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Development of design criteria and evaluation scale for web-based learning platforms

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ABSTRACT

Standardized and objective design criteria for evaluating web-based learning platforms can effectively distinguish the quality of a platform and, therefore, contribute in improving web-based learning outcomes. This is a two-phase study, in which Delphi technique and heuristic evaluation were employed in the first phase to develop the evaluation criteria and scale of web-based learning platforms; in the second phase, questionnaire survey, real online evaluation, and experts' analyses were used to analyze the reliability and validity of the developed scale. Contributions of this study include (1) providing an example of developing evaluation criteria for web-based learning platforms via a standardized procedure; (2) developing a reliable and valid scale for evaluating web-based learning platforms; and (3) establishing a basis for guiding and evaluating the design of a web-based learning platform, as well as enhancing the quality and development of a web-based learning environment.

Relevance to industry: This study provides objective criteria for designing a web-based learning platform. It also provides an evaluation scale using a standardized development procedure. The results of this study could contribute to enhancing the quality of a web-based learning environment.

1. Introduction

As the Internet continues to expand and develop, e-learning offers a completely new teaching mode. This new mode has become the new standard and norm in the circle (Allen and Allen, 2002; Horton, 2000). Therefore, the entire technological structure of digital learning requires a good learning platform to establish a complete digital learning environment (Roberts and McInnerney, 2006). Effective design criteria can help users to evaluate and improve the quality and development of the web environment (Keith, 2003; Waterhouse and Rogers, 2004); a standardized procedure contributes to the development of such criteria (Industrial Development Bureau, Ministry of Economic Affairs, 2004). Many studies have proposed the design criteria for web-based learning platforms (Hsu and Cheng, 2005; IST, 2003; Ou, 2000; Sarapuu and Adojaan, 1998). These criteria, however, were not developed based on a strong theoretical basis of learning or a holistic approach in which multiple criteria are considered; moreover, the development procedures of these criteria were not clearly described. This study, therefore, attempts to propose effective design criteria for web-based learning platforms and develop an evaluation scale for web-based learning platforms via an elaborative and standardized procedure.

2. Principles of designing a web-based learning platform

2.1. Integrating learning and instructional theories

A good web-based environment design should consider learning theories and methods (Chen and You, 2001). The theory of Constructivist Learning Environment emphasizes that the learning environment should provide related cases, information resources, cognitive tools, communication tools, and scaffolding which help students acquire an integrated set of cognitive skills (Jonassen, 1999; Yazici et al., 2001). Meanwhile, the meaningful learning theory builds on constructivist learning theory and stresses that learning is active, situated, goal approaching, and issue-centered (Barab and Duffy, 2000; Jonassen, 2002; Peck et al., 1999). Furthermore, the theory of Computer Supported Collaborative Learning (CSCL) aims at providing both an authentic environment and rich resources to solve the problem of limited human working memory, which is critical for improving learning outcomes. It has also been suggested that integrating instructional theory for proof and practical application is the most important factor for successful web-learning management (Hong, 1999). Finally, anchored

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instruction emphasizes the importance of acquiring knowledge from a real scenario or discussion and encourages the sharing of real-world experience, which is in line with the goals of web-based learning.

Therefore, theory-based design criteria and evaluation scales for web-based learning platforms should enhance meaningful learning, integration of cognitive skills, effective web-learning management, and sharing of real-world experience. These elements are, therefore, integrated into the criteria and scale developed in this study.

2.2. Considering multiple criteria

Many researchers (Becta, 2005; Bostrom et al., 1990; Khan, 1997; McGreal, 1998; Rasmussen and Davidson-Shivers, 1998; Swisher, 1994; Wang, 2000; Wu, 2000; Yu, 2002) have identified that web-based learning construction and design should consider multiple criteria, including curricula, learning styles, interactive design, and multimedia application. For example, Tung (2003) declared that course content, student participation, learning interactivity, and technical support influence web-learning outcomes. In the same vein, Khan and Vega (1997) claimed that course objective(s), course interactivity, and content quality are the three most important evaluation criteria for web-course effectiveness. Moreover, it was pointed out that course content must be appropriate, organizational, and facilitative to material application in learning environment planning (Yue, 2003).

