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Critical functionalities of a successful e-learning system — An analysis from instructors' cognitive structure toward system usage

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ABSTRACT

While an overwhelming majority of information systems research on e-learning has focused analyses mainly on the student level, this paper provides a fresh complimentary perspective from that of the instructors in understanding what critical functionalities of an e-learning system instructors will deem useful such that they will continue using the system. This research applies the means–end chain methodology to analyze the relation between instructors' personal values and the functionalities of the e-learning system. This research finds that the most critical functional requirements of the e-learning system for instructors can be categorized to two dimensions — instruction presentation and student learning management. The instruction presentation requirement includes e-syllabus and electronic whiteboard, while student learning management requirement are fulfilled by online forum, online roll call, threaded discussions, and assignment management. This research discovers that instructors develop sense of accomplishment, self-fulfillment, and fun and enjoyment of life through using the e-learning system with the aforementioned functionalities, which motivate them to continue using the system for instruction. Our research findings provide practical implications for the design and implementation of successful e-learning systems.

1. Introduction

The rapid development of Internet and information technologies has heralded new modes of instruction and learning with e-learning as the prime example, and generated new opportunities for the delivery of education in this information age. Earlier work in the e-learning area focused on presenting detailed descriptions of the architecture of the system per se. Siemer and Angelides [33] are among the first to propose a comprehensive method for the internal and external evaluation of an intelligent tutoring system to provide suggestions on the overall improvement of the architecture and behavior of the system. Xu and Wang [39] develop a personalization model for virtual learning environments and a prototype system to demonstrate the implementation of dynamic e-learning processes. They further conduct a field experiment to compare the performance of the virtual learning environment with personalization versus that of a non-personalized one. Developing and empirically testing an analytical framework grounded on economic theory, Ozdemir et al. [26] identify the important institutional and student characteristics that affect the adoption of technology-mediated learning.

As e-learning systems become more readily available, many instructors started their trials of using e-learning system in their teaching. Their willingness to try the e-learning system, however, does not guarantee that they will continue to use the system. Prior studies show that information system users' continued usage of the system is determined by their perceived usefulness of the system. The studies in [5,30] indicate that a major factor for the continued usage of the system is the perceived usefulness formed through the actual usage experience. Thus, the design of an information system should take into account those functionalities useful to its users. However, what functionalities of the system are useful to the users are not actualized until they actually use the system.

How to perform requirement analysis phase in the system development life cycle efficiently and effectively has been a long standing research issue in information systems research.[1] There are three main approaches described in prior literature to analyze the functional requirements of an information system in general and an e-learning system in particular. The first approach uses the traditional systems analysis and design methodology to identify instructors' requirements that will fulfill their instructional goals. For example, Govindasamy [10] favors this approach and believes that the instructor has five major requirements for an e-learning system

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[1] For example, using "requirement analysis" as the exact phrase to search Google Scholar results in 12,300 research articles as of December 2008.

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including developing content, storing and managing content, packaging content, student support, and assessment. The second approach employs pedagogies as the basis of requirements to develop an e-learning environment suitable for instruction. For instance, Mishra [23] believes that constructivism is the most suitable theory for e-learning system design, and develops an integrated framework to transform learning theories to basic instructional approach and online approach. Further, Ainsworth and Fleming [1] analyze several different pedagogies and develop authoring tools that allow instructors to create learning environments by customizing imported computer-based training domain content according to their views of how materials should be delivered. The third approach applies problem-oriented approach to identify requirements. The first step in this approach is to list the problems that will be encountered in the teaching and learning process. Then, the system is designed according to the solutions to those problems identified [3,9,20,25].

Since requirements analysis as an early phase of the systems development life cycle cannot account for users' usage experience ex ante, the e-learning system more often than not doesn't meet instructors' real needs for teaching, irrespective of which requirements analysis approach described above is adopted [21]. Absent real usage experience, Govindasamy [10] finds that the e-learning system with most functionalities will be selected for development although many of those functionalities or tools may not be used at all, resulting in a waste of development effort. A worse case ensues when some functionalities are not easy to use, creating instructional difficulty and increasing the cognitive burden of the instructors. These unexpected negative effects that are difficult to foresee during the design phase have significant impact on instructors' perceived value of the system and hamper their willingness to continue to use the e-learning system.

