is the contrast that is important. For example, if the majority of a visual is in color, then it is the black and white image that stands out. Conversely, if an image is largely black and white, then the use of color draws attention (see Figure 3.16).

Daryl Moen, Professor in the School of Journalism at the University of Missouri, advises that the stronger color should be used to show the most important information. He adds, “This color should not exceed more than 50 percent of the overall area, or the impact will be lost.”

3.5.2 Use Color to Create Visual Hierarchy, such as in Headings. It is important that the color choices remain consistent.

3.5.3 Use Color to Link Related Elements. Color can be used to build recognition and organization. For example, in Figure 3.17, all biographical callouts were identified with a blue box behind the text. This created immediate visual organization (see Figure 3.17).
Figure 3.16 Color used to emphasise information within an image. Jan V. White, *Color For the Electronic Age* (New York: Watson-Guptill Publications, 1990) 155.
Figure 3.17 Color used to visually organize information. Images from NASA. Carl Nestor, Page Design.
Prof. Moen added some caution:

Screens apparently do attract attention to the stories, but they don’t necessarily translate into readership at any greater rates than unscreened stories... They can also cause legibility problems if the color is too dark and the type is too small. It is important to dilute the color when it is placed over text.36

3.5.4 Use Color to Help Create Personality for the Piece. Prof. Moen writes, “Color is just as important in creating a personality...as is typography.” He further added,

Designers who are choosing colors should remember not only the emotional values of colors but also the mix on the page. Silver (1961) recommends using warm colors as the feature color because they are aggressive. Cool blues are useful as background colors because they are passive. Tints, shades, and tones are also retiring. The stronger the color, the less is needed.37

3.5.5 Pre-Test Color Choices to Ensure that the Colorblind can see the Difference. Prof. Moen writes,

About eight percent of the North American white male population is red/green colorblind. The inability to distinguish between red and green is even more prevalent among men; some estimates are as high as 25 percent. Color blindness shows up in about 4 percent of black males and in only 2 percent of Hispanic males. Few females in any category are color-blind.38

3.6 THE USE OF CLEAR INSTRUCTIONS TO AID COMPREHENSION

Understanding how to utilize a textbook is instrumental to its effective use in aiding the learning process. For this reason, educational material should provide some explanation of its visual design features. Figure 3.18 is an example of how this information can be presented (see Figure 3.18)
Table of Contents

Section One  Page 7
Section Two  Page 12
Section Three  Page 19
Section Four  Page 26

All men are created equal. What does that mean? America in the 1770s had many contradictions. All men were created equal, but what about the women of America? Were African-American women included in this phrase? Were women allowed to vote? Find out about these issues and more as you start to piece together the story of the American Revolution. It is the story of their contribution.

How to use this book
This book is set up so that the narrative text is in the upper portion of the page. The lower portion presents parts of the material in a more visual format.

Color-Coded Information
Key terms and definitions are introduced in the text. They are color-coded for easy identification. Look for color to give you clues as to a word's importance.

- Green text is key words marked with geography.
- Orange text is key words marked with vocabulary.
- Blue text is key words marked with details.

How to look at Images
The reader can learn a lot from images. Each image is accompanied by a caption. Read the caption to get information and to know what to look for in the document.

Figure 3.18 Providing instructions on how to use the material. Images from "The American Journey" by Carol Neveu, Page Design.

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CONCLUSIONS

Six main criteria have been proposed to address each of the three major design problems areas outlined in Chapter One. Below, each design problem area has been addressed separately below to provide greater clarity.

As for design-specific problems, information should be visually organized to aid the learning process. This can be done by using a design grid that supports the encoding strategy. Making the navigational system direct, clear, and self-explanatory eases movement through the material. The text display should be open and readable to maintain the reader's attention.

Images should be selected that reinforce the text, and the captions should link these images to the text. Captions should also expand upon visual information within the images. Finally, clear textual hierarchy makes for stronger retention.

As for user-specific problems, the textbook's initial impression should be as positive and appealing as possible. The navigation should be obvious and self-explanatory. A “how-to-use-the-material” section should be included to assist the unskilled reader.

As for industry-specific problems, the criteria serve as a tool to assist graphic designers to make decisions. These guidelines are suggestions, and that the exact usage should depend on the encoding specificity needs of the material.

The use of these criteria as a tool will be expanded upon in the following chapters. In Chapter 4, a visual demonstration will be presented that will clarify the criteria further. This demonstration will provide a bridge for design discussions between graphic designers and editors. Additionally, the end user evaluations to be conducted in Chapter 6 and 7 will provide additional information not publicly available to designers. It is unknown if textbook publishers have conducted usability testing; if so, however, this information does not appear to be public and would probably be propriety.

Unfortunately, finding a solution to the market-driven pressures of textbook design was beyond the scope of this research.
ENDNOTES FOR CHAPTER THREE

3 Fleming 32.
4 Fleming 32.
5 Fleming 47.
7 Fleming 33.
8 Fleming 67.
9 Fleming 67.
10 Fleming 86.
13 Levie, 218.
14 Krug, 11-15.
16 Levie 273.
18 Brody 313.
19 Brody 307.
20 Dwyer 16.
21 Levie 223.
22 Brody 304.
23 Fleming 109.
25 Fleming 30.
26 Fleming 109.
27 Fleming 35.
29 Moen, 137
30 Moen, 135
31 Moen, 130.
32 Moen, 134.
CHAPTER 4

VISUAL DEMONSTRATION OF CRITERIA

In this chapter, visual demonstrations of the research based visual design criteria are presented in two sample sets. The purpose of these demonstrations is to further clarify the information presented in Chapter 3. As designers have few visual resources that provide clear conceptualizations, these examples can also be used as discussion points between a designer and an editor. They can serve as a bridge towards creating designs that aid the learning process.

For these samples, I worked with Deborah Cochran, a science editor. We collaborated on the content, the choice of supporting imagery, and the book’s design features. Deborah used national and Ohio state standards for science curriculum to guide the text’s preparation.

Images used in these examples were obtained via the NASA website (www.nasa.gov). They were high-resolution, copyright-free images.

4.1 Overview of Sample Set Contents

There are two sample sets, labeled as Design Styles One and Two. Both sets consisted of the following:

4.1.1 Summary Sheet

A summary outlined the approach taken by the design style (see Paragraph 4.2.1 and Paragraph 4.3.1.)

4.1.2 Overview Sheet

A one-page overview showed all three spreads within the design style (see Figure 4.2.2 and Figure 4.2.2)

4.1.3 Page Layouts

There were three two-page spreads to each design style. There was a total of six pages each. (see Figures 4.2.1-4.4 for Design Style One; see Figures 4.3.1-4.11 for Design Style Two.)
4.1.4 Priority of Design Characteristics Chart

These charts provided a quick visual reference as to the design's ability to address each criterion. These charts also provide a more objective, less subjective, means to evaluate the quality of a design's effective to aid the learning process (see Tables 4.1 and 4.1).

4.1.5 Annotated Pages

These pages provided comments explaining design features that aided the learning process (see Figures 4.5–4.7 for Design Style One; see Figures 4.12–4.14 for Design Style Two).
4.2 Design Style One

4.2.1 Summary of Design Style One

The design style emphasizes a lot of separate facts and figures: information ranging from the size and temperatures of planets to separate sections on the Hubble Telescope and Mars exploration. The encoding specificity needs of the chapter are that readers need to remember basic planetary facts and be able to recall them on a test. The user is a 14-15 year old 8th grade student.

This design focuses on feature analysis and is appropriate for the presentation of a lot of facts and figures. Its uniqueness is the marginal column in which specific information can be highlighted and makes a quick reference for later retrieval and review.

Another feature of the design is the use of graphic elements, such as a dotted line, to direct the reader's attention. It also helps provide visual unity.

For readability, Univers65 is used for display type and headings, Times New Roman is its text type. Paragraphs are indicated with a line space.
4.2.2 Overview of Design Style One

Figure 4.1 Design Style One. This overview presents all three spreads within the design style. Each spread is examined further in the following pages.
4.2.3 Page Spreads for Design Style One

Figure 4.2 Spread One of Design Style One.
Figure 4.3 Spread Two of Design Style One.
4.2.4 Priority of Design Characteristics for Design Style One

<table>
<thead>
<tr>
<th>Priority of Design Characteristics Based on Research-Based Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Visual Hierarchy</td>
</tr>
<tr>
<td>Use of a grid that supports encoding strategy</td>
</tr>
<tr>
<td>Use of Global Navigation to aid reading</td>
</tr>
<tr>
<td>Use of studying features</td>
</tr>
<tr>
<td>Selection of images</td>
</tr>
<tr>
<td>Use of Captions to explain</td>
</tr>
<tr>
<td>Use of color to organize</td>
</tr>
<tr>
<td>Initial Perception</td>
</tr>
<tr>
<td>Use of instructions to explain visual design</td>
</tr>
<tr>
<td>Relationship between image and text</td>
</tr>
<tr>
<td>Readability of type</td>
</tr>
<tr>
<td>Signaling of text hierarchy</td>
</tr>
</tbody>
</table>

Table 4.1 Priority of Design Characteristics Chart for Design Style One. This style emphasizes the use of elaborative questions along the top margin. This design stresses more thoughtful interaction with the text. Separate ideas are developed and explored further in the top margin.

