# *Web Design for Instruction:*
# *Research-Based Guidelines*

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"Web Design for Instruction" is a web site that introduces novice web designers to some of the principles involved in design and navigation of instructional web sites. This article discusses the process involved in designing the site, the lessons learned while developing it, and some recommendations for further research. It also includes a list of research-based guidelines derived from the literature in the areas of screen design, multimedia, human-computer interface design, and usability testing.

« Web design for Instruction » est un site web qui initie les apprentis créateurs de sites web aux principes qui sous-tendent la conception et la navigation sur les sites web destinés à l'apprentissage. Cet article traite du processus utilisé dans la conception d'un site, des enseignements tirés de l'élaboration de tels sites, et de certaines recommandations pour la poursuite des recherches. Il comporte également une liste des principes tirés des études déjà effectuées en matière de conception de formats d'images, de création d'interfaces être humain-ordinateur et de tests d'utilisation.

### The Project

"Web Design for Instruction" is a web site that introduces people without a background in graphic design to some of the principles involved in design and navigation of instructional web sites. The site was developed as part of a Master's project in Educational Technology and contains the following topics: design theory, research-based recommendations about site design, page design, and multimedia: a section with links to teacher resources; a summary of research-based guidelines for the design of instructional web sites as well as recommendations from a survey of practicing web designers. This web site can be found at http://www.usask.ca/education/coursework/skaalid/.

### Why this Site was Developed

This web site was developed as a learning resource to provide access to information about designing instructional web sites. Although there are many resources available on the web for beginning web designers, searches of the web have not found many online resources that discuss research-based findings about screen design and usability. There are books and articles available on these topics, but these are scattered and difficult to find. I have never located a web site that addresses either the theoretical concepts of graphic design or gestalt perception. Finally, although many sites give recommendations concerning web design, few are based on explicit research (Boling, Bichelmeyer, Squire and Kirkley, 1997). My objective was to design a resource that pulled together all the relevant information needed to design an effective instructional site.

### The Process

I examined two different models for the information design process. One model is taken from the book *Interactivity by Design* (Kristof & Satran, 1995) while the other model comes from *Web Navigation: Designing the User Experience* (Fleming, 1998).

## Comparison of the Two Models

Fleming's model is considered a development cycle for web sites and consists of 6 phases:

*Phase 1: Information gathering - This phase consists of collecting background information such as resources available, goals for the site and the target audience. (corresponds to Part I : Information Design in the other model)*

In this project, the resources were collected for the most part during an independent study project on design. While maintaining and revamping a large, complex web site for the College of Education, I collected information about web design, navigation, and usability. The final objective of this project was to summarize and present all the information painstakingly gathered in order to make it available to others also involved in web design. I also felt that teachers might find this information useful, since many of them were in the process of developing sites to present information, or having students develop sites to publish their knowledge about a topic.

*Phase 2: Strategy* · *The focus is on defining an approach through brainstorming and problem-solving, identifying any problems which may occur during development.*

This element was minimal in the project. Various potential problems were discussed at the preliminary oral conference which were considered throughout development. One problem which was discussed and still needs to be considered regularly is the problem of broken links. Broken links occur when pages of information are moved or deleted from another site. If a site contains links to these missing or deleted pages, then the user will be given an error message to that effect. Strategies for dealing with this problem include trying to make a web site as self-contained as possible, and using special link-checking software which informs the web designer when a link is broken. At that time, the designer can choose to remove the link or find a substitute link which illustrates the same concept.

*Phase 3: Prototyping* · *In this phase, the designer creates a rough plan for the site and considers navigational issues. Prototypes may include paper mockups, storyboards, hypercard stacks or rough web sites. (corresponds to Part 2 & 3 in the other model)*

During this phase, the top level navigation pages were designed in order to test usability and navigation. With my limited art skills, it was just as easy for me to use Claris Home Page to design the pages as it was to design storyboards or paper mockups! At the same time, colors, fonts and grid layouts were developed to create a certain "look and feel" for the site. A number of prototype navigation designs were produced and tested using formative evaluation. After several iterations and some new menu categories, a final navigation scheme was adopted (Figure 1, next page) which seemed to be logical and less confusing to use.

