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A Value-Adding Process Using the Ontological Engineering Approach for an e-Learning System Design

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Abstract. This paper provides an input-process-output view to describe the process of e-Learning system design and uses the concept of operation management to construct a value chain of the e-Learning system design and to gain explicit knowledge, with ontological engineering approach, on creating a valuable process for e-Learning instructional design.

Keywords: Value-Adding, operations management, ontological engineering, e-Learning, system design

1. Introduction

People use different learning methodologies and skills to obtain knowledge and solve problems. Aware of their inadequate knowledge, they strive to learn in order to achieve different objectives. A common factor among learners is their expectation of a successful learning experience. A successful learning experience is one that is effective and adds value to a person. If the answers to the above mentioned questions are given, the goals of teaching may be achieved under a value-adding instructional design. Instructional scenarios appear not only in traditional classrooms but also in virtual e-Learning environments.

However, the shift from traditional learning to e-Learning is complex and poses problems (Chen & Lo, 2004a & 2004b). The traditional instructional design needs to transform into system design and further into instructional system design, thus extending the time required for and raising the cost of instructional preparation. Bourdeau & Bates (1996) thought the necessity of a long-term instructional planning was indicated.

Creating a value-adding instructional system design for an e-Learning system is necessary. Thus, the objectives of this paper are the following:

- Describe the problems involved in traditional learning and e-Learning by adopting a process-oriented and systemic method of analysis
- Draw a value-adding model for an instructional system design for e-learning
- View instructional system design as a domain knowledge and construct knowledge ontology of instructional system design
- Provide an ontological instructional system design process

Based on the four objectives, we refer to related works to understand the problems involved in traditional learning and e-Learning as described in Section 2. We use the concept of operation management to draw the value chain for an e-Learning system design as described in Section 3. The ontological engineering (OE) approach employed to build the knowledge ontology of instructional system design is described in Section 4. An ontological instructional system design process is presented in Section 5. Section 6 describes the conclusions on how to gain explicit knowledge, using the OE approach, on creating a valuable, e-Learning process for instruction design.

2. Problems Confronting the Traditional Learning and e-Learning Processes

The traditional learning process is different from the e-Learning process. Under the traditional learning process, which entails a face-to-face learning environment, the teacher provides implicit knowledge to students. Moreover, the teacher finds it easier to prepare for class because the class requires only a classroom, a blackboard, and textbooks, among other usual materials.

Learning, however, has shifted from being acquired in a classroom to being acquired in an e-Learning environment. The e-Learning process is complex both for the learner and the instructor. The major reason for this is that the e-Learning process—such as mobile learning, ubiquitous learning, and Web 2 learning from online blogs and Wiki—entails the use of constantly changing information technology.

However, traditional learning and e-Learning processes are confronted with the same problem, which is the creation of a value-adding process for instructors and learners. Since instructional system design is one of the critical success factors for the learning process (McPherson & Nunes, 2007), the e-Learning process becomes a failure if it cannot provide explicit knowledge more than traditional learning can. Therefore, designing or providing a value added e-Learning system with explicit knowledge becomes a challenge for instructional system design.

An instructional designer should use a process-oriented approach to understand the e-Learning process and to find related problems and value. Thus, the concept of operation management can be used effectively to aid in the beginning of the e-Learning system design process.

3. Operation management in e-Learning

The basic concepts in operation management are modeling of the input, process of the system, and output. Hanna & Newman (2001) thought traditional operation management is assumed to also create value-adding activities from input to the transformation process and then to the product-service bundle. Input includes raw materials, labor, capital, and information. Finch (2008) also thought business is shown to require a plan for creating value. Business not only has value transferred from suppliers (input) but also value created by producers or enhanced by suppliers. This means that in the process of production, value should be transferred from suppliers and should be created by the producer itself. According to Finch (2008) and Hanna & Newman (2001), the instructional design process such as online e-Learning system and development, can be viewed in different ways. In starting the instructional system design, the requirements and all learning processes from the view of learners should be considered before beginning the tasks of system design and development.