75
4.2.5 Annotated pages for Design Style One

Photo bar used for showing the various topics to be discussed in the upcoming chapter. This provides advanced activation of schemata. The elaborative questions below each section also helps to begin discussion of the information.

Figure 4.5 This is an annotated copy of Spread One of Design Style One. Specific features that aid the learning process are indicated.
Figure 4.6 This is an annotated copy of Spread Two of Design Style One. Specific features that aid the learning process are indicated.
Figure 4.7  This is an annotated copy of Spread Three of Design Style One. Specific features that aid the learning process are indicated.
4.3 Design: Style Two

4.3.1 Summary of Design Style Two

This design focuses on increased interactivity between the reader and the information. Its uniqueness lies in which elaborative interrogative questions and specific information can be used to engage the reader in more thought-provoking discussion and help retention. This design is also appropriate when the encoding specificity needs deal with the synthesizing of information and the introduction of abstract ideas.

The science standards state that students will recognize the interconnected cycles and systems that make up our environment and understand the concepts, processes, and principles of the earth and space sciences including the universe; the Earth system; processes that shape the Earth; and the historical perspectives and scientific revolutions associated with the earth and space sciences. The user is a 14-15 year old 8th grade student.

Another feature is the slim marginal columns used to indicate main topics. This allows for quicker reader access and helps summarize information.

For readability, Eurostile is used for display text and headings. New Century Schoolbook is its text type. Paragraphs are indicated with an EM-dash indent.
4.3.2 Summary of Design Style Two

Figure 4.8 Design Style Two.
4.3.3 Page Spreads for Design Style Two

Figure 4.9 Spread One of Design Style Two.
Figure 4.10  Spread Two of Design Style Two.
Figure 4.11 Spread Three of Design Style Two.
4.3.4 Annotated Pages for Design Style Two

**Chapter Identifier**
Clearly visible for immediate recognition.

**Advanced Organizer**
This allows for quicker focus to retrieve essential information at a glance.

**Placement of image and text for maximum comprehension.**
Upper left position is initial focal point. Reader then naturally scans to the left and down—following flow of information.

**Advanced Organizer**
Helps reader to think about what will be learned in next chapter.

**Use of text increases reader interactivity with photo.**

**Use of color and people within photo increase attention.**
Image is related to text and provides point of discussion into text. Use of novelty and dynamic angle increases attention.

**Visual clue that leads eye back to first page information.**

Figure 4.12: This is an annotated copy of Spread One of Design Style Two. Specific features that aid the learning process are indicated.
Section Head
Type spec: Univers
30 pts, 2 pt leading
Good versatility of font size and weight. Strong display typeface. San Serif

One column, 73 characters per line

Subsection Header
Two column layout, 40 characters per line

Image supports text.
Provides visual of the sun. Quick facts below relate to reading and help reader focus attention.

Text
Type spec: Times New Roman
12 pts, 2 pt leading
Serif typeface. This font allows for quick, easy reading.

Explanatory photo.
Text discusses the placement of planets. This visual provides information in form familiar to student which enhances comprehension and retention.

Figure 4.12 This is an annotated copy of Spread Two of Design Style Two. Specific features that aid the learning process are indicated.
Figure 4.14 This is an annotated copy of Spread Three of Design Style Two. Specific features that aid the learning process are indicated.
4.3.5 Priority of Design Characteristics for Design Style Two

<table>
<thead>
<tr>
<th>Priority of Design Characteristics Based on Research-Based Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Visual Hierarchy</td>
</tr>
<tr>
<td>Use of a grid that supports the encoding strategy</td>
</tr>
<tr>
<td>Use of Global Navigation to aid reading</td>
</tr>
<tr>
<td>Use of studying features</td>
</tr>
<tr>
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<td>Signaling of text hierarchy</td>
</tr>
</tbody>
</table>

Table 4.2 Priority of Design Characteristics Chart, Design Sample Two. The marks for this design are similar to those of Design Style One. This style emphasis the use of a side margin for specific details. This side margin provides quick visual reference.
CHAPTER 5

COMPARATIVE ANALYSIS

In this chapter, a portion of an existing textbook is modified according to my criteria. The two samples are then compared side-by-side and aspects of their visual design are discussed.

I will show each page of the original design along with a revised demonstration. The purpose of the comparison is three fold. First, it provides another visual example to further reinforce the information presented in Chapter 3. Second, it provides a critique of an existing textbook design and offers suggestions on how to improve the design so that it strengthens the learning process. Third, these two samples, the original chapter and the revised chapter, will be the basis for a follow-on usability test to evaluate the effectiveness of my research-based visual criteria.

For the comparison, I chose Chapter 6 of Glencoe's *American Journey* 8th Grade Social Studies textbook. My choice was based on four reasons: First, my research interests focus on social studies and history textbooks; second, *American Journey* is used widely in the Columbus, Ohio public school system; third, I had access to view a 10th Grade social studies classroom at the Walnut Ridge High School, Columbus Ohio and the 8th Grade class of the Ashland Christian School, Ashland, Ohio; and lastly, the *American Journey* textbook had sufficient visual design deficiencies to warrant the redesign.
Figure 5.1 Comparative analysis, Chapter 6, American Journey
Comments on Figure 5.1A
1. The picture shows Washington's return to New York after the victory of the American Revolution. This image provides little support to learn the material because it baffles the reader to the end of the revolution. Compare this image with the large cover image of the redesign.

2. The meaning of the callout's title "History and Art" is not understood nor explained. It adds nothing to the learning process and adds visual clutter. A similar callout on a different page is entitled "Viewing History." The importance of these two categories is unknown.

3. Color is being used to signify information, however, its use is not clearly stated nor understood. For example, green is used to identify important terms and main ideas to remember; however, it is also used to identify the callout "the storyteller."

4. Headings are identified by larger type in color and by a red box with a gold star. The box is not needed and simply adds to the visual clutter.

5. A section identified "Primary source" is for the reader to learn from primary source documents. A reader is instructed to flip forward nearly 800 pages to find this section. There the reader finds only text supposedly taken verbatim from an original document. The reader does not see the original document or the full text in context.

6. The term "Chapter Themes" is not clearly explained or understood.

7. Color and the use of a blue box with gold stars do create a sense of an "American theme." This does get the design a clean, although busy, feel.

8. This page is visually appealing, but is weak in educational design.

Comments on Figure 5.1B
1. This is the cover for the revised sample.

2. This is a 52-page soft cover, spiral-bound booklet, instead of the 1,600 page hard bound textbook. The cover gives the title of the book and a clear chapter identifier.

3. The visual captures the drama of the revolution.
Table of Contents

Section One  Page 3
Section Two  Page 13
Section Three Page 19
Section Four  Page 25

All men are created equal. Were the men of America in the 1770s all men? Many understood all men to mean white men. Were women and Native Americans included in this phrase?
This chapter looks at the events and people involved with the American Revolution. It tells the story of their contributions.

How to use this book

This book is set up so that the narrative text is in the upper portion of the page. The lower portion presents parts of the material in a more visual format.

Color-Coded Information

Key words and definitions are introduced in the text. They are color-coded for easy identification. Look for color to give you clues as to its word's importance.

Green text is key words involved with geography.

Orange text is key words involved with vocabulary.

Blue text is key words involved with names.

How to look at images

The reader can learn a lot from images. Each image is accompanied by a caption. Read the caption to get information and to know what to look for in the image.

Figure 5.2 Comparative analysis, instruction page
Comments for Figure 5.2

1. There is no similar page in Glencoe's sample.

2. Many current textbooks do not include specific instructions on how it is to be used. Many students have low visual literacy skills and need to be told what is important in a particular image or how it relates to the text.

3. This page is provided to aid the reader with understanding the information presented. It explains the color coded vocabulary system used at the bottom of the pages. This color code is used as a study guide.
Figure 5.3 Comparative analysis, Section One Openers
Comments for Figure 5.3A
1. Color is used to signify information; however, its use is not clearly stated nor understood. For example, green is used to identify important terms and main ideas to remember; however, it is also used to identify the callout “the storyteller.” The result is that the reader knows that the heading has some value, but is unsure of its importance.

2. Headings are identified by larger type in color and by a red box with a gold star. The red box is not needed and simply adds to the visual clutter. According to visual communicator, Oscar Fernandez, the two elements together is “like wearing suspenders with a belt.”

3. In the “Storyteller” callout, the story is about the British invasion of Long Island. Nowhere is the use of cannons mentioned in the text. What is the relevance of the image? What is the reader to observe and learn about the cannon? The image catches our eye simply because it is the only visual on the page.

