

# Individual Differences in Web-Based Learning

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## INTRODUCTION

As the Web becomes as an important means to disseminate information, a growing number of education settings are developing Web-based learning (WBL). Unlike traditional computer-based instructional programs, WBL systems are used by a diverse population of learners, in terms of their background, skills, and needs (Chen & Macredie, 2004). Therefore, individual differences are becoming an important consideration. In the past decade, many studies have found that individual differences have significant effects on WBL. In particular, gender differences (e.g., Roy & Chi, 2003), prior knowledge (e.g., Calisir & Gurel, 2003), to cognitive styles (e.g., Chen & Macredie, 2004) are the most critical individual differences elements. In this vein, this article will present a comprehensive review on their influences on Web-based learning. The reader of this article is expected to get an overview of the state of the art research associated with these individual differences elements.

## GENDER DIFFERENCES

The literature in the computing field has examined gender differences since the early 1980s (Young, 2000) and has recognized gender as an important variable that influences computing skills. In general, males report lower levels of computer anxiety than their female counterparts. In addition, it also seems that males achieved much better outcome than females (Karavidas, Lim, & Katsikas, 2004). As the WBL has become more popular, a growing body of research has been conducted to examine gender differences in the use of the WBL. Research suggests that gender differences have significant effects on students learning on the Web.

Roy and Chi (2003) examined student's navigation styles. Fourteen eighth grade students, with equal numbers of boys and girls, participated in the study. A searching task was assessed through target-specific

prompts and target-related questions. Searching behavior was measured by using field notes along with computer logs of all the Web pages accessed by students during their search. Their findings indicate that boys tended to perform more page jumps per minute, which indicates that boys navigate in the information space in a nonlinear way. The findings relatively concur with that of Large, Beheshti, and Rahman (2002), who examined gender differences in Web navigation. Fifty-three students, comprising 30 females and 23 males from two sixth grade classes, were the subjects of the study. The results revealed that males were using different strategies to retrieve information from the Web than females. Males preferred a broader search strategy than females. In addition, male group was more actively engaged in browsing than the female group, and the male group explored more hypertext links per minute. They also found that the males tended to perform more page jumps per minute, entered more searches at search engines, and gathered and saved information more often than the females while males spent less time viewing pages than females. Other similar results were found by McDonald and Spencer (1998a) and Felix (2001). The former examined gender differences in Web navigation. The results indicated that males express a greater degree of confidence to nonlinear navigation than females. The latter investigated potential of the Web as a medium of language instruction and found that female users have higher demands from human tutors.

In addition to navigation patterns, gender differences also influence the preferences of screen design. Chrysostomou, Chen, and Liu (2006) examined the influences of human factors with 80 students. They found that males preferred a screen with fewer colors while females favored a screen with numerous colors. A possible explanation for this may be that females tend to experience more difficulty when interacting with computers compared to males, so they prefer the use of several colors as a means of maintaining their interest in the task at hand. This potentially implies that females might prefer a screen that incorporates a pleasant visual display by using attractive graphics or

the use of several complementary colors. These results are in agreement with those of Miller and Arnold (2000), who investigated how gender differences influenced the design of Web pages. They report that females favor the use of pretty images, such as flowers, contrasting with macho technical images, such as a computer favored by males. These different preferences might be caused by their life styles, in which females prefer aesthetics while males tend to be more practical.

These research findings suggest that gender is a major predictor of learning preferences in WBL. In terms of navigation patterns, males prefer broader searching than females. Furthermore, males have higher confidence and interest in nonlinear navigation than females. In respects of screen design, females like that the screen includes numerous color whereas males prefer that fewer colors are used. These imply that males and females might need different levels of navigation support and different types of interface design. As suggested by Ford, Miller and Moss (2001), gender is a relatively fixed variable, thus it requires adaptability from the system perspective, suggesting that it is important that user interfaces of WBL should be developed to support adaptation to gender.

## **PRIOR KNOWLEDGE**

In the past decade, a growing body of research has examined the influence of prior knowledge in WBL. Such research has suggested that different levels of prior knowledge suited to different types of content structure (Calisir & Gurel, 2003) and different navigation tools (McDonald & Stevenson, 1998b).

In terms of content structure, of which interactions with learners' prior knowledge have been examined by a number of previous studies, the findings suggest that experts and novices differ in their performance depending on content structure in WBL. McDonald and Stevenson (1998a) examined the effect of content structure and prior knowledge on navigation performance. Three types of content structure—hierarchical, nonlinear, and mixed (hierarchical structure with cross referential links)—were investigated using 30 university students as the sample. The results show that the performance of knowledgeable participants was better than that of nonknowledgeable participants, as they had a better conception of the subject matter than non-knowledgeable participants did. The results also show

that nonknowledgeable participants performed better in both browsing and navigating in the mixed structure condition than in the nonlinear structure condition.

In a similar vein, Calisir and Gurel (2003) also investigated the interaction of three types of content structure—linear, hierarchical, and mixed (hierarchical structure with cross referential links)—with prior knowledge of the learners. In contrast to the study by McDonald and Stevenson (1998a), they examined the influence of text structure and prior knowledge on learning performance (reading comprehension, browsing, and perceived control) rather than on navigation performance. The authors' analysis of the findings suggests that a hierarchical content structure is most appropriate for nonknowledgeable subjects, probably because this structure provides a clear insight into the organizational framework of the subject content.

In summary, these findings show that experts and novices differ in their performance depending on content structure and that it is necessary to take learners' prior knowledge into consideration when designing effective content structure for WBL. Experts profit most from a learning system that provides flexible paths, whereas novices seem to benefit more from a learning system that is more structured. This may be explained by the fact that expert learners have acquired a great deal of content knowledge so they are more able to impose structure on the content. On the other hand, novice learners lack the domain knowledge; they prefer content structures that may compensate for their lack of a conceptual structure of the domain. Hierarchical structure is considered as being most appropriate for novice learners (Calisir & Gurel, 2003) as it presents a conceptual structure of the material that helps them to structure the text.

In respect of navigation tools, most of WBL systems today provide various navigation tools to allow learners to use multiple approaches for their learning. Hierarchical maps and alphabetical indices are most commonly used in WBL and each of them provides different functions for information access. For example, hierarchal maps provide a view of the global structure of the context, while alphabetical indices are useful for locating specific information (Chen & Macredie, 2002). Therefore, navigation is a critical design issue in WBL because it influences how students can develop their learning strategies.

Regarding the relationships between learning strategies and navigation tools, students' prior knowledge is

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