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# User Interface, Multimedia Richness, and Learning Style on the World Wide Web: A Literature Review

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## Abstract

Electronic commerce had witnessed considerable growth over the past few years and is expected to continue growing in the future. The World Wide Web is increasingly becoming an important avenue of the marketplace. However, unlike the traditional retail outlets of business, it lacks certain aspects like being physically in a store and interacting with customer sales people. A well-designed user interface can overcome some of these limitations and aid customers in their search of products and services. This paper examines user interface and the richness of a multimedia site on the World Wide Web, as well as users' learning styles, in terms of the literature.

## Introduction

Electronic commerce has exploded on the Internet over the past few years and is expected to continue growing at a phenomenal rate (Kannan, Chang, and Whinston, 1998). According to the *GVU's 8th WWW User Surveys* (1997), the most important issues facing on-line users are privacy (31%), censorship (24%), and navigation (17%). Since user interface design impacts navigation and affects user's interaction with a web site, this paper will examine user interface and multimedia richness on a web site, as well as users' learning style, in terms of the literature. User interface is important since a given system relies a lot on its interface "look and feel" (Nielsen, 1995, 2000).

## Literature Review

### *User Interface Models*

An interface is generally defined as the shared link that allows two independent systems to communicate or interact together. In computer-human interaction, it can be graphically expressed as the intersection overlapping the human and computer systems. Specifically, the interface involves all the hardware input and output devices (such as the mouse, keyboard, computer monitor, etc.) and software (operating system, application, etc.) that allow the user and the system to interact.

The user is flexible and adaptable (Mayhew 1992). However, the system is neither flexible nor adaptable, which in turn places the responsibility of successful interaction on the user. This responsibility makes the role of a well designed user interface an important issue in how users perceive the system.

## GOMS Model

Goals, operators, methods, and selection rules (GOMS) cognitive model was developed by Card, Moran, and Newell (1983). The model assumes that humans define goals, such as creating a document in a word processor, and subgoals, such as inserting words. These goals are attained by using methods or tasks, such as moving the cursor, using the four arrow keys. The operators on this context are tasks of the brain that include basic perceptual, motor, or cognitive tasks. These tasks, such as recalling a filename, moving the mouse on the screen, etc., are important in changing the user's mental state or the task environment. The selection rules are the control mechanisms for selecting among the available methods for achieving a goal, such as erasing text in a document.

## Object-Oriented Interface Model

Shneiderman (1998) redefined a user interface model he proposed earlier. The new model is called the object-action interface (OAI) model. The model emphasizes the manipulation of user objects and actions in a visual way. For example, folders of letters might be represented with envelopes (objects) and the deletion of these files (actions) could be represented with trash cans, such as the first ones introduced in the Apple Macintosh.

In the OAI model, the first step is to understand the action or task to be carried out. The task in turn is broken further into intermediate goals and individual steps. Once the task objects and actions and their decomposition have been well defined, then a metaphor can be applied. The designer must then represent the actions visually to the user, such as the movement of the mouse as the user clicks. Since the OAI model does not rely on syntax, it is easier to learn.

The OAI model supports two components in web page design: metaphors and handles for interface actions. Actions in web sites can be represented using action handles: the labels, icons, buttons, images, etc. that allow the user the choice of clicks to start a specific action or sequence of actions. For example, navigation action can be represented by a turned page corner to indicate next-page action, or a magnifying glass to be used to zoom in or out of a page.

The OAI model (Shneiderman 1998) specifies five main elements in web page design: compactness and

branching factors; sequencing, clustering, and emphasis; support for universal access; good graphical design; and navigation support. The first is compactness and branching factors. These refer to page length and number of links, respectively. As web pages grow and get more complex, the number of layers of index pages grows. Hence, an index is not appropriate. The solution is a higher branching factor. Good examples of web page design include Yahoo home page ([www.yahoo.com](http://www.yahoo.com)), which displays links in a compact two-column format.

The second element is sequencing, clustering, and emphasis. Internet users expect that the most important item to be placed at the beginning of a page, which reflects the proper sequence of objects based on spatial importance. Clustering refers to grouping relevant items together to show their relationships. For emphasis, large fonts, coloring, and drawing elements could be used to have certain items stand out.

Support for universal access is the third element. Different settings, such as resolution, color, refresh rate, bandwidth, and type of browser must be taken into account by web designers. That could be achieved by building two versions of web sites: text only and graphical. This would accommodate users of differing computers and bandwidth, especially in developing countries which may lack the sufficient telecommunications infrastructure.

The fourth element is good graphical design. Tufte (1997) has written several books on information presentation. Each design philosophy must take into account the purpose of the site, as well the users who will be visiting it. For example, Wired magazine's web site ([www.wired.com](http://www.wired.com)) attracts attention to certain topics by using multiple colors and multiple font sizes.