Comments for Figure 5.3B
1. The section’s title is changed from “The Early Years” to “The War Begins.” This strengthens the meaning and makes for more immediate recognition.

2. The large image shows the British military landing on Long Island. This image visualizes the major event early in this section. A caption describing the image is shown in the lower portion of the page. It provides the reader information about what is important within the image.

3. To further aid the learning process, the term “read to discover” is changed to “Learning Objects.” The encoding specificity is clarified in these objectives along with direct page references.

4. The term “Terms to Learn” was changed and chucked into three separate sections entitled “Vocabulary,” “Identify,” and “Geography.” This makes the objectives clearer and more immediate for use.

5. The timeline has been shifted to a vertical format instead of horizontal format. This format also allows for more entries on to the timeline.

6. The “Storyteller Callout” has been deleted. This callout provided too little information. It creates distractions and confuses the layout.
Figure 5.4 Comparative analysis, pages 4 and 5 with pages 164 and 165
Comments for Figure 5.4A and B
1. The heading, from the previous page, reads "the opposing sides," yet the only subheadings are "the loyalists," "African-Americans," and "Patriot Advantage." This does not aid in comprehending (or recalling) all the parties of the two opposing sides.

2. The callout "Linking Past and Present" relates the present situation of women in the military to their involvement in earlier military service, specifically the American Revolution. Both photos are clipped from their original contexts, thus limiting the amount of information the reader can get from the image. The reader does not learn about Molly until page 176 (11 pages later). Nor is there any reference to read the future entry. The reader has no information to understand the significance of Molly Pitcher or what she is performing in the present callout. Also, what is the linkage between the past and the present? Here, a modern female soldier is walking carrying bottled water and a rifle. Was she involved in direct combat as was Molly Pitcher?

3. Large green quotation marks identify a quote. The color adds to the overall design and provides some visual identification.

4. The large visual focuses on the loyalist versus patriot dislike. While visually interesting, encoding of opposing forces would be stronger with visuals more related to identifying key forces in the conflict.

5. Confusing text. Under the subheading "patriot advantages," the term "Hessians (German mercenaries fighting for the British are explained.

Comments for Figure 5.4C and D
1. The informational diagram shows the forces involved.

2. Key words are color-coded and identified below.

3. Information is chunked for quicker review and visual clarity. The number of forces are clearly stated to help with retention. The sizes of circles also reinforces the size differences.

4. Information has been rearranged for better readability. The original text was disjointed. The revised design organizes information for quicker reading. While this is more of an editorial call than a visual design issue, if the narrative is not written to support the visual layout with good textual hierarchy, the visual design has limited impact to aid the learning process.
Comments for Figure 5.5A
The map is visually appealing and well produced. However, it captures the reader’s eye and disrupts reading. The map is not referenced in the text. Once the reader has finished looking at the map, they must go back to the text and find where they left off—and begin reading again.

Comments for Figures 5.5B and C
1. The visual comparison between the Patriot and the British soldier provides immediate visual reference. The reader can see differences in clothing and weaponry. This image is taken from the *Kids Discover Magazine*.

2. In Figure 5.5B, the group of three images visually tell the story of the Long Island invasion.
Comments on Figure 5.6A.
1. The photo caption provides minimal information about the person shown. What is to be learned from this photo? What is its significance? Who is the person shown? The reader is to infer that this is an African-American member of the Patriots' forces.

2. The callout "biography" is identified with icons. Its visual distinction was minimal.

3. The visual organization lacks visual contrast and interest.

Comments on Figures 5.6B and C.
1. The close-up of Thomas Paine's face creates strong visual interest.

2. The information about Thomas Paine is highlighted in a blue box for visual organization.

3. The images of these black soldiers provide multicultural images.

4. George Washington crossing the Delaware River is a historical image. It is solid visual reference back to the text.
Figure 5.7 Comparative analysis, pages 10 and 11 with pages 168 and 169
Comments on Figure 5.7A and B.
1. The bar on Figure 5.7A provides minimal interest.

2. None of the excitement of the Revolution is captured in the imagery.

3. The activity on Figure 5.7B is crammed into the lower corner.

4. The reader's eye is drawn to the two visuals and the assessment section's golden oval shape.

Comments on Figure 5.7C and D.
1. The visuals are clearly linked to the text above. Clear linkages of the images to the text is mentioned.

2. The battle plan diagram clearly outlines essential information. It also acts as a reference for review.

3. The battle plan outlines three major offensives for 1777. Notice that there are three images on page 11; an image is related to each offensive.

4. The information about the flag is visually organized with color to aid understanding.
Figure 5.8 Comparative analysis, page 12 with page 170
Comments on Figure 5.8A
1. This seems to be a good activity page.

2. The border treatment distanced this page from the overall design. All "Skill Builder" pages, however, have this similar design.

Comments for Figure 5.8 B
1. In the section entitled "Primary Source Activity," an authentic document is presented. This provides the reader with direct access to original documents.

2. The assessment section of Figure 5.8B needs learning problems that require the student to interact with the material at a deeper level.
The War Continues

Learning Objectives
- Define the term "troops" in the context of the Revolutionary War
- Identify key figures in the Continental Army and the British Army
- Discuss the significance of the Battle of Saratoga
- Explain how the war affected the American colonies

Vocabulary
- Troops
- George Washington
- Benedict Arnold
- Richard Montgomery
- Saratoga

Geography
- New York
- Canada

Timeline
- 1775: American Revolution begins
- 1777: Battle of Saratoga

Figure 5.9 Comparative analysis, Section Two Openers
Comments on Figure 5.9A
1. The title of Section 2 is clearly identified and well placed.

2. The significance of the Ben Franklin medal is not mentioned. Other than Ben Franklin being discussed in the callout story, there is no relationship involved with the coin. If this is a medal, what are the reasons someone is awarded the medal? There is no clear linkage to the text.

3. The page’s poor visual organization and distracting visual elements slows reading.

Comments on Figure 5.9B
1. The layout is clearly organized.

2. The large graphic catches the eye.

3. Information needed for review (and testing) is clearly indicated.

4. The visual layout aids the reader. It presents the information in an obvious and self-explanatory format.
Figure 5.10 Comparative analysis, pages 14 and 15 with pages 172 and 173

107
Comments on Figure 5.10A and B.
1. The reader has no visual aids to help navigate which year they are studying.

2. There are no visual references as to where Valley Forge is located. The reader, if interested, must find it in the text.

3. The callout entitled “Footnote to History” talks about the devaluation of the U.S. currency. The text, however, does not discuss inflation until the following page. This makes the callout have no relevance to the current page.

Comments on Figure 5.10C and D.
1. The cause and effect diagram has been modified to help with retention. The causal factors are placed on one side, while the effect factors are on the other. The image of Benjamin Franklin acting as a diplomat at the French Court provides a strong visual reference for this chart. It is directly related to the information.

2. The three images related to the winter at Valley Forge work together. They provide a combined effect to help visualize the event.
Comments on Figure 5.11A and B
1. The callout "Linking Past and Present" compares the past relations between the U.S. and France with the present.

2. The callout "Economics" discusses the financial problems facing the Patriots. It has minimal visual distinction.

3. The section entitled, "Life on the Home Front" has no visuals to reinforce encoding.

Comments on Figure 5.11C and D
1. The visuals on page 16 cover different aspects of "life on the homefront." The Colonial paper money is turned for more visual interest. All of these images are directly related to the text, and direct references are made in the text. A student could review this material by looking at the images.

2. Visual interest is created with Abigail Adam and her quote.

3. Several of the images express ideas related to women's rights, which adds to the multicultural aspect of the design.

4. Several key terms are mentioned in the color-coded section at the bottom of the pages.
Figure 5.12 Comparative analysis, Section Three Opener

111
Comments on Figure 5.12A
1. The "storyteller" article is about Molly Pitcher. The picture is an ammunition pouch similar to one carried by Molly. The date of the battle is given, yet the reader has no further information of how the battle fits into the overall story. Also, there is no linkage of this story with the earlier callout about Molly ten pages earlier.

2. Native American involvement is limited to two short paragraphs on page 176. Indian involvement with the war is otherwise neglected. A multicultural perspective is limited.

3. The biographical callout on John Paul Jones is identified with an icon; otherwise, no other visual distinction is made.

4. The overall visual contrast of the page spread is minimal. Numerous icons and colored text all compete at the same intensity. The eye is drawn to the large, well-placed, section opener title: "The war moves west and south." The eye then moves to the timeline, and then to the visuals.

Comments on Figure 5.12B and C
1. Figure 5.12B is extremely empty and appears unused. Activities associated with the original text were dropped. It was deemed unlikely that 8th grade students would be interested in so many drawing activities associated with the chapter. New assessment activities need to be constructed. They were beyond the scope of this project.

2. The section three opener is very graphic, and will definitely catch the reader's eye. It's powerful imagery will also be remembered. It shows British and Indian raids in the Western settlements.