**Web Design for Instruction**

**Web Design for Instruction**
Research-Based Guidelines

Introduction to the Site for New Visitors

Design Theory

Site Design

Page Design

MultiMedia

Teacher Resources

Table of Contents

Summary of Guidelines

Web Survey Questionnaire Results

Home Page

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**Design Theory**
[Classic Graphic Design Theory] [Gestalt Principles of Perception] [Human-Computer Interface Design]

**Site Design**
[Hypermedia Basics] [Metaphor] [Web Site Categorization] [Navigation] [Site Design Testing]

**Page Design**
[Multimedia & Web Page Design Principles] [Screen Design Research] [Screen Resolution & Size] [Writing Style]

**Multimedia**
[Multimedia Research] [Using Graphics & Pictures] [Animation] [Video] [Audio] [Response Times]

**Teacher Resources**
[Instant Web Sites] [Sources for Graphics and Animations] [Web Tutorials and Design Resources] [Web Resources for Educators]

*Figure 1.*

*Phase 4: Implementation* - *Use the results from the formative evaluation (phase 3) to build the site.*

In this case, prototyping and implementation were often happening at the same time. Once the look and feel was finalized, it was just a matter of cutting and pasting the existing text onto template pages in order to complete the site.

*Phase 5 & 6: Launch, Maintenance & Growth* - *Launch is the period just before and after the web site goes online during which extensive testing is carried out to ensure consistency, compatibility and stability. Launch is also the time when the site is advertised or linked so that people can find it. Maintenance and growth addresses the need to keep the site current and accurate and to ensure that all links still work.*

Pages were uploaded and tested throughout the implementation period so there was not a single significant testing period during the launch. In order to ensure that people could find the site, a link was created from the College of Education **Student Produced Resources** section to this site. As well, the site was submitted to a number of search engines for cataloguing.

Resources are still added to the site if they are found to be relevant, and

links are checked once a month to ensure they are still working. If a link has expired, it will be removed from the site. Periodic site revisions are also a necessary evil in web site design to ensure people come back to a site more than once.

### *Design   Considerations*

The site was designed with multiple pathways through the data depending on the user's background and interests. Navigation was completely within the user's control at all times. The preliminary Theory section was included to scaffold web designers without a background in graphic design, gestalt theory, or human-computer interface theory. The sections on Site Design, Page Design, and Multimedia were designed to present based guidelines that might be used to design more effective instructional web sites. The Teacher Resource section was designed as a jumping-off point for the actual design of web sites. To this end, the section is filled with links to page templates, web creation tutorials, resources for web design such as graphics, sounds and video, and links to other exemplary educational sites.

The site was designed in a hierarchical manner with the top level navigation page designed to allow access to almost every page in the site. This gives new users an overview of the entire site when they first enter while also giving repeat users quick access to any section. The home page also contains three links not found on any other pages. One link leads to an orientation page for new users which discusses what the site was designed to do, as well as what it will not do. The orientation page also provides a key for any symbols used as well as an in-depth discussion about each one of the topics in the site. A second link leads to a special summary page which gives an overview of all the research findings for users who just want the final results. A third link discusses the findings from a survey of web designers.

*Web Navigation,* Fleming (1998) poses a number of questions which users of learning sites will often ask. One of Fleming's questions that I felt was important to address was: "How do I know what you say is true?" Many tutorials on web design give advice about the way things should look, or the way navigation should work, but few actually provide information about the reasons supporting that advice. Advice may appear to have the same credibility whether it is given by a person who has been designing for two weeks, or by Jakob Nielsen PhD., a Sun Systems engineer who has conducted years of usability tests to determine effective navigation strategies. This web site was designed to show that information was based on research data, not just the "folk" wisdom which is prevalent on the web.

Therefore, in this site, you can pursue links back to the original documents or web pages where the research is discussed.

