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From Novices to Experts: User Performance, Confidence, and Satisfaction on the World Wide Web

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Abstract

This study focuses on two aspects of research findings from empirical studies on usability of user interfaces on the World Wide Web (WWW): (1) it examines the differences among users from novices to experts and their interactions with various user interfaces on the World Wide Web and (2) it compares task performance, confidence, and satisfaction among different types of user interface designs on the Web-based systems. Can we design user interfaces that are equally effective for all the subjects who have different levels of computer expertise? Implications of these results for various interfaces are discussed as well.

Introduction

In the past years the global hypertext information network of the World Wide Web (Berners-Lee et al. 1994) has seen exponential growth and become the de facto standard for internet based information systems (Larson 1996). User interface is an essential element of computer systems. Many aspects of its use are not well understood. Understanding the potential, the design, and the application of user interface requires an understanding of several diverse fields; these include human factors, graphic design, cognitive science, and so forth.

Every user is the first time user (or new user) when they begin using computer systems. How quickly they become familiar with the systems, and reach the point where they are using the features of user interface elements and manipulating the systems productively, depends on their knowledge of computing, how closely the interface resembles something they are already familiar with and how easy the interface is to be use.

Since a majority of web activities involves the “browsing and searching” activity and disorientation problem may occur while searching for information, especially in the systems that offer no navigational cues, users who are in difficulty are likely to visit more nodes as they seek to locate relevant information. Therefore, users easily get lost in the information space, thus showing a sign of the user having a poor sense of the database's structure. Consequently, it may discourage exploration, and usage. In order to help users navigate the “Web”, user interface designer should assist them understand and recognize their present location in the entire structure, possibly eliminating a large amount of unnecessary traffic on the Internet.

Experts and Novices

As mentioned by Marchionini 1995, electronic systems have affected the actions that expert and novice users take while seeking information. Users differ, their styles differ, their cognitive needs differ, so the way they access, process, and reuse information varies (Hinrichs and Morris 1996). Because of less knowledge of the domain, novices seem to discern the situation by utilizing a ‘bottom up’ strategy. Experts on the other hand appear to use a mixture of ‘bottom-up’ and ‘top-down’ strategies. Both experts and novices browse the text to elicit terms for keywording while navigating the Web. Frequently, experts seemed to manipulate searching tasks efficiently, although their rules may vary widely among individuals.

According to Hoffman et al 1996, a majority of web activities involves the searching task. We need to design a Web that can provide users with a way of seeing where they are with respect to the entire web structure (Hinrichs and Morris 1996). The author proposes a context path to let the user see the associations that provides navigational cues and hierarchical data structures, and backtracking to the previous locations.

A context path is a user interface element that is composed of a series of textual buttons. It contains a directional path of direction which the user controls. It can be a facility to backtrack, enabling the user to return to a stage of the browse reached previously (analogous to leaving a bookmark in a printed text). The backtracking facility is one of the most important navigation facilities, especially for novice users (Nielsen 1990). Users frequently depend on backtracking to save them when they are in any kind of trouble. A context path can take users back to the general locations in the hypertext where they visited previously. As reported by Pitkow and Kehoe 1997, the most frequency of strategies that users use when browsing the Web involves bookmark which is over 80% of the cases. In addition, backtracking facilities need to be simple and consistent, so that users can always rely on them as a lifeline to get out of trouble (Nielsen 1990). The idea underlying user interface element is to enhance user performance (speed and accuracy), confidence, and satisfaction in browsing the WWW, and reducing navigation effort while alleviating and reducing cognitive overload.

Experimental Design

Different types of user interface elements were evaluated using four measures of effectiveness as dependent variables: speed, accuracy, confidence, and satisfaction between traditional plain hypertext and four different types of user interface techniques -- (1) an index, (2) an imagemap, (3) an index with a context path, and (4) an imagemap with a context path – on the Web-based systems. The two-phase study involved fifty first-year students at The Washington University.

During phrase one, students completed the background survey to identify the current level of computer expertise from (1) beginner, (2) advanced beginner, (3) intermediate, (4) advanced, and (5) expert. Current level of computer expertise can be measured through a background survey that was administered in the phase one portion of the experiment. General information about the subjects was collected from the background survey during the first phase of the study. This information included education, gender, age, and computer experience data.

The dependent variable data were collected using an experimental design with students randomly assigned to each type of user interface and to each set of task during the second phrase of the study. Analysis of variance was utilized to analyze user performance, attitude, and satisfaction.

Results: Effect on User Performance, Confidence, and Satisfaction

As shown in Figure 1 and 2, the result of this study was supported at both 0.05 and 0.1 level in the effect of user interface elements on user performance at different levels of computer expertise. The F-ratio of speed is 9.79 with a p-value of 0.000; reject the null hypothesis, and conclude that there was significant evidence of difference among different levels of computer expertise.