3. The section's learning objectives are visually organized for easy use.
Comments on Figure 5.13A.
1. The map is good. It clearly shows the events surrounding Clark's attack on Vincennes.
2. The biography for John Paul Jones is indicated by icons. Little visual distinction is noticed.

Comments on Figure 5.13B and C.
1. The subheading “Glory at Sea” has been changed to “Waging War at Sea.” This provides the reader with more information.
2. The subheading “Settlement Raids” has been changed to “Native American Involvement with the war.” This emphasis better supports the section’s assessment questions.
3. The image of Joseph Brandt is reinforced with a quote. Combined with the graphic image creates a strong learning visual.
4. On Figure 5.13B, there is an icon indicating ancillary multi-media material.
Figure 5.14 Comparative analysis, pages 22 with pages 178 and 179
Comments on Figure 5.14A and B.
1. The Battle of Cowpens is shown in Image 5.14B, but there is no textual reference to the battle. The only reference is on the map. On the following page, there is a textual reference to the battle—but no reference to the image on the previous page.

2. The map on Image 5.14A is packed with chronological facts. To understand the information presented, the user must study the information—thus disrupting the reading of text.

3. On Image 5.14B, the text speaks about "guerrilla warfare" and a successful guerrilla leader, Francis Marion. An image supporting the text is on the following page. There is no reference to it here. When the reader sees the image, if interested, they must flip the page back to read the text again.

4. On Image 5.14B, the callout "Footnote to History" talks about poor medical practices during the Revolutionary War, yet there is no linkage back to the text. It is just an interesting factoid.

5. The callout "American Memories" is a disjointed article dealing with aspects of the battlefield. The painting is of the battle of Cowpens and is related to the text. The caption gives no further information about the painting or the people in the painting. Circling the painting are stems of clothing worn by the Patriots; ironically, some of the clothing is red and white are worn or used in the painting. The media's appearance is unknown. This example has limited educational value.

Comments on Figure 5.14C
1. The callout "Guerrilla Warfare" is separated from the text with the use of color.

2. Rather than just show guerrilla warfare, an additional image is shown to further clarify the different styles of warfare.
Comments on Figure 5.15A and B

1. On Figure 5.15A, the icon "History and Art" serves no purpose.
2. In the Assessment block on Image 5.15A, Question Three asks the reader to explain why most Native Americans sided with the British. This answer covers only two paragraphs in this section. None of the imagery reinforces its meaning.
3. The text on Figure 5.15A talks about the Battle of Cowpen. There is no reference to either the map nor to the image on the previous page. Opportunities for visual reinforcement are lost.
4. The activities listed on Figure 5.15B do not require deep processing of the information. In the "art" section, the activity asks the student to create a poster using one of the following topics: "The Boston Tea Party, the boycott of British goods, opposition to the Stamp Act, or the recruitment of troops to serve in the Continental Army." Ironically, none of these topics are discussed in this chapter.
5. Image of Paul Revere on Figure 5.15B has no relationship to this chapter.

Comments on Figure 5.15C

1. The subhead has been changed from "British retreat" to "British Retreat North to Virginia."
2. Subheadings for "Patriot Victories at Kings Mountain" and "Patriots win at Battle of Cowpen" add clarity to the text. These also help with test preparation.
3. The map gives immediate visual reference to the locations of battles and major cities discussed on the page. There is no flipping back and forth to other pages.
4. A website with additional information is listed towards the bottom of the page.
The War Is Won

Figure 5.16 Comparative analysis, Section Four Openers
Comments on Figure 5.16A
1. The callout "the Storyteller" has no relationship to anything. It creates a distraction, as the reader attempts to process this with the rest of the text.
2. The image of Rochambeau is very static and without interest. It provides no visual information to aid retention.

Comments on Figure 5.16B and C
1. The section opener on Figure 5.16C gives vivid imagery about an important event within this section - the surrender of Cornwallis.
2. The Learning Objects are clearly stated and outlined.
Comments on Figure 5.17A and B
1. The image on Figure 5.17A, shows Lafayette with his slave. The caption discusses the slave, but ends with the question, "How did the French help the Patriots win the war?" This leads the reader into different directions. What is the reader to retain about the image? Is the information about the slave or France's involvement? Also, is there any visible information within the picture? What is Lafayette pointing at?
2. The image on Figure 5.17B shows the surrender of Cornwallis. The caption, however, directs the reader to think about the terms of the Treaty. While this is good lead into the "Treaty of Paris," the next immediate callout talks about events in the surrender. This causes a break in the reader's concentration.

Comments on Figure 5.17C and D
1. The images of Figures 5.17C and D provide good visuals to process the information. These images are, however, rather small. In the image "Seize the hill," much of the excitement is lost in the small size.
2. All the visual elements on Figure 5.17D direct the reader's attention to processing the surrender. Even the caption directs the reader to see elements within the painting related to the surrender.
Figure 5.18 Comparative analysis, pages 28 and 29 with page 185

123
Comments on Figure 5.18A
1. The subheading, "Washington's Farewell," talks about the end of the war and Washington's announcement of retirement in New York City. No mention is made of the chapter opener image of Washington's return to New York (see Figure 5.1).

1. The assessment block stands out visually on Figure 5.18. The Activity box seems an afterthought.

Comments on Figure 5.18B and C
1. The map gives a clear visualization of the treaty terms. The terms are listed in one column, with an adjacent map.

2. The Indian icon on Figure 5.18B draws the reader's eye to the caption. The line then directs their attention to the map. The icon reinforces the information.
Comments on Figure 5.19A and B
1. The "cooperative activity" on Figure 5.19B asks the student to research about soldiers during the Revolutionary War.

2. The "technology activity" on Figure 5.19B asks the student to search the internet for famous quotes associated with personalities in the chapter.

Comments on Figure 5.19C and D
1. The signatory page of the Treaty of 1783 is shown in Figure 5.19C. This allows the student to see actual primary source documents.

2. Figure 5.19C lists the photo credits.
All men are created **equal**... or are they?

Read about the **American Revolution** and discover the answer.

**Did you know...**

- Native Americans fought mostly for the British because they felt they had better chance of survival.
- All race Americans fought with both the Americans and British during the War of Independence.
- Unable to enter the military as a woman, Debra Smelter disguised herself as a man and enlisted.
- In the heat of battle, she wound up shot in the face.
- Is this true? Do you think she was treated differently to avoid discovery.

**The American Revolution (1776-1800)**

*Designed by Carl Henn, Department of Instructional Design, Visual Design, and Visual Communications, Eastern Illinois University.

*The illustration is for educational purposes only.*

*Copyright 1993: G.T. Lunsford, American Memory.*

Comments on Figure 5.20

This is the back cover to the redesign. Questions are asked in attempts to draw the reader into the material.

Figure 5.20 Comparative analysis, back cover of redesign sample

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CHAPTER 6

END-USER EVALUATIONS

All designers should incorporate some form of end-user evaluation into their work. In Chapter 5, a portion of an existing textbook was modified according to the proposed criteria. A comparative analysis was done of these two textbook chapters to compare and contrast their relative qualities to aid the learning process. The next logical step in the design process was to conduct end-user evaluations of these two designs.

In this chapter, the methods and procedures used in conducting the end-user evaluations were explained. The evaluations consisted of a usability test and design critiques. The results of these evaluations will be analyzed in the next chapter.

6.1 Exploratory Research Usability Testing

The first, and main, means of evaluation is the usability test. This evaluation examines the functionality of a design. Unlike market research, which deals more with preferences and a product's potential to be marketed, a usability test measures a design's ability to perform its intended purpose. The objective of this test is to measure each design's relative ability to aid the learning process. Below are the logistical details of the test, including location of the test, selection criteria, a description of the test method, and recruitment method. This is followed by a customer experience model, which provides a detailed profile analysis of potential users. For this study, the end users are 8th grade students. Lastly, the actual questionnaires used in the testing are provided.

6.1.1 Details about the Testing Procedures

6.1.1.1 Location of Testing. The testing was conducted at the Ashland Christian School, 1144 W. Main Street, Ashland, OH 44805 on May 19, 2003.

6.1.1.2 Selection Criteria. For the test, the 8th Grade class was solicited. Eight participants for the usability test were needed. Four students would be tested on the original textbook, while the others would be tested on the revised design.
The main criterion was to get a diverse group with different learning styles. The second criterion, which was less critical, was to get a balanced group of males and females. To determine someone’s learning style, the VARK test would be used. VARK is a quick, informal questionnaire that measures someone's reading, kinesthetic, aural, and visual learning styles. More information about VARK can be obtained at www.vark-learn.com.

