Using Ontological Engineering Approach for Engineering Education e-Learning System

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Abstract

In this paper uses the concept of ontological engineering to consider what tasks before building an engineering education e-Learning system. How to build complete contents before users or learners learning on the web site in network community are difficult for system designer. Because, before each teaching the knowledge uploaded to e-Learning system, managers or designers usually rare consider building a suitable ontology, thus even there was a beautiful web site of e-Learning system also can not obtain a good learning results on online e-Learning environment for learners. In this paper considers about the problem uses input-process-output concept into the phase of system design, and uses ontological engineering approach to build common domain knowledge before system design and development for the engineering education e-Learning system.

Introduction

Traditional teaching from classroom to virtual e-Learning environment existing complex relationships and problems, even traditional instructional design also needed broadly to extend and change into system design, and then becoming instructional system design, at the same time increasing the time and cost for instructional preparation. In [2] thought it was necessary a long-term instructional planning.

For creating a value-adding instructional system design for e-Learning system is necessary, therefore, the purposes of this paper are including as follows:

1) Problems description for learning method between traditional and e-Learning.
2) Drawing a value-adding model for design of e-Learning system.
3) Constructing framework of ontology in instructional system design.
4) Providing an ontological instructional system design process.

Therefore, based on four purposes after we refer to some related works then know what problems between traditional and e-Learning described in Section 2. A value-adding model of e-Learning for designing process described in Section 3. The ontological engineering approach employed to system design is described in Section 4. An ontological instructional system design process thus showed Section 5. Section 6 is our conclusions for explicit knowledge with ontological engineering approach on creating a valuable designing process for engineering education e-Learning thus are achieved.

Problems description for traditional and e-Learning - learning process

Traditional learning process is more different than current e-Learning process. Traditional learning process based on face-to-face learning environment, teacher provides their implicit knowledge to students, learning process for teacher is easier to prepare, may only classroom, blackboard and textbook are enough. Currently, traditional learning has shifted from classroom to e-Learning environment, the learning process is more complexities than traditional learning for learner or instructor, the major reason is the e-Learning process accompanies with information technology quickly growth then be changed, such as today's mobile learning, ubiquitous learning, and uses technique of Web 2.0 learning on on-line Blog and Wiki.

However, ether traditional or current e-Learning learning process was faced same problem which is how to create a value-adding learning process for instructor or learners. Because of instructional system design is one of critical success factors in learning process [11], if e-Learning can not provides explicit knowledge more than traditional

learning, the e-Learning process will be failed and unsuccessful. Therefore, how to design or provide a value-adding e-Learning system with explicit knowledge becomes a challenge for instructional system design. For solving above problem we thought instructional designer should use process-oriented approach to understand how to analyze e-Learning learning process and find the problems and value. Thus, the concept of operation management can effective assistance and could be used in the beginning of e-Learning system design process.

Operation management in e-Learning

The basic concept in operation management is modeling of input, process of system, output. In [8] they thought in traditional operation management also can create valued-adding activities from inputs to transformation process, and then to product-service bundle. In the inputs were including raw materials, labor, capital and information. In [7] thought business needed a plan for creating value. He thought business not only with value transferred from suppliers (inputs), but also with value created by producer or enhanced from suppliers, that means in process of production should be obtained value transferred from suppliers, and value created by producer (business themselves).

According to [7, 8] we know that is we can from different ways to view the instructional design process such as online e-Learning system design and development also like a input-process-output project, thus when starting the instructional system design should be considered the requirements and all learning processes from the view of learners to begin the tasks of system design and development. The input-process-output model of operation management can complete to capture whole learning process as an especially domain knowledge, the learning process also became a value chain with value-added.

Input: including system designer, instructor, students, Internet, software, hardware, and syllabus. We can find the Internet is one of input materials, also can to be online e-Learning system [4, 5]. And then the syllabus thus can to be the knowledge for students learning. However, in here rare studies focused on building ontology for domain knowledge in web-site contents.

Teaching or learning process: including interactive, cooperation, and communication. We can find the teaching for teachers, learning for users or learners (students), through the transferred processes of interactive, cooperative, and communicative, can thus value transferred from inputs, and also can value created by producer (students themselves).

Output: including concepts, skills, and knowledge. We can find if students through input and teaching or learning process, then students can thus have concept of domain knowledge, sometime also can through practices to capture the skills.

Control: that is quality management. We know that is the first stage of input to process (teaching or learning materials); if it has any problem in the first stage, the usage of e-Learning system will be failed in final results, because if the input is incorrect, and then output will be incorrect. Therefore, how to control each process with view of quality management became very important.

When we using process-oriented method modeling all things of designing e-Learning system, the e-Learning system of input, process, output can be considered in detailed. Therefore, we can thus according to the model of input-process-output continuously to generated next task of designing e-Learning system which is employed the ontological engineering approach building ontology of designing e-Learning system.