As much as possible, the research recommendations listed in the site were modelled within the site. Graphics were only used when they were needed for explanation of a concept. Navigation elements were located at the side for ease of use and repeated at the bottom. Colored borders and boxes were used to enhance the page and create balance but were limited to the non-text areas so that readability of the text was never affected. Navigation labels were text-based to ensure the pages loaded very quickly. Page location was indicated inside the navigation boxes by changing the current page to a different color and eliminating its link. Feedback was provided inside the bottom navigation box by changing the color of visited links so that users would know which links they had already seen. (Figure 2)
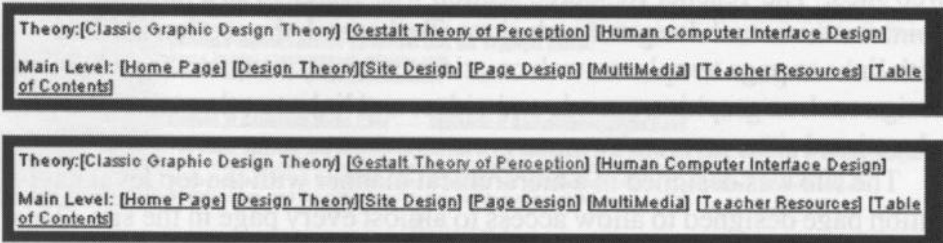
Theory:[Classic Graphic Design Theory] [Gestalt Theory of Perception] [Human Computer Interface Design]

Main Level: [Home Page] [Design Theory][Site Design] [Page Design] [MultiMedia] [Teacher Resources] [Table of Contents]

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Main Level: [Home Page] [Design Theory][Site Design] [Page Design] [MultiMedia] [Teacher Resources] [Table of Contents]

*Figure 2*

### Summary of Research-Based Guidelines

This summary lists the research recommendations found within each of the research-based sections of the web site. In many cases, the research recommendations are in the author's own words. Although all of these guidelines are based on research, not all the research was conducted specifically for the web. Some of the guidelines come from studies of Computer Assisted Instruction (CAI) or multimedia.

### Design Theory

***Guidelines from human-computer interface design research:***
1. Recognize Diversity
• make your main navigation area fast loading for repeat users
• provide a detailed explanation of your topics, symbols, and navigation options for new users (FAQ or introduction page)
• provide a text index for quick access to all pages of the site
• ensure your pages are readable in many formats, to accommodate

users who are blind or deaf, users with old versions of browsers, lynx users, users on slow modems or those with graphics turned off

2. Strive for consistency in:

menus

help screens

color

layout

capitalization

fonts

sequences of actions

3. Offer informative feedback · rollover buttons, sounds when clicked.

4. Build in error prevention in online forms.

5. Give users control as much as possible.

6. Reduce short term memory load by providing menus, buttons or icons. If you use icons, make sure you have a section which explains what they mean. Make things obvious by using constraints    grayed out items in menus for options not available in that page.

7. Make use of web conventions such as underlined links, color change in links for visited pages, common terminology.

8. Provide  a conceptual model of your site using a site map or an index. (Shneidetman, 1998; Norman, 1988)

### *Site  Design*

#### *Guidelines   for   Hypertext   Creation*

1. Know users and their tasks.

2. Ensure that meaningful structure comes first.

3. Apply diverse skills (by including information specialists, content specialists and technologists on the project team).

4. Respect chunking.  Organize information into chunks that deal with one topic, theme or idea.

5. Show interrelationships (by using links to related articles).

6. Ensure simplicity in traversal. Design the link structure so that naviga-tion is simple and consistent throughout the system.