In the event that there are too many participants, selection will be based on first filling all learning style categories, followed by the gender category. Every attempt would be made to find candidates for each learning style. Race would not be a variable for this test. The ideal breakdown would be:

- two visual learners (male/female)
- two aural learners (male/female)
- two reading learners (male/female)
- two kinesthetic learners (male/female)

The teacher orally solicited participants in class. The teacher then administered the VARK learning style test to the volunteers in order to determine their learning mode. No additional material was provided to the potential participant prior to the usability test.

6.1.1.3 Testing Method. Each student was interviewed individually. Four students were tested using the original textbook and four were tested with the revised textbook design. Each student was asked a series of questions that will require them to navigate through their designated sample. Their responses were audiotaped. The questionnaires are provided (see paragraphs 6.1.3 and 6.1.4). All testing was reviewed and approved by the Behavioral and Social Sciences Institutional Review Board of The Ohio State University, and conducted in accordance with their guidelines.

Due to time constraints, the testing of all eight participants was completed in one day. Each test lasted approximately 45 minutes, with only one session per student. There was no physical, medical, or mental distress risks involved with the testing. Should a participant become upset for any reason, the test would have been terminated immediately and the participant would be taken to an authorized school official for attention.

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6.1.1.4 Recruitment of Participants. Eight volunteers were recruited. Their involvement could have been self-terminated at any time without any penalty. Students could have offered, if they like, the reason for their termination, but no answer was necessary. All Federal regulations pertaining to special protections with minors were reviewed, and no relevant concerns were noted.

The actual selection process relied heavily on the teacher, as they were familiar their students' performance and motivations. Participants were provided a written form, prior to the testing day, that explained that the test was voluntary and that the students could withdraw at any time without penalty. The form also explained the nature of the usability test and that the student's answers would be transcribed onto paper. The participant's parent or legal guardian needed to sign this form prior to participation.

As a reward for their involvement, all participants, including those who withdraw from the study, were served a lunch of pizza and soda.

6.1.1.5 Recording Information. The only information gathered was the participant's age, gender, and learning style (visual, oral, or kinesthetic). No names were recorded. The answers from the usability tests, along with other research information, was stored at home. Upon completion of my thesis, all original interview questionnaires would be shredded.

6.1.2 Customer Experience Model of an Eighth Grade Student

A customer experience model provided a profile of potential users. The characteristics of eighth grade students are diverse. This profile looked at students collectively across all of Ohio. Ironically, although they are the end user, the selection of which textbooks best meets their needs is done by teachers in textbook adoption committees.

6.1.2.1 Desired Emotional Response. The desired emotional response of using a textbook was "History is interesting. I want to learn more about this particular historical figure and event. History plays an important role in my life."

6.1.2.2 Motivations of an Eighth Grade Student. Students must pass the state proficiency in social studies to graduate to the ninth grade. Some students may have low motivation for his-
tory, seeing it as boring and not applicable to their lives. This is also a difficult time for this age group. They are undergoing social pressures for acceptance and are becoming interested in the opposite sex and dating. For many, their focus is increasingly on social acceptance.

6.1.2.3 Age Range. They are between 14 and 15 years of age.

6.1.2.4 Skill Level. Their basic skill levels are extremely broad. Possessing different learning styles, some students may be advanced while others have difficulties. See enclosure on national statistics for history proficiency.

6.1.2.5 Eighth Grade Student Population in Ohio

Number of students enrolled: 1,886,018 (Ohio K-12 public school students)

Racial/Ethnic Background: (Ohio K-12 public school students)
- White: 81.1%
- Black: 16.1%
- Hispanic: 1.6%
- Asian/Pacific Islander: 1.1%
- American Indian/Alaskan Native: 0.1%

6.1.2.6 Parental Education Levels. Nearly 30 percent of students come from families with low parental education. An additional 26 percent of students come from families with medium low parental education

6.1.2.7 Competition. There are roughly five main competitors for the eighth grade history textbook for the public school market. Textbooks are normally selected by a middle school adoption committee. The competitors are:

1. Pearson/Prentice Hall's *The American Nation*
2. McGraw-Hill/Glencoe's *America Is*
3. Houghton/Mifflin's *The Story of America*
4. Oxford's *History of US*
5. Houghton/Mifflin's *Call to Freedom*

All of these books are of comparable size, page length, and weight. Some publishers offer different supporting material.
6.1.3 Usability Test Questions for the Standard Textbook Design

These were the questions read by the interviewer to the student during the usability test. These questions were for the original Glencoe sample only.

1. What is your initial impressions of this textbook?
2. When you look at this textbook, how difficult would you expect the learning to be?
3. What are your initial impressions of the page's graphic design?
4. What do you see first when you look at this page?
5. Read these two pages. Indicate where the text begins on the page. With your finger, show me the text flow on the page. How difficult was it to follow the text?
6. What are your initial impressions of the photographs on this page?
7. Where would you look to find more information about a photo on the page?
8. On Page 171, what are you expected to look at in this photo?
9. How does it relate to the text?
10. Find the first page in Section Two of Chapter Six.
11. Find page 184.
12. What would you expect in the caption?
13. Find the Battle of Saratoga.
14. Read a paragraph. How difficult is it to read the type size?
15. On page 173, what are you supposed to do with this diagram? What does it explain?
16. What is the difference between the "Picturing History" and the "History and Art" icons?
17. On page 179, explain how these images are related?
18. On page 179, the word "guerrilla warfare" is colored? Why?
19. On page 184, what is the meaning of the gold star in a red box?
20. On page 167, what is the meaning of this icon? (It is a book icon)
21. On page 167, what is the meaning of the blue type?
22. On page 167, what is the meaning of the red type?
23. In Section Two, find the term “desert” and explain its definition as shown in the text.
24. How will you be tested (or assessed) on this material?
25. When you hear the word “textbook,” what words do you associate with it?
26. How would you improve the design of the chapter?

6.1.4 Usability Test Questions on Revised Textbook Design

These were the questions read by the interviewer to the student during the usability test.

These questions were for the revised textbook sample only.

Hello. There are no right or wrong answers to this test. I want to learn what you think about this design. I have a series of questions that I would like to ask you. You can stop the test at any question. If you have any questions, feel free to ask them at any time.

1. What is your initial impressions of this textbook?
2. When you look at this textbook, how difficult would you expect the learning to be?
3. What are your initial impressions of the page’s graphic design?
4. What do you see first when you look at this page?
5. Look at pages 16 and 17. Indicate where the text begins on the page. With your finger, show me the text flow on the page. How difficult was it to follow the text?
6. On page 19, what is your initial impressions of the photographs? Too graphic?
7. Where would you look to find more information about a photo on page 21?
8. What should you be expected to look at in the images on page 20?
9. Find the learning objectives to Section Three.
10. Find the answers to the three Learning Objectives Section Three.
11. Where would you expect to find a page number?
12. What do you think the section at the bottom of the page is for?
13. Why do you think some words are colored in the text?
15. Without asking the teacher, how would you determine the purpose of the colored words?
16. What would you expect to find in a caption?
17. According to the assessment for Section Two, what is the definition of desert? Who was Friedrich von Struben? (how difficult was it to find answers?)
18. What do you think about the type size? Too large? Too small?
19. On page 14, what are you supposed to learn from this diagram?
20. How will you be tested (or assessed) on this material?
21. When you hear the word "textbook," what words do you associate with it?
22. How would you improve the design of the chapter?
23. Which would you prefer: one textbook or a series of smaller booklets?

6.2 DESIGN CRITIQUE

The second form of end user evaluation was the design critique. These critiques were informal reviews by individuals associated somewhere in the textbook design process. Several were chosen for their noted work with this area. These critiques provided another means to elevate the effectiveness of the design.

6.2.1 Evaluation Method. I submitted my visual design for critique to five individuals. They reviewed it and commented on its ability to aid the learning process. They commented on the educational value of the visual organization and layout. The Glencoe sample was not be sent along with the review.

6.2.2 List of Peer Reviewers

Five individuals were chosen to critique. They are:

a. Dr. James Hartley. Professor of Psychology, University of Keele, U.K. who has carried out research on text design for over 30 years. He is the author of Designing Instructional Text (3rd edition), East Brunswick, N.J. His research has been quoted in Chapter Three.

b. Richard Anderson. Former President of Ligature Inc. Ligature was the design development house that redesigned Houghton-Mifflin's social studies series in the late 1980s. Their
design process was written about in *The Visual Turn: The Visual Transformation of Textbooks* in Chapter One. Ligature no longer exists.

c. Bill Bennatta. President of the Textbook League, an educational watchdog organization. Mr. Bennatta is a long-time critic of the educational quality of textbooks. His newsletter has been quoted several times in Chapter One.

d. Edith Reynolds. Reading Specialist, Masters in Reading, Chicago Public School System, Chicago, IL.

e. Richard Larson. Social Studies Teacher, Walnut Ridge High School, Columbus, Ohio.
CHAPTER 7

ANALYSIS OF FINDINGS

On May 19, 2003, usability tests were conducted using a portion of a textbook and a redesigned version modified, according to the criteria outlined in Chapter 3. The purpose of the test was to measure each design's capacity to aid the learning process. It examined students' ability to navigate text, understand visual information presented in images, understand the relationships between images and the text, and use captions to aid understanding. In addition to the usability test, copies of the redesign were sent to five individuals. The purpose of these critiques were get comments from people knowledgeable about educational design. The analysis gleaned from these evaluations is outlined below.

