

**IDENTIFYING THE CRITICAL FUNCTIONALITIES OF eLEARNING SYSTEMS:  
RELATIONSHIPS BETWEEN TEACHERS PERSONAL VALUES AND eLEARNING  
SYSTEM FUNCTIONALITIES**

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**ABSTRACT**

*This paper summarises the findings of a research project which applied the means-end chain methodology to analyse the relationship between the personal values of teachers and eLearning system functionalities. While eLearning is being promoted for implementation in learning and teaching settings, there is a lack of understanding of the critical functionalities of eLearning systems which teachers perceive are useful so that there is a likelihood that teachers will continue using eLearning systems. This paper reports that the most critical functionalities of an eLearning system for teachers can be categorized in terms of two dimensions – instruction presentation and student learning management. The instruction presentation dimension requirements include eSyllabus and electronic whiteboard, while the student learning management dimension requirements include online discussions, online roll call, threaded discussions, and assignment management. Therefore, this research indicates that where these critical functionalities are met, then teachers are more likely to develop a sense of accomplishment, self-fulfilment, fun and enjoyment, which will motivate them to continue using eLearning systems for teaching and learning.*

**THE IMPORTANCE OF CRITICAL FUNCTIONALITIES OF eLEARNING SYSTEMS**

While eLearning is being promoted for implementation in learning and teaching settings, there is a lack of understanding of the critical functionalities of eLearning systems which teachers perceive are useful. This assertion starts from the premise that if teachers perceive functionalities of an eLearning system to be useful, then there is a likelihood that teachers will continue using eLearning systems. This paper provides a summary of research undertaken to identify where these critical functionalities are met and reports that the most critical functionalities of an eLearning system for teachers can be categorized in terms of two dimensions – instruction presentation and student learning management.

Due to the improved connectivity in schools, eLearning is being adopted in many schools and education systems, resulting in teachers and their students engaging in eLearning environments. While this is relatively new areas for research, eLearning studies have already identified that usage of an eLearning system is determined largely by the users' perceived usefulness of the system. Subsequently, the architecture and design of an eLearning system should be informed by the usefulness of the functionalities as perceived by its users. The challenge is that identifying the critical functionalities usually cannot be identified until after users engage and actually use the eLearning system. Studies (Chiu et al., 2005) suggest that a major factor for the continued usage of the system is the perceived usefulness formed through the actual usage experience.

Evident in the relevant literature, three main approaches have been adopted to identify the critical functionalities of an eLearning system; namely

1. **Traditional systems analysis and design methodology** to identify and design instructor's requirements that will fulfill the instructional goals. For example,

- Govindasamy (2002) favors this approach and believes that the instructor has five major requirements for an eLearning system including developing content, storing and managing content, packaging content, student support, and assessment;
2. **Pedagogies** as the basis of requirements to develop an eLearning environment suitable for instruction. For example, Mishra (2002) believes that constructivism is the most suitable theory for eLearning system design, suggesting an integrated framework to transform learning theories to basic instructional approach and online approach. In addition, Ainsworth and Fleming (2006), from an analysis of different pedagogies, develop authoring tools that allow teachers to create learning environments by customizing imported computer-based training domain content; and
  3. **Problem-oriented approach** to identify requirements. This approach undertakes a process to list the problems that will be encountered in the teaching and learning process, which then informs systems design according to the solutions to those problems identified (Chou, 2003).

Difficulties occur as a result of analyses of requirements cannot precede users' usage experience. As Major (1995) indicates, irrespective of which approach listed above is adopted, the eLearning system often doesn't meet teachers' needs. Without evidence of the analysis of real usage experience, Govindasamy (2002) indicates that the eLearning system adopted is often the system with the most functionalities, with many of those functionalities not used at all, and incurring unnecessary costs. Moreover, some functionalities might be provided which are not easy to use, creating instructional difficulty and increasing the cognitive burden of the teachers. These unexpected negative effects that are difficult to foresee during the design phase have significant impact on teachers' perceived value of the system and diminish their willingness to continue to use the eLearning system.

## **MEANS-END CHAIN THEORY**

In contrast to those approaches, means-end chain theory can show the relationship among the attributes of an object, the consequences of using the object by an individual, and the personal values derived from these consequences. The means-end chain analysis has been successfully applied in product development and marketing (Wansink, 2003), and more recently in information systems development and user requirements gathering for web communities (Aschmoneit & Heitmann, 2003). For the purposes of this research, means-end chain analysis is applied with the objectives of examining teachers' cognitive structure toward eLearning system usage, and illuminates the relationship between teachers' perceived values of the functionalities of an eLearning system. This informs the identification of the critical functionalities of eLearning systems.