The last element is navigation support. Many sites have a site map, showing the different sites in a diagram. Others use Java to expand items into submenus when the mouse is placed on top of a specific item. As an example of an educational software, Compton's Encyclopedia uses various types of multimedia and many windows to give a rich and interactive experience of information presentation. Tractinsky and Meyer (1999) showed empirically that information presentation and display formats impact user preferences and decisions.

### ***Mental Models***

Ashcraft (1994) described a mental model as the domain knowledge or as "any body of information you have stored in memory about a situation, an event, a procedure, and so on can be termed a mental model in this sense" (p. 561). Other synonymous terms are a user's model or user's conceptual model. For example, when someone goes to a restaurant, they have a mental model about restaurants that may include the following: menus to select food, waiters to take orders, cooks to prepare

meals, etc. Ashcraft (1994) stated that experience and further changes made to that knowledge are the sources of mental models. Satzinger and Olfman (1998) stated that a user's mental model will affect how the user will use an application, based on the consistency of an interface. They defined a mental model as what the user knows about a particular application. Norman (1988) said the following regarding mental models:

The operation of any device--whether it be a can opener, a power generating plant, or a computer system--is learned more readily, and the problems are tracked down more accurately and easily, if the user has a good conceptual model... The designer must develop a conceptual model that is appropriate for the user, that captures the important parts of the operation of the device, and that is understandable by the user (p. 189).

### ***User's Learning Style***

Davis and Bostrom (1993) determined that learning style has an impact on how users learn and interact with the user interface. They discussed two types of learning according to Assimilation Theory: meaningful learning and rote learning (or memorization). Meaningful learning occurs when new knowledge is connected to existing information in a meaningful way to be applied to new situations and concepts. On the contrary, rote learning links old and new information in an arbitrary way, whereby memorization of new knowledge does not relate old and new knowledge in a new meaningful way. The learning style will affect how novice (versus expert) users learn and adapt to a new interface, and how they deal with its functionality.

Other learning theories, such as Kolb's learning style theory classify learning style into a four stage cycle across two modes: active experimenters (actives) and reflective observers (reflective). Kolb's cycle moves from concrete experience to reflective observation to formation of abstract concepts to testing hypotheses through active experimentation, resulting in four learning styles: diverger, assimilator, converger, and accommodator. Here there is a parallel to how novice and expert users differ: novices start with concrete concepts and progress to abstract ideas as they become experts.

Satzinger and Olfman (1998) concluded that interfaces should be consistent and that a distinct visual appearance would aid users at the early stages of learning new applications. Therefore, they linked how transfer of learning would enhance a user's ability to work with a new interface or an exiting interface with new additional features. Transfer of learning refers to having knowledge of one application transferred to another application. For example, learning Microsoft Word would make it easier to learn PowerPoint since they share a common "look and feel."

## ***Richness of the Media Used***

Multimedia plays an important role in the design of a web site since it adds interactivity. Eighmey (1997) determined that entertainment value is the main factor for a user's perception of a web site. He also stated that users will tend to favor sites that are exciting and interesting and would tend to visit them more often over poorly designed and uninteresting sites.

According to media richness theory (Daft and Lengel, 1986), the richer or more varied the medium of communication, the richer the capabilities of information. For example, using hypermedia (audio, video, and text) is an improvement over using just hypertext (plain text) to display information on a web site.

It is the designer's responsibility to balance the design trade-offs and priorities of the web site for optimum effect. For example, media richness of the site would be costly to add all the various multimedia and 3D effects so that customers could "experience a product" on-line by rotating it and viewing from different angles. However, a company like Black & Decker may not see cost as a priority as much as advertising its product line very well.

Palmer and Griffith (1998) support the use of rich media with web sites that provide information intensive products and services. Information intensive products and services include those provided by such companies like insurance firms, which require the firm and in turn its web site to provide as much information as possible to assist the consumer in making a purchase decision. This allows customers to almost "test the products" on-line. For example, web sites like Microsoft's Carpoint ([www.carpoin.msn.com/gallery](http://www.carpoin.msn.com/gallery)), a site that sells cars on-line, and Sharperimage.com utilize 3-D graphics and animation so that consumers could "experience" products by viewing them from different angles and rotate them. Capabilities such as zooming in and out also allow customers to view the products from the inside, getting a closer look, such as purchasing a house on-line, using a company and its web site like bamboo.com.

## **Conclusions**

Customers who visit web sites do not get the same shopping experience as those who visit the retail store physically. In order to make up for this disparity, a web site must have a well-designed interface so that consumers can experience the products and services on-line.

This paper explored user interface on the web and richness of the media used, in terms of the literature. A user's mental model would affect an on-line experience, as well as how knowledgeable the user is about the application or the domain of knowledge. How a user learns an application and interacts with the interface will also have an affect. Richness of the media of a web site

would be an important factor that interface designers must take into account in developing a web site, since attracting new customers and keeping existing ones is the goal of a good commercial site.

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