7.1 Findings from the Usability Test

7.1.1 Key Findings from Usability Test

Eight usability tests were conducted. Seven of the tests were completed at the Ashland Christian School, while an eighth was done separately by Professor Paul Nini using his son, also an 8th Grade student. From this testing, 17 key points were realized.

1. Users were initially attracted to color and images on the page
2. Users do not look closely at images and maps unless directed
3. Users could not find related meanings between the text and some Glencoe images
4. Color in the Glencoe design attracted attention but provided minimal aid in learning
5. In the redesign, users found the images reinforced the learning in the text
6. In the redesign, once users read the "how to use this book" section, their understanding of how to use color in aiding their learning process increased
7. Glencoe's captions provided little value to build understanding of the image

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8. Glencoe's captions provided weak, indirect links between the images and the text.
9. Most of the students did not read the captions closely for greater understanding.
10. All users found the presentation of learning objectives in the redesign helpful.
11. Most of the navigational aids in the Glencoe design were not understood and ignored.
12. The color-coded study guide on the revised design was initially overlooked.
13. Only two out of the seven users fully understood Glencoe's colored textual cues.
14. All preferred the clearer presentation of the learning objectives in the revised design.
15. Seven out of eight users preferred the revised design, calling it "clean" and "organized."
16. Seven out of eight students preferred one textbook instead of a series of modules.
17. None of the students had any training on how to utilize the features of a textbook.

7.1.2 Detailed Findings from the Usability Test

1. Users didn't understand the majority of the navigational aids in the Glencoe design. These design elements did nothing to aid the learning process. They did, however, add visual chutter to distract the reader.

2. Many images in the Glencoe design were poorly related to the text. For example, in page 176 (see Figure 5.14B), the image of the George Washington Medal had no relationship to the text.

3. Some image placement in the Glencoe design did not help the learning process. For example, the text talks about Marquis de Lafayette on page 173 (see Figure 5.10B) - yet his portrait isn't until page 183 (see Figure 5.16A). In the callout, "Linking the past and present" on page 165 (see Figure 5.4B), students were to cognitively find links between colonial women, like Molly Pitcher, and today's women in the armed forces. The student did not, however, have any information about Molly Pitcher until eleven pages later.

4. The color-coded study bar along bottom of revised design pages were initially overlooked. Once shown, however, they were used more frequently to aid understanding and retention.

5. Users were attracted to colorful layouts. Color plays an important role in making designs appear lively and interesting. The user quickly became bored with dull layouts.
6. Users, unless directed, do not encode images and maps with any depth. When questioned about the images, users initially stated that they understood them; however, when questioned about discrepancies in image relationships and its caption, users could not explain these discrepancies. For example, on page 179 (see Figure 5.14B), there is a scene of warfare from the Battle of Cowpen. Several additional images surround this central picture. They are articles of clothing and a rifle. When questioned why these additional images were there, all users responded that’s what they wore back then. I then mentioned that none of the soldiers shown in the painting were wearing this type of clothing or used this rifle. None of the users initially noticed this discrepancy, nor could they explain the rationale of their earlier answer.

7.1.3 Impact of VARK Test

7.1.3.1 Breakdown of User.
The breakdown of the user group at the Ashland Christian School is as shown:

<table>
<thead>
<tr>
<th>Female One</th>
<th>visual/kinesthetic</th>
<th>V8</th>
<th>A4</th>
<th>R3</th>
<th>K8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Two</td>
<td>kinesthetic</td>
<td>V3</td>
<td>A4</td>
<td>R3</td>
<td>K9</td>
</tr>
<tr>
<td>Female Three</td>
<td>kinesthetic</td>
<td>V5</td>
<td>A4</td>
<td>R2</td>
<td>K9</td>
</tr>
<tr>
<td>Male One</td>
<td>reading</td>
<td>V3</td>
<td>A2</td>
<td>R8</td>
<td>K2</td>
</tr>
<tr>
<td>Male Two</td>
<td>kinesthetic</td>
<td>V4</td>
<td>A5</td>
<td>R6</td>
<td>K8</td>
</tr>
<tr>
<td>Male Three</td>
<td>visual/kinesthetic</td>
<td>V8</td>
<td>A3</td>
<td>R3</td>
<td>K11</td>
</tr>
<tr>
<td>Male Four</td>
<td>low multi-modal</td>
<td>V4</td>
<td>A5</td>
<td>R5</td>
<td>K6</td>
</tr>
<tr>
<td>Male Five</td>
<td>low multi-modal</td>
<td>V5</td>
<td>A5</td>
<td>R4</td>
<td>K5</td>
</tr>
</tbody>
</table>

7.1.3.2 VARK Results and the Usability Test

VARK was used as a qualifier in selecting participants. Below are conclusions about VARK impact on the testing.

1. The usability test did not have a user with an aural learning style
2. The user sample was too small to make generalizations about the influence of learning styles on the effectiveness of design criteria to aid the learning process.
3. Female One (visual/kinesthetic) preferred the redesign sample
4. Female Two (kinesthetic) preferred the redesign sample. She did prefer the Glencoe cover stating the redesign cover was “too gruesome, more depressing.” She added that the Glencoe cover was “creative” and “illustrated the title - American Journey.”
5. Female Three (kinesthetic) was sick and did not attend school
6. Male One (reading learning style) preferred the redesign sample
7. Male Two (kinesthetic learning style) preferred the redesign sample, stating it was “less confusing; easier to follow.”
8. Male Three (visual-kinesthetic) preferred Glencoe style
9. Male Four (low multi-modal) preferred redesign style, but later stated that he liked them both.
10. Male Five (low multi-modal) preferred redesign style, stating “has more color,” “brighter,” “easier to find things, not having to flip through so many pages.”

7.1.4 Answers to Specific Questions on the Usability Test

1. What is your initial impressions of the redesign textbook?
   *More clear and simple - easy to read*
   *Easy to read*
   *More casual, like a magazine*
   *More professional - more appealing*

2. When you look at this textbook, how difficult would you expect the learning to be?
   Neither sample was deemed to be overly difficult.

3. What are your initial impressions of the page's graphic design?
   Glencoe - Users found it colorful and “nicely laid out.” Their comments were all aesthetically based, and made no mention of how the design aided their understanding.
   Redesign - Users found the redesigned sample to be “very organized and clean.” All users immediately realized the design's educational function.
4. What do you see first when you look at this page?
   Pictures were the first thing noticed by both groups.

5. Look at these two pages. Indicate where the text begins on the page. With your finger, show me the text flow on the page. How difficult was it to follow the text?
   Glencoe - all users indicated the text's flow was easy to follow (with their finger).
   Redesign - All users indicated that the text's flow was very obvious.
   *Note: Users were not asked to read the entire sample, they simply had to trace the text's flow with their finger. In two follow-on reading tests, however, users with the Glencoe sample were distracted by the verbal/visual mixture.

6. What is your initial impression of the photographs on this page? (Image shows a Native American scalp
ing someone)
   No one appeared overly surprised or offended by the image. The school's director felt that the image was very appropriate, stating, "it's nothing worse than what they can see on TV. People have been historically cruel."

7. Find the answers to the three Learning Objectives in Section Three
   This task was done for the redesign sample only. Users had no difficult finding answers.

8. What is the purpose of the bottom section of the page (on the redesign sample)?
   Most answered that it involved summarizing important information in the text.
   * Note: After this question, I had users go to page 2 and read the "how to use" section.
   After reading this, users had no problems identifying key information in the color-coded section on the bottom of the redesign page.

9. Find the first page in Section Two of Chapter Six.
   No one had any problems finding the section opener on either copy.
10. Find page 184.

No one had any problems finding the page number on either copy.

11. What is the difference between the "Picturing History" and "History and Art" icons?

No one could explain the difference or its possible importance. In all cases, I had to point the icon out to the user; and in each case, the user leaned forward, studied the icon, and had consciously think about its purpose. Clearly, these icons were overlooked.

12. On page 179, Glencoe sample, explain how these images are related?

Users gave the immediate response of "this is what they (the fighters) wore on the battlefield." This comment was based on the callout's title On the Battlefield, and the caption's elaborative question - "Describe the patrons' clothing and weapons." However, when the users were asked to explain the discrepancies between the images and the painting, none could provide a deeper meaning or understanding. These images did not aid the learning process.

13. On page 179, some headings were colored blue. Why?

Users of the Glencoe sample were unsure of the coloring. Some comments were "its important" or "a special event." Only one person understood that it signified the beginning of a new sub-section.

14. On page 184, what is the meaning of the gold star in a red box? (Glencoe sample)

Users had mixed understanding. Comments were "something important."