Due to limitations of the length of this paper, a summary is presented of the means-end chain theory used in research to elicit the critical functionalities of a successful eLearning system for instructors, and an overview of the research methodology. Subsequently, key findings and discussion drawn from the analysis is presented, and practical implications are provided.

The means-end chain model constructs a hierarchical value map (HVM) to systematically obtain information about individuals' perception of an object under consideration by analysing the attributes of the object with consequences and values accrued to individuals (Gutman, 1982). The means-end chain model enables the categorisation of the attributes, consequences, and values. In the context of eLearning systems, attributes are functionalities provided by the system. Consequences are defined as any result accruing to the individuals after experiencing the object, including functional consequences and psychosocial consequences (Gutman, 1982). Functional consequences are the benefits of experiencing the object, while psychosocial consequences for individuals can be psychological or sociological in nature. For example, suitable eLearning software, in catering for the individual differences of learners, 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. 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).

## RESEARCH METHOD

To identify critical functional requirements of successful eLearning systems by understanding the cognitive structure toward system usage and values of using the eLearning system of those teachers who have used such systems, we researched thirty-one teachers from southern Taiwan who have used eLearning systems in teaching, and who agreed to participate in our study. Table 1 shows the background of the teachers in this study. Details about the interview were emailed to the participants prior to the conduct of face-to-face, telephone, Skype, or MSN interviews, chosen on the basis of convenience for the interviewees.

**Table 1: Background of the Teachers (N=31)**

Characteristics	Information
Age	Mean = 36 years old; Range = 25-54 years old
Gender	Male = 64% Female = 36%
Years of teaching	Mean = 9.4 years
Frequency of offering online courses	Once = 16% 2-3 times = 55% 4 or more times = 29%

### **Method of Data Collection**

A ladder in laddering, a common analysis methodology of means-end chain to collect and analyse data, represents a linkage between the key perceptual elements across the range of attributes, consequences, and values of the interviewee. The subject might not form a ladder or might form many ladders. Laddering can be classified into soft laddering and hard laddering (Hofstede et al., 1998). Using one-to-one in-depth interviews, soft laddering explores the hidden values of the subject in order to find the factors affecting those values. Hard laddering relies on large samples from questionnaires, and performs validity analysis using statistical methods. Soft laddering was selected in this study, since we sought to gain in-depth understanding of the values and perceptions of teachers who have used various functionalities of eLearning systems. To enable sufficient linkages, the collection of data from thirty-one teachers exceeded the required twenty respondents reported in the study of Reynolds et al. (2001). On average, five ladders were generated for each participant. With three elements in each ladder, this generated 465 data points, which also exceeding the required number of samples to generate useful linkages. The limitation of this approach is that skilful in-depth interview techniques were a very time-consuming process, with the average interview time, excluding the preamble, taking from forty to sixty minutes for each educator.

The interview agenda of this study was to ask the teachers to:

1. compare the traditional teaching environment and online learning environment, and describe which functionalities of the eLearning system are useful;
2. why such functionalities are useful for instruction; and
3. explain why such consequences are of value to them.

### **Summary of Content Analysis and Findings – The Critical Functionalities**

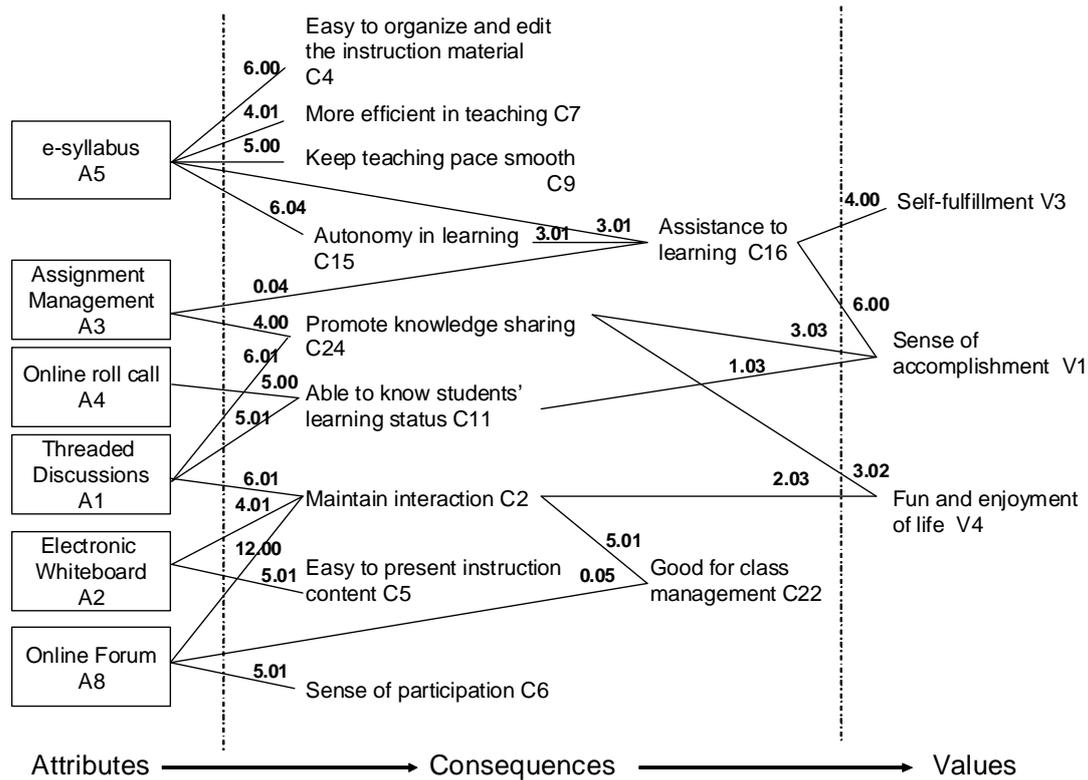
The data collected from the interview were coded and categorised independently by six teachers who have experience of using eLearning systems to produce the summary content code table of attributes, consequences, and values, as displayed in Table 2. The coders were unable to communicate with each other during the coding process. Disagreements on coding were resolved after consultation with area experts.