Ontological engineering approach

In [1] though ontology aims to capture consensual knowledge in a generic way, and that they may be reused and shared across software applications and by the groups of people, they are usually built cooperatively by different groups of people in different locations. In [2] they though an intrinsic link existed between instructional design (ID) and distance learning (DL), because typical instructional conditions also appeared to distance learning including instructional planning, cost analysis, curriculum and course development, instructional materials development and maintenance, delivery plans and detailed evaluation rules.

Based on the importance of instructional design learners on distance or online learning, we know how to provide a suitable instruction design for the online learning became a challenge. In [12] focused their studies on instructional design have been provided a direction for building an ontology-aware authoring system in past years. In [12] they

though task ontology provides us with an effective methodology and vocabulary for both analyzing and synthesizing knowledge-based systems and ontology devotes on research from an engineering point of view is called ontological engineering. In their investigation, they provided idea of a road map which was considered about system how to communicate with human knowledge in Intelligent Instructional System (IIS).

Except for ontological engineering (OE) can as an effective methodology for building intelligent instructional system, in [3] they also indicated ontological engineering can as 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. In [10] also introduced their Learning Design Palette which was a cost-effective and ontology-aware authoring system for learning design. In their study we have found the Learning Design Palette with some international standards (such like Sharable Content Object Reference Model, called SCORM) to enhance share ability and reusability of learning design.

In [13] described the ontology of instructional objects which captures the educational "essence" of a learning resource, and this "essence" from a teaching/learning perspective, and then the ontology can be mapped onto several knowledge representations in today e-Learning system, and also can benefit on educational web services. In [6] developed an ontology-based knowledge organization framework for information technology, they intended to design and development of IT-related curriculum, in their study also using integrated approach for both ontological view of IT pedagogical knowledge hierarchy and ontological representation of a pedagogical system, and then mapping between competencies and layered IT pedagogical knowledge organization.

An ontological e-Learning system design process

From above mentions we know that instructional design is very important ether on traditional teaching or on distance learning (e-Learning). In particular, some researches progress using ontological engineering approach to improve instructional design for intelligent online e-Learning community system. Usually, e-Learning is well-known using environment of web site for interactive, cooperative, communicative between learners and instructors [4, 5]. For instructional designer should consider more conditions than traditional instruction design than e-Learning instructional design. In [9] their study indicated that instructional design process consisted of analyze, design, develop, implement, and evaluate. Based on the five phases of instructional design process the system designer can convince their design fitted goal of instructional design. However, the five phases of instructional design process is not enough for current e-Learning system design and not considered as domain knowledge to design, therefore we integrated previous concepts of learning process, operation management and ontological engineering into instructional system design process, thus we called this approach is an ontological e-Learning system design process. Each phase explained in below:

1) Input-output analysis: in section 2 and 3 we have detailed describing process-oriented systemic analysis method such as operation management to understand the problems of e-Learning.
2) Valve chain modeling: in section 3 we have used method of operation management to draw a value-adding model for instructional system design of e-learning.
3) Ontological instructional system design: we considered ontological engineering approach into instructional system design process. Then viewed instructional system design process as a domain knowledge and constructing knowledge ontology of instructional system design. The detail reasons and related works we also have described in section 4. We thus according to the phase 1 and phase 2 then development the phase 3.
4) e-Learning web site develop: when designer has finished from phase 1 to phase 3 then can view instructional system design process as a domain knowledge. And this ontology including task-level ontology in second level such as system designer, teacher, student and teaching classroom respectively. Each task also has themselves domain-level ontology, for example, teacher's task is uploaded teaching material to e-Learning system (web site), therefore, teachers need to prepare their syllabus and curriculum, and then according to the curriculum to prepare contents of teaching subject.
5) Quality evaluation: the last phase is quality evaluation. In all designed process that can find our core concept in section 3 is value-adding. Because learning is valuable operation process, from a process-oriented view we can find primary process or materials through system transferring became valuable. Therefore, the quality in each process or step thus should be controlled.

Conclusions

When e-Learning system designer would like to design an online engineering education e-Learning community system not only needs to consider systemic design and development, but also needs to consider some problems before the design and development. Because we know the system design process was process-oriented from designer, sometime did not consider the requirements of users or learners, thus, they should be lost some critical factors from users or learners (including perspective on domain knowledge). Therefore, in this paper uses concepts of operation management and ontological engineering to view above problems. In this paper thus considering above problems for the online engineering education e-Learning system design, we use concepts of operation management to build the INPUT-PROCESS-OUTPUT model before the online e-Learning system designed, thinking about how to build a suitable ontology which task should be consideration as the domain knowledge of instructional system design. And then the designer can thus based on the common ontology to provide the related teaching materials for the users or learners. Finally, we can effectively achieve the goal of building online engineering education e-Learning system with ontological engineering in computer educational environment.

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