15. How will you be tested (or assessed) on this material?

In the Glencoe sample, users looked more to the assessment sections in the back of the sections. Users tended to overlook the callout "discover to learn." This callout states
same information as in assessment. In the revised sample, users found them on the
opening section pages. They made comments like, "easy to see on opening page."

16. When you hear the word "textbook," what words do you associate with it?
   "Boring, just facts, homework, thick, colorful, a lot of information, it could be interesting
   or boring, a little boring, big, heavy, long, lots of words, homework, not many pictures."

7.1.5 Summary of Usability Test Results

1. Users were attracted to layouts with color and images. They find the aesthetics to be pleasing,
   and the text not to appear overly difficult. These comments, however, are based "surface
evaluations." Users did not encode more deeply until directed. When users studied the Glencoe
text, visual design problems affecting comprehension were identified.

2. Images are an essential element in attracting attention and aiding learning. Some images
   choices in the Glencoe sample had minimal learning value associated with the text and were
   often not effective to help learning. Image placements were often poorly done and provided
   minimal aid to the learning process.

3. Images in the redesign sample appeared to aid learning. The informational chart on pages
   4 and 5 made a clear visualization in the size differences between British and Patriot forces.
   Users also found the visual on page 6 to be helpful and eye catching. Many users made positive
   comments about the anchoring of images below the text.

4. Captions in the Glencoe design provided little value to further build understanding within
   the image. If the caption asked a question, it was not directed to learning more within the image
   but directed the thought process into another direction. There were no references, either in the
   text or the captions, linking the images and text to increase understanding.

5. Captions in the redesigned sample made information obvious and were visually organized
   to aid the learning process.

6. Users could navigate the Glencoe text, but learning was not maximized. Many navigational
   icons were not understood and provided no additional learning.
7. Twelve separate callouts were identified in Glencoe design. Many of these callouts were not linked effectively to the text or images to strengthen understanding.

8. Glencoe's section openers were not visually organized effectively to strengthen learning.

9. The visual organization of the redesigned section openers made learning objectives obvious.

10. Two users liked the Glencoe design over the redesign, stating that they liked the mixing of imagery and text.

11. Six users liked the separation of the text and imagery, stating that it made the reading easier to follow.

7.2 FINDINGS FROM THE DESIGN CRITIQUES

7.2.1 Key Findings from the Design Critiques

Five critiques were mailed out to individuals chosen for their past involvement in the textbook design process. From these critiques, seven key points were realized.

1. Four out of the five critiques felt the redesign was an improvement over current textbook designs.

2. Four out of the five critiques felt the separation of the visual and the text was extremely effective and aided the learning process.

3. Four out of the five felt the overall visual organization was improved the linkage between the visual and verbal elements.

4. The use of images was considered appropriate and would likely increase the reader's interest and understanding of the text.

5. The selection of images was considered extremely effective in building understanding.

6. The use of color-coded study guides on the page bottoms was considered as an effective tool.

7. The use of color for organization was considered appropriate, but care was needed to ensure consistent use.
8. There were conflicting comments on the degree of multiculturalism present. One critique cited that the redesign having a weak multicultural approach, while another commented that over emphasis was made to accommodate multiculturalism.

7.2.2 Individual Comments From the Design Critiques

7.2.2.1 Comments from Richard Anderson. Richard Anderson was the President of Ligature Inc. It was under his direction that Ligature developed the more visual style discussed in Andrew LaSpina's The Visual Turn and The Transformation of the Textbook. Ligature produced the social studies series for the State of California which LaSpina credits with changing textbook design.

In an email, Anderson wrote:

"I think we tried to do two things that I don't see in your approach. ...First, we tried to tell a story, using narrative and quotes from the players. Your copy seems more encyclopedic. ...Second, your diagrams again seem more fact stating rather than describing a process or leading to a conclusion and your calls for visual seem a bit more fact stating than forcing to create a story.

Segregating the text from the visuals exacerbates the problem of broken, choppy bits of information. I get the sense that you are trying to spoon feed facts.

I was always disappointed that we didn't do a more thorough job of storytelling and integrating visuals with text. As you stated, length and bulk begin to add up when you try to do these two things.

I hope this is helpful, and I applaud your efforts. Please try to focus more of your obvious creativity to story telling with both your words and your visuals. Get as far away from listing and displaying facts."

In a second email, Anderson wrote,

"The feature we adopted to accommodate the extra space required by instructive visuals and rich narrative was to break the chronology across grades 5, 8 and 11, not giving equal emphasis to the entire pre-Columbian period to today at each of grade. Instead, we devoted most of the pages in grade 5 to the period pre-Columbia to 1870, grade 8 to the period 1870 to 1920 and grade 11 to the period 1920 to today. ...I think you will be quite surprised to see what we did. It is trying to do exactly what you are attempting to do."

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7.2.2.2 Comments from Dr. James Hartley. Dr. Hartley is Head of the Department of Psychology at the University of Keele, Keele, England, and author of Designing Instructional Text. He is well known within educational design circles.

Dr. Hartley writes in an email:

I think that the layout of this text is very pleasing, but I have one --- not very important --- comment.

I think it a good idea to separate the visuals from the text in this way. I don't know of any research on the matter but it would be interesting to compare versions with the visuals on the top half of the page versus visuals in the bottom half.

I wonder if it might be a good idea to put the visual for the beginning of each chapter as it is currently presented in the bottom half of the page too -- just to be consistent. Your text on p. 2 says that the narrative text is in the upper portion of the page and that the visuals are in the lower portion. You then flatly contradict this on page 3.

7.2.2.3 Comments from Edith Reynolds. Ms. Reynolds has a Masters in Reading. She has worked as an educational editor for over three years, and currently serves as a reading specialist in the Chicago area school district. She has written educational material ranging from preschool to the sixth grade.

She writes in an email:

Overall, the page set-up is a vast improvement over the way textbooks are currently set up. For one thing, the format is predictable. Once students knew that the text will always appear at the top of the page and the illustrations will always appear at the bottom, students can approach the page with the confidence of knowing where to look for different kinds of text features. Another advantage of the layout is that the amount of text on each page is significantly reduced. This helps the learner in a number of ways. One, it makes the page visually interesting -- students will not feel visually overwhelmed by the amount of text in front of them. Many students, including adults, will feel discouraged when they see a "wall of text."

Reducing the amount of text helps the learner feel that there is a manageable amount of information to "master." And reducing the amount of information can help students and teachers in organizing the information for later review and study. Your organization of "chunks" of text, organized by subheadings, particularly supports this. For example, on page 6, students can be taught to use the subheads as
organizers for their information. For each of the subheadings "Red Coats," "Hessians," "Indian Tribes," and "Loyalists," students can be taught to jot down the subhead, read the information in the paragraphs under that subhead, and then summarize, either orally, or in writing, the information they have read.

Although students can certainly use these same techniques even in traditionally-fold-out textbooks, the significantly reduced amount of information on each page makes it more likely that students will follow through on using these techniques independently—simply because they feel they can.

Another strength of your layout is the variety of types of visuals you use to support the information. This book is exciting to look at! Not only are students highly motivated by color and visuals, but "visualizing," or creating pictures in their minds of people, places and events, is a key comprehension strategy we teach readers. Since most students have very limited background knowledge about the content contained in history and science textbooks, using visuals that help them visualize the people and events from history is not only an effective way to engage them, but is critical in helping them build the background they need to accurately visualize these scenes from history. By looking at the illustrations on pages 8 and 9, for example, without any text to tell them this information, one thing students can learn is what type of uniform the patriots army wore.

For this reason, I would probably use fewer illustrations throughout and enlarge the remaining, critical ones, using illustrations that provide or support only the most important information. For example, the map on page 15 showing the location of Valley Forge, because it is so small, does not provide the reader with much detail. Here, the information "Valley Forge, located 25 miles from Philadelphia..." is probably sufficient without a visual. On page 16, four illustrations seem like too many, and students could see more detail if there were fewer illustrations. I would suggest using the "Shot of Loyalists" illustration because it visually supports the colloquialism "run out of town on a rail"—information that is not provided in the text. I would also include the "Women Defend the Land" photo because, again, because it provides information not provided in the text, and because it helps students "visualize" historical events. It also includes African-Americans which, along with the illustration of Thomas Jefferson and his slave on page 17 can help students develop an understanding of the history of slavery in this country before the Civil War.

Especially effective are the places where you provide an illustration of a person, such as Abigail Adams (correct the spelling of her name, please!) on page 17, or of John Paul Jones on page 20, along with a quote.
This is an excellent way to help students visualize a key figure in history and link, or "anchor" it with a key piece of information about him/her. I would suggest, however, that whenever you use a particular text feature, like quotes in lighter italic, that you use it consistently throughout. You've done this for the most part, like with Abigail Adams and the Mohawk chief on page 21, but not with John Paul Jones on page 26. You also use italic for the caption under the picture on page 27 when it is a summary statement. Maintaining consistency in text features is important to help signal readers about what to expect when they see certain types of text features.