**Table 2: Content Codes Summary**

Values					
V1	sense of accomplishment	V4	fun and enjoyment of life	V7	sense of security
V2	self-respect)	v5	active learning	v8	sense of belonging
V3	self-fulfillment	V6	self-growth		
Consequences					
C1	useful	C9	keep the teaching pace smooth	C17	more engaged in learning
C2	maintain interaction	C10	more effective teaching	C18	enrich teaching
C3	more accessible for both student and teacher	C11	able to know students' learning status	C19	Assistance to assessment
C4	easy to organize and edit instructional material	C12	easy to communicate	C20	increase the fluency of teaching
C5	easy to present instructional content	C13	More alternative learning methods	C21	foster the inspiration of teaching
C6	sense of participation	C14	learning flexibility	C22	good for student learning management
C7	more efficient for teaching	C15	autonomy in learning	C23	digital instruction material
C8	save time in preparing instruction material	C16	Assistance to learning	C24	promote information sharing
Attributes					
A1	threaded discussions	A6	ftp	A11	online assessment
A2	electronic whiteboard	A7	web template for instruction material	A12	bbs
A3	assignment management	A8	online forum	A13	online questionnaire
A4	online roll call	A9	online messenger	A14	Email
A5	e-syllabus	A10	video-recording tool for instruction		

As displayed in Table 2, the attributes in this study refer to functional elements of the eLearning system including the functionalities, tools, and user interfaces of the system, while consequences are the benefits for teachers' instruction and students' learning afforded by engaging in the eLearning system, and values are the personalised beliefs for teachers derived from the consequences. Fleiss Kappa's inter-coder reliability measure was used to verify the coding reliability. The K value computed was 0.714, implying that the coding of our study was within the range of trusted reliability (Fleiss, 1981).

In the second step of content analysis, we constructed a summary implication matrix that recorded the number of direct and indirect linkages between attributes and consequences, between consequences and consequences, between attributes and values, and between consequences and values. In the third step of content analysis, we converted the summary implication matrices to a hierarchical value map (HVM) with special attention paid to the five types of relations and cutoff levels described in Reynolds et al. (2001). We adopted a cutoff of four relations to construct the HVM, to comply with the methodological advice provided by Grunert, Beckmann and Sørensen (2001) who indicate that the cutoff level should be at least three when the number of samples is between thirty and sixty. In constructing the HVM from summary implication matrices, we started from those relations in the A-C matrix that exceeded the pre-determined cutoff level, then moved to C-C matrix, and finally the C-V matrix. For example, starting from A1 attribute, the first entry meeting the cutoff level of 4 was (6.01) linking to C2, which lead us to examine the C2 row where the (5.01) entry linked to C22. Repeating these steps produced the HVM shown in Figure 1, which displays six critical functionalities of eLearning systems (i.e. attributes), eleven consequences, and three values.



**Figure 1: The Hierarchical Value Map (HVM)**

Therefore, the six critical functionalities of the eLearning system shown in the HVM (Figure 1) were e-syllabus, electronic whiteboard, threaded discussions, assignment management, online forum, and online roll call. The e-syllabus and electronic whiteboard functionalities of the eLearning system can be categorised further as *instructional presentation*, while the threaded discussions, assignment management, online forum, and online roll call can be viewed as those for *student learning management*.