This research applies the means–end chain analysis method to examine instructors' cognitive structure toward e-learning system usage, and identifies critical requirements of successful e-learning systems by uncovering the relationship between the functionalities of an e-learning system and the instructors' perceived values derived from those functionalities. The means–end chain theory can show the relationship among the attributes of an object under consideration (namely, the functionalities of an e-learning system in this research), the consequences of using the object by an individual, and the personal values derived from these consequences. The means–end chain (MEC) method per se is a decision analysis methodology with wide range of applications in both decision analysis and decision support systems. For example, to investigate how marketing strategy decision making evolves within a new environment of technological advances, global competition, and re-alignment of organizational processes, Jarratt and Fayed [15] apply the MEC technique to probe the respondent for their strategy development experience and how they incorporate organizational and market challenges in the strategy decision process. The MEC theory provides the theoretical underpinnings that accounts for the differences in consumers purchase decision making with and without DSS support and with and without the availability of physical products for inspection [38]. Montibeller et al. [24] propose a reasoning map tool for multi-criteria decision aid with an aim to provide an integrated approach to problem structuring and evaluation where the MEC captures a decision maker's reasoning in the problem structuring phase. Grenci [11] applies the MEC in the decision abstraction phase that transforms customer needs to product specification in an online customer decision support system that configures or defines complex and customizable products on an individual basis. Lin, et al. [19] adopt an expanded MEC theory to develop a logic deduction procedure for creating a more effective marketing decision support system.

The rest of this paper is structured as follows. Section 2 reviews the means–end chain theory used in this research to elicit the critical functionalities of a successful e-learning system for instructors. In Section 3, we describe the subjects participating in our study, the method of data collection, and the analysis methodology used to derive the hierarchical value map that depicts the relationship between the functionalities of an e-learning system and the instructors' perceived values derived from those functionalities. The main research findings and discussions drawn from the research results are presented in Section 4. Section 5 provides concluding remarks and practical implications of our research.

2. Means–end chain theory

The means–end chain model constructs a hierarchical value map (HVM) to systematically obtain information about individuals' perception of an object under consideration by analyzing the relation between the attributes of the object and consequences and values accrued to individuals [13,16,32]. An example of the HVM is shown in Fig. 1. The means–end chain model categorizes the perception and requirements of individuals toward the object under consideration to provide a concrete basis for relevant decision making.

The attributes of an object in Fig. 1 refer to its physical observable characteristics as well as abstract feelings derived from the object. In the context of e-learning system, attributes are those functionalities provided by the system, e.g., discussion forum and electronic whiteboard. The consequences in Fig. 1 are defined as any result accruing to the individuals after experiencing the object, including functional consequences and psychosocial consequences [13,27]. Functional consequences are the benefits of experiencing the object. For instance, using multimedia instruction can attract students' attention and make the instruction process more efficient. Psychosocial consequences for individuals can be psychological or sociological in nature. For example, using suitable e-learning software can take care of the learners' individual differences, thereby ensuring the learning rights of learners. Values, including instrumental values and terminal values, refer to the psychological needs of individuals accomplishing important goals through the object [31]. The instrumental value reflects an external orientation relating to how we are perceived by others (e.g., “makes me feel more important” or “makes me feel accepted”), whereas the terminal value is concerned with the desirable end-states of existence (e.g., happiness, security, and accomplishment).

The analysis methodology of means–end chain model has been improved by many scholars after its inception. The laddering technique [28] is the most recent and frequently used analysis methodology to uncover the attributes–consequences–values hierarchy. Through in-depth one-on-one interviews, laddering technique

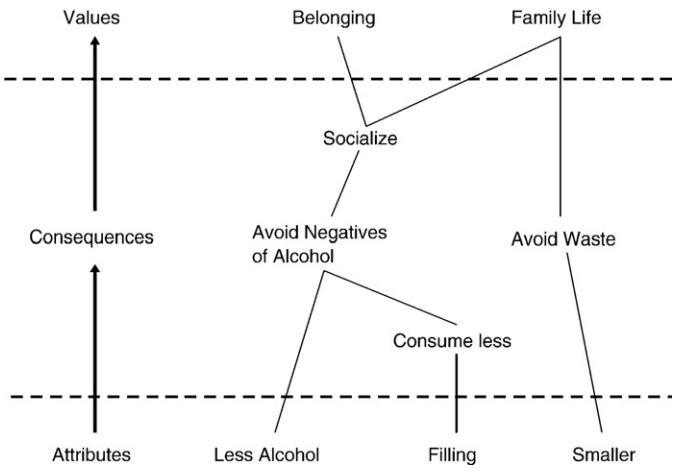

Fig. 1. Hierarchical value map (HVM) of wine cooler category [28].