Source	DF	SS	MS	F	P
Speed	4	41.87	10.47	9.79	0.000 *
Accuracy	4	0.0428	0.011	1.09	0.372
Confidence	4	1.419	0.355	1.86	0.133
Satisfaction	4	1.178	0.294	1.71	0.164

* = Significant at the 0.05 level

Figure 1. Analysis of Variance—Level of Computer Expertise

Source	DF	SS	MS	F	P
Speed	4	33.27	8.32	2.66	0.033 *
Accuracy	4	0.74	0.18	3.11	0.016 *
Confidence	4	0.75	0.19	0.46	0.765
Satisfaction	4	1.71	0.43	1.18	0.320

* = Significant at the 0.05 level

Figure 2. Analysis of Variance—User Interface

Experts who have been using computers and have domain information in their knowledge base on the WWW performed significantly faster at completing a series of tasks than novices who primarily have less knowledge and usage of computers as illustrated in Figures 3 and 4.

Furthermore, the study showed that user performance in completing the tasks was faster and more accurate for the user interface with navigational cues (a context path) – Interfaces 4 and 5. As shown in Figure 2, the F-ratio of speed and accuracy is 2.66 and 3.11 with a p-value of 0.033 and 0.016, respectively; reject the null hypothesis, and conclude that there was statistically significant difference in user performance among different user interfaces.

Level	N	Mean	Std. Dev.
Beginner	7	7.350	0.768
Advanced Beginner	11	5.233	0.783
Intermediate	15	5.741	1.206
Advanced	11	5.199	1.154
Expert	6	3.905	0.976

Figure 3. Mean and Standard Deviation of Dependent Variable—Speed

As shown in Figure 3, the means of subjects' time (minutes) to complete tasks when using five different types of user interface techniques --(1) traditional plain hypertext, (2) an index, (3) an imagemap, (4) an index with a context path, and (5) an imagemap with a context path -- among the subjects with different levels of computer expertise were in comparison. The study indicates that the higher the level of computer expertise the average task time tends to be faster. Specifically, the number in average task time between novice and expert accounts for almost 50% (47%) in reduction of completion time.

While there were no significant task accuracy differences, there was a tendency in the increment of mean number of correct answers from novices to experts throughout the experiment as shown in Figure

5. Upon analysis, there were no statistically significant differences in confidence and satisfaction. The majority of users were found to be more satisfied and confident with the user interface which includes a context path, albeit less for experts.

Finally, the results of the study indicate that navigation through the “Web” is improved when it provides a holistic representation of the screen content, a directional cue, and a facility to backtrack, thus avoiding disorientation and discouragement in exploration and usage.

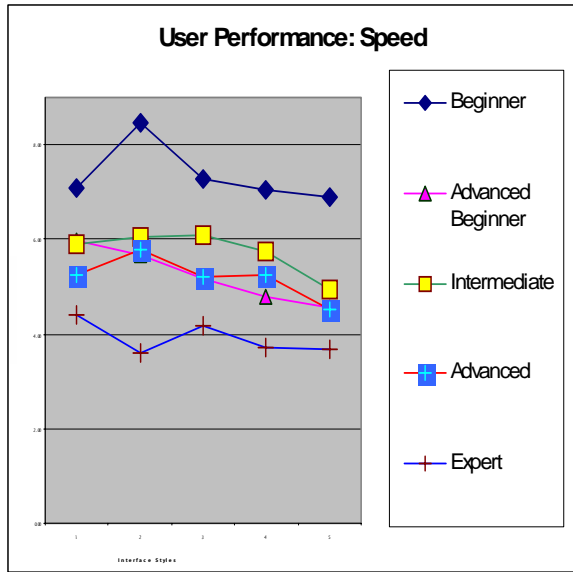


Figure 4. The Effect of User Interface Design and Level of Computer Expertise on Average Task Time

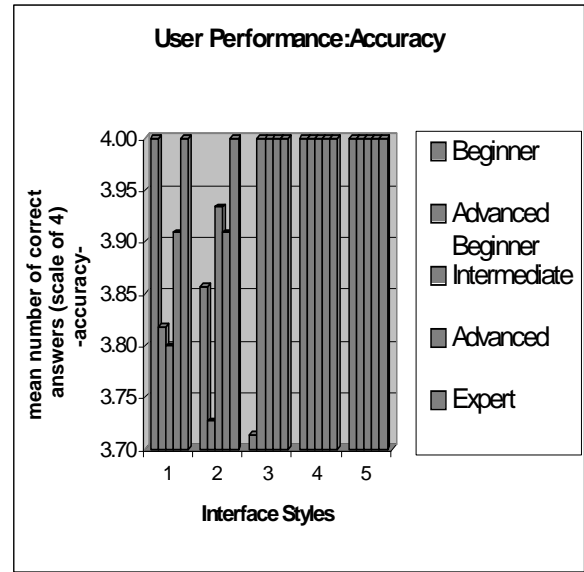


Figure 5. The Effect of User Interface Design and Level of Computer Expertise on Average Number of Correct Answers

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