Standardization is also an important criteria that must be considered. A standardized e-learning model can provide learners abundant integrated resources to communicate and share with others. For instance, the Sharable Content Object Reference Model (SCORM), an international and universal e-learning model, provides standardized materials for communication across learning platforms and, therefore, fosters reusable learning content in a sharable framework (Lin, 2004). Keith (2003) also pointed out that different distance learning systems should establish an exchange mechanism to use a common format for packaging, sharing, and browsing so that online learning resources could be reusable, accessible, durable, interoperable, adaptable, and affordable. To make e-learning materials usable in different countries, Zeng et al. (2003) created the Teaching Materials Markup Language (TMML), in which international course standard and local material features were employed. Moreover, the materials could be easily repackaged, exchanged, and reused.

With regard to course design, Waterhouse and Rogers (2004) addressed nine categories of course policy to give the instructor and students a clear understanding of a smooth-running course of e-learning. The main categories include student perusal of course information via e-mails, student grade and privacy protection, e-mail response rules, instructor participation in student discussions, and accessible instructional software.

Therefore, multiple criteria derived from a holistic perspective, especially the viewpoint of a standardized web-based learning model, must be considered when designing a web-based learning platform. Such criteria not only improve web-based learning quality and facilitate the sharing of instruction resources, but also enhance course usefulness and increase new technology acceptability.

2.3. Purposes of this study

The main purposes of this study were (1) to propose objective design criteria for web-based learning platforms from a holistic perspective; and (2) to develop a reliable and valid scale for evaluating web-based learning platforms based on the developed design criteria via a standardized procedure. In addition, via careful evolving process, this study attempted to set up an example on how to develop valuable design criteria, and an effective tool for evaluating web-based learning platforms.

3. Method

3.1. Research design

This is a two-phase study and both qualitative and quantitative methods were employed. Specifically, the first phase used the Delphi technique and the heuristic evaluation method to develop the design criteria and their corresponding indicators for web-based learning platforms. The second phase, based on the results of phase 1, employed a questionnaire survey, real online evaluation, and experts' analyses to develop an evaluation scale for web-based learning platforms as well as to examine its reliability and validity.

The Delphi technique obtains forecasts from an independent expert panel over two or more rounds. Normally, an administrator provides an anonymous summary of the experts' forecasts and their reasons for them after each round. The process stops when experts' forecasts change slightly between rounds, and final round forecasts are combined by averaging (Rowe and Wright, 1999, 2001). The Delphi technique keeps individual responses anonymous so that social influences are minimized (Huang, 1987, 2003; Wang, 1998). On the other hand, in the heuristic evaluation method, experts individually examine, evaluate, and communicate their opinions, which are combined to form a design decision or complete the design evaluation (Nielsen, 1993).

3.2. Procedures and participants

3.2.1. Phase 1

The researchers first collected test items from relevant questionnaires to collect design criteria. Then, the researchers purposely sampled qualified experts from university websites in Taiwan to conduct the Delphi technique. Based on professions and academic publications, 10 information management, design, and education scholars were selected. All of them possessed Ph.D. degrees and had rich experiences in instructional website construction or Internet instruction. Sufficient information about the study was provided when inquiring on willingness to participate, and a gift was given when the survey was finished. Meanwhile, the revised data were communicated via anonymous mails and, finally, these data were integrated to represent experts' viewpoints. The Delphi technique round lasted for 1 month and it took 5 months to compile the data into initial design indicators.

Then, this study used the heuristic evaluation method to refine the initial design indicators with regard to their appropriateness and distribution. Two professors specialized in developing distance instruction and two senior practical engineers specialized in designing web-based learning platforms were purposely sampled and each of them was paid US$ 50. Finally, the results were developed into the Evaluation Criteria for Web-based Learning Platform (EC-WLP). The EC-WLP was a five-point Likert scale with ratings ranging from "not very important" to "very important".

3.2.2. Phase 2

In phase 2, five college students were asked to provide suggestions to revise the EC-WLP. Then, a questionnaire survey was conducted to examine the internal-consistency reliability and construct validity of the EC-WLP via Cronbach's α analysis and factor analysis. One hundred and fifty-eight college students were randomly selected from two universities in the middle and south of Taiwan.

After the reliability and validity were confirmed, a real online evaluation of three learning websites was conducted via the