Figure 1 shows that the input process-output model of operation management can be completed to capture the whole learning process as domain knowledge in particular, and the learning process also becomes a value chain with an added value.

- Input: includes the system designer, instructor, students, Internet, software, hardware, and syllabus. The Internet, one of the input materials, can also fall under the online e-Learning system (Chen & Lo, 2004a & 2004b).
- Teaching or learning process: includes interaction, cooperation, and communication. Teaching for teachers and learning for users or learners (students) can find value transferred from input and created by students themselves through interactive, cooperative, and communicative processes.
- Output: includes concepts, skills, and knowledge. Through input and the teaching or learning process, students can have the concept of domain knowledge and through practice, acquire skills.
- Control: quality management. It is the first stage of input processing (teaching or learning materials). If a problem is encountered in the first stage, the usage of the e-Learning system and its results will be a failure.

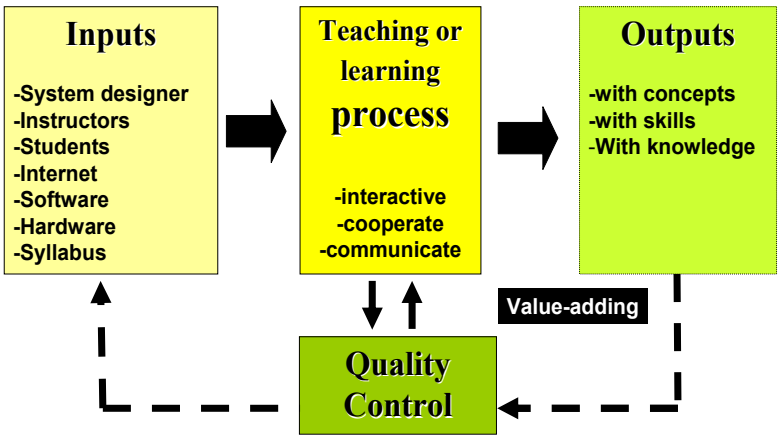

Figure 1. Input, process and output in teaching or learning operation management

When the process-oriented method of modeling is used for an e-Learning system, the e-Learning system of input, process, and output can be considered in detail. Therefore, according to the model of input-process-output, the succeeding task in designing e-Learning system, which uses the OE approach in building the ontology of the e-Learning system design, can be continually generated.

4. Ontological engineering approach

Asunción (2004) although ontology aims to capture consensual knowledge in a generic way, and it may be reused and shared across software applications and by groups of people, it is usually built cooperatively by different groups of people in different locations. Bourdeau & Bates (1996) an intrinsic link existed between instructional design (ID) and distance learning (DL). This is because typical instructional conditions also appear in distance learning, including instructional planning, cost analysis, curriculum and course development, and instructional materials for development and maintenance.

Mizoguchi & Bourdeau (2000) task ontology is thought to provide an effective methodology and vocabulary in both analyzing and synthesizing knowledge-based systems. Ontology devoted on research from an engineering point of view is called OE. In such study, the idea of a roadmap was provided, which was considered in determining how to communicate with human knowledge in an Intelligent Instructional System (IIS).

OE can be an effective methodology for building an intelligent instructional system. According to Bourdeau & Mizoguchi (2002) OE can be a collaborative process jointly conducted by an OE expert and an ID expert on a roadmap towards a theory-aware ITS (Intelligent Tutoring System) authoring system. Inaba & Mizoguchi (2004) the Learning Design Palette, which is a cost-effective and ontology-aware authoring system for learning design, is introduced. In the study, the Learning Design Palette based on international standards (such as Sharable Content Object Reference Model, called SCORM) was found to enhance the share capability and reusability of the learning design.