7. Design each screen carefully, providing on-screen prompts such as icons or menus. (Shneiderman, 1998)

#### *Guidelines for Metaphor:*

l.A useful metaphor will help users navigate your site. Good examples of metaphor include shopping sites based on the idea of paper catalogs and the hypercard  card index that looked just like a Rolodex. (Davis & Merritt,

1998, Bielenberg, 1993)

*Guidelines for Web Site Categorization:*

1. Boling, Bichelmeyer, Squire and Kirkley (1997) identified seven profiles for web sites based on a matrix of high information, high motivation to low information, low motivation. A quick summary of their profiles are as follows:

*Profile 1: No Expectations* - very low need to motivate users or deliver content - e.g. personal home pages

*Profile 2: All Motivation* - high need to motivate users to view site - e.g. promotional commercial sites

*Profile 3: All Content* - high need to deliver content where site may be the only provider of this information or users are highly motivated to use site already- e.g. search engines or research results

*Profile 4: High Motivation* - a need to provide some content along with motivating factors, at same time users must be able to distinguish between content and glitz

*Profile 5: High Content* - need for content outweighs the need for high motivational factors but an attractive site is necessary - e.g. government agencies, universities

*Profile 6: Mixed Elements & Profile 7: Great Expectations* - "in both these profiles the need to deliver specific content and the need to motivate users to a specific response are highly interdependent and interrelated" - e.g. commercial catalogue sites, sites devoted to charitable or political causes, or educational sites

*Guidelines for Navigation:*

*Structure*

1. Hierarchical menus are useful for straightforward searching tasks, but the additional clarification available from embedded, contextual menus will aid complex search tasks. Therefore, designing menus to be more verbose, or adding information in the form of textual indexes with clarification will help users to be more successful in finding what they are looking for (Lai & Waugh, 1995; Lynch & Horton, 1997).

*Orientation*

1. It is very important to include site information on every page of a site. It is also essential to include links to the local home page on every page to accommodate users who jump into your site. Links to other pages in a sequence are also useful.

2. Categorization of information into menus is a very difficult process as well as one which needs careful attention. Menu items need to be unique, non-overlapping and familiar. It is better, when designing a structure, to have breadth over depth (fewer long menus as opposed to many shorter menus).

3. Orienting devices such as textual indexes, guided tours or overview diagrams are useful to keep users from becoming disoriented in a site.

4. Navigation information is easiest to use if located in a similar location on every page of a site. This helps because the user knows where things are located from page to page. (Balasubramanian, 1993; Instone, 1997; Lynch & Horton, 1997; Nielsen, Nov. 1997; Rosenfeld, 1997; Shneidetman, 1998; Spool, 1998)

*Guidelines from Usability Research (Jakob Nielsen)*

1. Most users don't read, they scan for information.

2. The author's personality makes a site more attractive.

3. Web users are impatient, they don't want to be slowed down by cool features or self-promotion.

4. Search capability is very important.

5. Download factors are critical.

            is almost always annoying.

7. Frames are disliked.

8. Wild backgrounds disrupt reading.

9. Although more users are scrolling (pages no longer than 3 screens are recommended), many still don't go beyond the first screen.

10. Image maps are more usable now, especially if they are broken up into smaller sections that load more quickly than one large graphic.

11. Users want sites to work and are no longer tolerant of those that don't.

(Nielsen, Dec. 1997).

*Page  Design*

### Guidelines for Multimedia and Web Page Design

1. Keep the design principles of simplicity, consistency, clarity, balance, harmony & unity in mind when designing web sites (Schwier, & Misanchuk, 1993; Anglin, Towers & Levie, 1996; Norman, 1988; Mullet, & Sano, 1995).

### Guidelines for Screen Design

1. *Grid:* Use a grid to design pages. Map out where your navigation elements will be located and be consistent from page to page with this layout (Lynch & Horton, 1997)

2. *Screen Density:* Although results concerning screen density are conflicting, it appears from recent research that screens with too much white space are confusing (Hooper & Hannafin, 1986; Morrison, Ross, Schultz, & O'Dell, 1989; Ross, Morrison, &Schultz 1994; Spool, 1998).

3. *Fonts:* If possible, use fonts designed for the web such as Georgia or Verdana since they are easier to read - use ragged right justification on the screen as it is easier to read (Misanchuk, Schwier, & Boling, 2000).