Another example of potential confusion is on page 20 where the subhead "Purpos" is in red. Throughout, these types of subheads have been in black with key vocabulary in red, and this has the potential to confuse the reader as to the importance of this word. The changing of color to highlight important names or places is a bit confusing, too. I'd stick with one color throughout for all key vocabulary, people and places. I also wasn't sure about why you changed the size of subheads in different places throughout the text. For example, on page 26, I see two sizes of subheads. The size of the subhead "Washington Chooses His Strategy . . . " (and, by the way, you should use all capital for all subheads, just as you would a title, not using a period at the end as you have in some, like on page 5 and in the captions on pages 27, and page 29), because it is large, lends me to believe this is it is an overarching subhead and is more important than the subheads "French Troops Arrive . . . " and "Waiting for a Second Fleet . . . " when, in fact, it is of equal importance. We teach students that different kinds of text features signal different things, so your subheads should reflect that. I would suggest the same size subheads throughout.

I wasn't sure how much of the "set-up" features at the beginning of each section were yours, but I'll address them anyway. The way this page is laid out is clear and helps the reader begin to create what we used to call "anticipatory set"—that is, to help the reader set learning objectives and know what to expect. In short, it creates a "road map" for the reader.

Using different colors for the "Vocabulary", "Identify" and "Geography" seems good, too, because it helps diseminate the types of key information the reader will be expected to retain. However, instead of "Identify", I'd probably suggest using "Key People" and instead of "Geography", I'd use "Key Events." To maintain consistency, I'd change "Vocabulary" to "Key Vocabulary." I like that you extracted key dates from the text, but in actual timeline at the bottom of the page would not only be more visually useful to the reader, but would "break up" the text on this page in a more effective way. That way, the text would be in the middle, bordered at the top and the bottom by meaningful visuals that enhance and extend understanding of the information. Also excellent is the direct mirroring of these topic people, places and events at the end of the section.
A really great feature of your design is the foders with key vocabulary and the definitions. You managed
to do it really effectively without drawing attention away from the illustrations and "shattering up" the
bottom of the page.

Your work is a tremendous improvement over the textbook design currently on the market. Not only is
this textbook interesting to look at, motivating readers to want to read the information, but many of the
layout and design features you bring to the work aid in enhance student understanding.

7.2.2.4 Comments from Richard Larson. Mr. Larson is a social studies teacher in the
Walnut Ridge Public School, Columbus, OH.

In an email, Larson writes:

"I like the chunking of text, but your use of vivid colors instead of dull or "sad" back colors is a distrac-
tion."

It has good pace and flow and the pictures fit the material presented. As far as usefulness to a teacher, you
would need to develop ancillary material that would help the teacher to further utilize your text. Realize
that the text you present is colorful, eye catching, and very modern. But many text decisions are made
based on what the teachers need or have to assign them. I really cannot judge the package on what point. I
do know that the material you present is far more student friendly.

The only thing you may worry about is that your text may be a little busy and can provide a distraction.

But I feel that when any student is engaged in a good text, even with pictures, it is a good thing. I
believe your text will have comprehension improvements, but just my opinion.

Chunking of the visuals was a great idea, and more texts should follow that. It was distracting, but just
because texts of today are not written like that.

Captions are fine, but like I said, try to incorporate other areas of social studies and critical thinking
questions with in your captions. For above example, based on this graphic, who would you have fought
for and why?

It is so easy to engage inner city kids with just pictures and sayings from their generation. You could
really work on that aspect. Multicultural education in an urban environment is a near with all white
texts. You do make some multicultural references and that is good, but as I coded your material, you still
scored less than three percent of the material as appropriate for multicultural use.
7.2.2.5 Comments from Bill Bennett. Mr. Bennett is President of the Textbook League. This organization produces newsletters that critique the educational quality of textbooks. His newsletters were a main source of complaints regarding the quality of textbooks.

In a telephone conversation, Bill Bennett commented, "I love the whole thing in readability and spaciousness." He did feel, however, that the book could easily be reduced from 32 pages to 24 pages by closing up the white space and taking out the repetitive material. "By demanding that all subhead start at the top of the page," he advised, "you waste a lot of space." He then cited several examples where information was presented on one page, and then repeated on another. He also questioned the presence of certain minor historical characters, such as Deborah Samson. "She is making a quota," he remarked. 6

7.3 CONCLUSION

Analysis has showed that the revised design did aid the learning process. The following points were realized about the redesign:

- It used a grid system that facilitated reading without distractions
- It used captions that clearly linked images with text
- It selected images that clearly visualized the information presented
- It used a color-coded study aid/visual reference guide at the bottom of each page
- It made clear text references linking images
- It used a clear textual hierarchy

ENDNOTES FOR CHAPTER 7

1. Dr. Richard Anderson, email to author, 22 May 2003.
2. Dr. Richard Anderson, email to author, 23 May 2003.
3. Dr. James Hartley, email to author, 10 June 2003.
CHAPTER 8

CONCLUSIONS

In the late 1980s, Liguore Inc. advanced a design style that they promoted as being "more visually-engaging and interactive with the learner." Because of new thoughts on information design and the emergence of personal computers to assist designers with creating layouts, this "more visual" style was quickly accepted by Houghton Mifflin, and then adopted by other publishers. The style was visually appealing. It was likely, based on pressures to keep competitive in the fast paced market-driven industry of the late 1980s, that this is why other publishers began adopting this style. All the while, publishers shifted ownership in constant acquisitions. Some designers remained through these new mergers, while others were being laid off. Personal computers also effectively eliminated the need for professional typesetters and the detailed, well-outlined type matrices that they used.

Today, textbooks are still an essential element to classroom instruction. The demands placed on them by their many stakeholders can be staggering. Textbooks need to cover material presented in national standards, be attractively designed to be competitive against products of other major publishers, appeal to slow and disinterested learners as well as those interested in its topic, be a tool to new teachers or those who are teaching out of their subject field, and pass the scrutiny of a diverse range of watchdog organizations that check for accuracy of facts, racial biases, and even political correctness.

My research has shown that there are visual design shortfalls within the current textbooks, and that these problems distract from the learning process. My work has laid some foundational structure for research-based visual design criteria that future designers can build upon and further expand. My research provides a starting point for discussions between editors and designers. Using the visual demonstrations from Chapter 4, designers and editors will have a common tool to discuss ways to improve a product's visual design and thereby improve the learning process.
Six key criteria we proposed that need to be incorporated into any educational design. These criteria are guidelines. The final design will vary from project to project.

First, all designs should have visual organization that works with the encoding specificity needs. By doing so, the design becomes structured and assists the reader with visual understanding. It provides the reader with preattentive awareness to how the design functions and aids the reader's understanding. The visual hierarchy should take advantage of visual scanning behaviors. The eye should not be overly distracted by visuals while reading.

Second, designs should select images that reinforce and strengthen the learning process. Clear linkage between the text and the images needs to be made. Images should be placed in close proximity to the text to aid comprehension.

Third, captions should provide specific instructions on what to learn from the associated imagery. Without clear linkage, misinterpretations can be made.

Fourth, there are educational considerations in typography. Type must be readable. It must be set in a comfortable size font and given sufficient leading. Column widths should be wide enough for easy reading.

Fifth, color must be used with both purposefulness and caution. Color helps to organize and highlight information. If handled improperly, color can confuse and distract the reading process.

Lastly, the user should have a clear understanding on how the visual design reinforces the learning process. Visual learning skills among many new readers is relatively undeveloped. Unless the visual design is self-evident, readers may need some guidance on how to get full use of the layout's functionality.

Areas for Further Research

First, my research was focused on a specific grade level (8th grade) and a specific subject matter (history). Other subject areas, such as math and science, may have additional needs to need to be examined. Also, different ages of students will have different learning needs. Elementary students will be at different levels of cognitive development than high school students. The visual-verbal mixture will need to be adjusted to aid in learning to read. Designers...
need to consider the visual needs for students with disabilities, such as low vision or blindness.

Second, more usability testing needs to be done. My research allowed for only a limited test dealing with simple navigation, recognition of text cues, and overall visual layout. Further and more detailed usability tests should be conducted on each of the criteria.

Third, visual designers have only limited material available on the subject of reading strategies. Research is needed on visual designs that aid in reading strategies in educational situations.

Lastly, I would like to conduct a conference that would bring the various stakeholders together in a workshop format. The criteria would be distributed to these stakeholders and further discussion could be done. Each stakeholder would gain new experience and insight into the needs of the other stakeholders. I would invite a diverse group of speakers and ask that they present a paper dealing with research based visual design criteria. I would publish the collective papers following the conference.

In the end, learning begins with interest. Interest is created when good writing is presented in well-organized visual formats built to aid the learning process. The design choices are endless.
BIBLIOGRAPHY


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