Ullrich (2004) the ontology of instructional objects that capture the educational “essence” of a learning resource and this “essence” from a teaching/learning perspective can be described. The ontology can be mapped onto several knowledge representations in today’s e-Learning system and can benefit educational Web services. Chin et al. (2007) an ontology-based knowledge organization framework for information technology is developed. Designing and developing an IT-related curriculum involve the use of the integrated approach for both ontological view of IT pedagogical knowledge hierarchy and ontological representation of a pedagogical system. Then there is mapping between competencies and the layered IT pedagogical knowledge organization.

The instructional design is very important either in traditional teaching or in distance learning (e-Learning). In particular, some studies progressed to using the OE approach as a means to improve the instructional design for an intelligent online e-Learning community system.

5. Ontological e-Learning system design process

The e-Learning environment normally is a well-known environment for interaction, cooperation, and communication among learners and Web site instructors (Chen & Lo, 2004a & 2004b). Instructional designers should consider more conditions than traditional instruction designers and e-Learning instructional designers. The study in Inaba et al. (2001) indicates that the instructional design process consists of analysis, design, development, implementation, and evaluation. Based on these five phases of the instructional design process, the system designer can convince their design fitted goal of instructional design.

However, the five phases of the instructional design process are not enough for the current e-Learning system design and are not considered as domain knowledge for design. Therefore, previous concepts on the learning process, operation management, and OE are integrated into the instructional system design process. The approach is an ontological, e-Learning system design process. This design process is shown in Figure 2. Each phase is explained as follows:

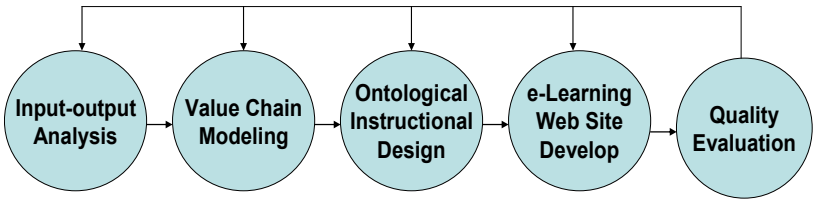

Figure 2. The ontological e-Learning system design process

Each phase explained in below:

- Input-output analysis: Section 2 presents a detailed description of the process-oriented, systemic analysis method, such as operation management, to understand the problems involved in e-Learning.
- Valve chain modeling: in section 3, method of operation management is used to draw a value-adding model for instructional system design of e-learning.
- Ontological instructional system design: The OE approach to the instructional system design process is considered. The instructional system design process is then viewed as domain knowledge and the construction of knowledge ontology of the instructional system design.
- e-Learning web site development: When the designer is done with phases 1 to, the instructional system design process can already be viewed as a domain knowledge. This ontology includes task-level ontology in the second level, such as the system designer, teacher, student, and teaching classroom, respectively. Each task also has domain-level ontology.
- Quality evaluation: This is the last phase. Section 3 pays attention to the core concept of value adding in all design processes. Learning is a valuable operation process, so the primary process or transfer of materials through system transfer becomes valuable as well. Therefore, the quality of each process or step should be controlled.

6. Conclusions

When an e-Learning system designer has to design an online e-Learning community system, he/she must consider not only systemic design and development but also the problems involved in the process. The system design process is based on the view of the designer. When the designer does not consider the requirements of users or learners, critical factors from users or learners (including perspective on domain knowledge) may be lost.

Therefore, the concepts of operation management and OE are used in this paper to discuss the problems involved in online e-Learning system design. Operation management concepts are employed to build the INPUT PROCESS-OUTPUT model before the online e-Learning system is designed, with due consideration of the creation of a suitable ontology. The task of this ontology should be considered as the domain knowledge of instructional system design.

Based on common ontology, the designer can provide related teaching materials for users or learners. Finally, the goal of building an online e-Learning system with OE in a computer educational environment can be achieved.

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