4. *Buttons, boxes and menus:* Buttons, radio buttons, check boxes and menus should look like something you would normally press, click, put x's in, or pull down. HTML includes special routines which draw radio buttons, check boxes, and pull down menus for you. The design of buttons is a bit trickier, since you have to draw your own graphic and make it look like a button (bevelled edges give the 3D effect which makes a graphic look like something you would press). Give the user some feedback that execution is occurring after a button is pressed. This was much harder in the past, but with the addition of Javascript to the newer web browsers, icons will flash or change color when pressed, giving the user the sense that something may happen (Shneidetman, 1998; Norman, 1988).

5. *Use of Icons:*
- represent the object or action in a familiar and  recognizable  manner
- limit the number of different icons
- make the icon stand out from its background
- consider three dimensional icons; they are eye-catching but also can be distracting
- ensure that a single selected icon is clearly visible when surrounded by unselected icons
- make each icon distinctive from every other icon
- ensure the harmoniousness of each icon as a member of a family of

icons

(Horton, 1994; Shneiderman, 1998)

*6. Use of color:*

- design conservatively, possibly starting with black and white, and consider older or color-blind users

- do not make color the only way to discriminate between choices

- use color to add reality

- use color to discriminate between elements of a visual

- use color to focus attention on relevant cues

- use colors to code and link logically related elements

- be consistent in general color choices throughout materials

- use colors such as highly saturated red and violet to attract attention and to create an emotional response

- use highly saturated colors for materials intended for young children

- consider commonly accepted color meanings i.e. red and yellow are warm, green and blue are cool, red means stop, green means go, etc.

- when producing materials for persons from varied cultures consider the meanings they attribute to colors

(Misanchuk, Schwier, & Boling, 2000; Murch, 1995; Pett, & Wilson, 1996)

### *Guidelines for Screen Resolution and Size*

1. Design for the smallest standard screen which is:

- Macintosh size (Macintosh screen area is smaller than Wintel machines) 595 pixels wide by 295 pixels high

- 14 inch monitor (640   x 480 pixel area)

*- 256* colors

2. Start your design in black and white to ensure readability for persons with color deficiency.

3. Include ALT tags on all image files to ensure that people using text-only browsers or special readers (i.e. blind or sight deficient users) are still able to access the information provided in your pages.

(Misanchuk, Schwier, & Boling, 2000; Lynch & Horton, 1997)

### *Guidelines for Writing Style*

1. Users like summaries and the inverted pyramid style used by journal-where the most important information is presented first in an article.

2. Users appreciate headings which help them to scan and locate the information they are interested in.

3. Users do not appreciate flowery or "marketese" writing and want

web pages to be concise.

   4. Simple and informal writing is preferred over formal writing style.
   (Morkes, & Nielsen, (1997)

### *MultiMedia*

#### *Guidelines  for  Multimedia*

   1. Be careful that you don't overload your communication processing channels by sending information in more than one way at the same time (listening to words and trying to read text at the same time causes interference) (Moore, Burton, & Myers, 1996).

   2. Guidelines  for  using  graphics  and  pictures

   - illustrated visuals used in the context of learning to read are not very helpful

   - illustrated visuals that contain text-redundant information can facilitate  learning

   - illustrated visuals that are not text-redundant neither help nor hinder    . learning

   - illustration variables (cueing) such as size, page position, style, color, and degree of realism may direct attention but may not act as a significant aid  in  learning

   - there is a curvilinear relationship between the degree of realism in illustrations and the subsequent learning that takes place (Anglin, Towers, and Levie, 1996)

   - visuals that complement the text information being presented increase the likelihood for retention of that information, but visuals which are not related to the text have no effect on retention. When bandwidth is a problem, gratuitous visuals would seem to be unecessary in page design (Misanchuk, Schwier, & Boling, 2000)

   3. Guidelines  for  using  animation

    Appropriate uses for animation include:

   - showing continuity in transitions - proving the Pythagorean theorem by animating the movement of various squares and triangles as they move around to demonstrate that two areas are the same size

   - indicating dimensionality in transitions - animated arrows pointing left and right can indicate movement forward and back, zooming boxes can indicate one screen was enlarged from another

   - illustrating change over time - showing population change by fading from one density map to the next over time

   - multiplexing the display - showing more than one piece of information in the same location    i.e., buttons which change color when the

mouse rolls over them, help labels which appear when the cursor is on top, menus which pull down when you hold the mouse down