### ***Instructional Presentation***

The electronic whiteboard functionality helps teachers illustrate the content of their instruction. For instance, the electronic whiteboard can show the detailed process of solving a mathematics problem and record the associated discussions more clearly and conveniently than the traditional teaching environment. This functionality helps both the teachers in teaching and students in reviewing the materials afterwards. In addition, teachers believe that the electronic whiteboard helps the interactions between the teacher and students since students are more willing to ask questions on the electronic whiteboard, and users who are slow typists find it a good communication medium. The interactions via electronic whiteboard make the teaching experience fun and interesting, hence providing the linkage with “the fun and enjoyment of life value”. In an asynchronous learning environment, teaching materials such as text and multimedia video are posted on the web to interact with learners. Some functionalities of the system are designed to make navigating the materials more structured and efficient. For instance, e-syllabus with hyperlink features enables the learners to quickly locate the content they wish to explore. With the e-syllabus functionality of the eLearning system, teachers can organise and revise teaching materials promptly. Other functionalities of the eLearning system such as threaded discussions and student management can be linked with the e-syllabus to make it more convenient for the teachers. From the students’ perspective, the e-syllabus functionality allows the students to learn in their preferred way. Ultimately, the e-syllabus functionality results in the value of fulfillment for teachers.

### **Student Learning Management**

The management of students' learning has two components – ensuring the students' concentration and participation during class, and ongoing monitoring of students' learning results. The online roll call and online forum functionalities can help teachers monitor students' concentration and participation in online courses. Whether students concentrate and participate in the eLearning system has an effect on the quality of instruction. For example, students may browse other web sites and are distracted from learning during class, negatively impacting upon the desired learning outcomes. To ensure that students are engaged is an important consideration in eLearning. This research indicated that online roll call, having five direct linkages to keeping track of students' learning situation (C11), is a functionality needed for effective eLearning by keeping track of students' attendance and reminding students' to be on task. Online roll call is hence a critical functionality for a successful eLearning system.

Many teachers in our research consistently reported that the online forum functionality can bring about students' interest in discussion. Those students who initially are reluctant or unwilling to contribute become more involved and active, increasing their sense of participation in eLearning. Although some respondents stated that the depth of discussions is limited by the time constraint, online forums facilitates interactions among students and bridges the transactional distance between the teacher and students, indirectly improving the management of students' learning.

Assignment management and threaded discussions are two functionalities for ongoing monitoring of students' learning results. Through the delivery of assignments and due date management, the assignment management functionality makes students more focused and efficient in learning, and helps instructors in assessing students' learning and identifying students needing further assistance. Although the linkage between assignment management and students' learning is indirect as shown in HVM, instructors believe that assignment management helps students' learning through the delivery of assignments and discussions. The assignment management functionality makes the distribution of knowledge far more efficient than in a traditional classroom, thus, in our study, it was seen as a well regarded functionality by teachers.

### **Values Important for Continued eLearning System Usage**

In earlier research, Chiu et al. (2005) pointed out that an important factor influencing users' continued usage of an information system is the values accrued to users. However, prior studies have not clearly reported what values influence users' decision to keep on using an eLearning system. Our research found that sense of accomplishment, self-fulfillment, and fun and enjoyment of life are the values teachers derived from using the eLearning system. Elsewhere, Malmberg (2006) reported that the values of sense of accomplishment and self-fulfillment obtained from teaching are the internal motives that drive teachers to continue their professional growth and the pursuit of teaching profession. This is often overlooked as teachers become required to engage in eLearning environments. The value in Malmberg's research is that we are reminded that when teachers use a well designed eLearning system that gives them sense of accomplishment, self-fulfillment, and fun and enjoyment of life, their internal motives to continue using the eLearning system are strengthened. Hence, to ensure the continued usage of the system, system designers can use our research results to develop the functionalities that enhance teachers' values.

### **Conclusion**

A major contribution of this research has been to apply the means-end chain method to analyse teachers' cognitive structure towards eLearning systems usage in order to systematically identify their required critical functionalities. To help design a successful eLearning system, our study drew upon literature which identified the general factors that influence the usage of an eLearning system, such as usefulness, personal values, and motivation to use the system. Furthermore, this study demonstrated that the functionalities of an eLearning system needs to be simplified to meet the instructional environment required by teachers. That is, our research found that only six functionalities of an eLearning system form

effective means-end chains - electronic whiteboard, e-syllabus, online roll call, threaded discussions, assignment management, and online forum. In conclusion, we recommend that eLearning systems are designed to allow teachers to use these six functionalities in intuitive ways and that other, more advanced functionalities can be used by teachers and learners when needed. Such design will not only meet the requirements of different users but also make the design of user interface of system functionalities more likely to be effectively used for teaching and learning.

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