- enriching graphical representations - animated icons can give a better understanding of the function of the icon - i.e. an eraser icon which erases pixels to explain its function

Do not use animations that continue endlessly - they irritate users - **Never** use the Blink command

(Nielsen, Dec. 1995, Nielsen, Dec. 1997)

### *Guidelines for video, sound and response time*

1. Due to restrictions in bandwidth, video is not recommended. If used:
- include information about its size so that users can decide whether or not they want to wait (Nielsen, Dec. 1995)

- never incorporate the automatic downloading of a video into the loading of a page

2. If audio is incorporated in your site, make sure it is the highest quality you can produce (Reeves, & Nass, 1996)

- audio can be used to give help or directions without obscuring the screen

3. Currently, the minimum goal for response times should be to get pages to users in no more than ten seconds, since that's the limit of people's ability to keep their attention focused while waiting.... speed must be the overriding design criterion. To keep page sizes small, graphics should be kept to a minimum and multimedia effects should only be used when they truly add to the user's understanding of the information (Nielsen, Mar. 1997)

### *Recommendations*

The section on guidelines identified a myriad of elements to consider in web design. Although I think all these guidelines should be considered in web design, after reading the recommendations from my intensive interviews and the web survey questionnaires, as well as reflecting on my experience with designing web sites, I have chosen to highlight several guidelines that I feel are the most important when designing a site.

1. Carry out formative evaluation designed to elicit ideas about zation very early, before much time and effort is expended on aesthetic considerations. It is very important that you have a final version of your main categories very early on in site design. If you have to move blocks of pages from category to category, this will necessitate a large amount of relinking (which introduces the likelihood of misplaced links). User testing to determine problems in terminology and misunderstandings about navigation must be done very early on.

2. Although page creation programs are very good, they all have their limitations. Ensure that you are somewhat familiar with HTML coding so you can look at source code and understand what is going on. Some activities can only be done by writing HTML code.

3. It is important to consider users who may be handicapped, or who use Lynx browsers, or who surf with graphics turned off.

4. Make sure that you test your web site often to ensure that links are working. Online programs like Netmechanic can go through your site and report back on links that aren't working.

5. Since download time is such a critical factor for many users, use the minimalist approach to design. Do not use graphics or animations unless there is a pedagogical reason for their use.

### *Research Questions*

With the exception of usability studies, most of the research-based guidelines identified in this project were not web-based but were derived from studies of instructional software and multimedia. Although studies of usability have provided valuable insights into the navigational design of a web site, many other questions specific to web design remain to be answered. In the process of collecting the guidelines and developing my own web sites, the following questions emerged as ones for which I would like to see research carried out.

1. What are the elements which should be present in an instructional site? Is there a certain way in which sites should be designed when used for instruction? Are there differences in the way a site should be structured for younger versus older learners?

2. What about the traditional design issues of line length, page density, and choice of fonts? Are there optimal choices for these elements in terms of making web instruction more effective?

3. Which multi-media modes can be combined and which should be avoided in combination with each other in order to optimize learning?

4. What are the elements which combine to make the most effective instructional web site? For example: Is interactivity the most important element in effective web instruction? What about aesthetics? Inclusion of graphics, videos, and sound?

5. What about the use of metaphor? Does it help or hinder when navigating a web site?

Any studies addressing these research questions must consider the context within which the research takes place. It is meaningless to discuss elements such as optimal font size, for example, without also discussing screen resolution, font color or type, what brand of computer is used, what

age group is tested and a myriad of other factors which impinge upon the outcome. Similarly, identification of factors which lead to successful web instruction should consider the learning contexts, the preferences and characteristics of individual learners, and the nature of the learning tasks when studies are devised.

### *Conclusion*

Web design is a very exciting process to be involved with - you can create a site that is interesting and visually stimulating as well as reflective of your own creativity. At the same time, it is necessary to temper creativity with the knowledge of what an effective, pedagogically sound web site needs to look like. My hope is that this site is a small beginning towards accumulating that knowledge.

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