Using an ontological engineering approach and e-learning on instruction of a practical project - a case study of vocational education

Wei-Shuo Lo

Meiho University
Pingtung, Taiwan

ABSTRACT: Traditionally, teamwork is used as the instructional design for practical projects in business colleges, and students are asked to select a suitable teacher as an adviser. The teacher should be able to assist them in finding a good topic and guide them on using theoretical methodologies to complete their project. However, the traditional instruction method has created challenges for vocational education in Taiwan. These include difficulties in studying research methods, which cause students to feel pressure during the learning process, and difficulties in understanding the syllabi for solving practical problems. This article uses an ontological engineering approach to construct the knowledge ontology of learning subjects. Then, based on the knowledge ontology, it provides practical teaching content into an e-learning system, from which students can learn and practice in an e-learning environment through more structural knowledge and practical experiences. This is an actual case study on vocational education in Taiwan.

INTRODUCTION

The vocational education of Taiwan has an over 50-year history, in which vocational education is focused on practical training, teaching, and industrial internship or visiting. Therefore, practical experience is increasing among vocational students and in learning environments.

In Taiwan, vocational education exists in universities and high schools. Examples of the latter are the SHU TE Home Economics and Commercial High School and the SAN SIN High School of Commerce and Home Economics, which are famous high schools in Kaohsiung in Taiwan. They train students with practical skills and knowledge in vocational education; most students under training must obtain one or two certifications in technology before they graduate. After students graduate from high schools such as SHU TE and SAN SIN, they can choose to continue their vocational education. Therefore, students in Taiwan have many choices in terms of selecting a vocational or a non-vocational university.

Founded in 1966 with the approval of the Ministry of Education, Meiho Nursing Junior College is the first private nursing junior college in Taiwan. Over the past 44 years, Meiho has put its efforts into vocational education, and has provided many skillful students into different industries. These students have promoted industries across different economic levels, assisting in Taiwan's industry and creating economic miracles. Meiho also evolved from a nursing junior college into an institute of technology; on 1 August 2010, it became a university. Despite the change in name, the mission of vocational education in Meiho has not changed.

The Department of Public Finance is a department in the Business College at Meiho University. For over 19 years, the department has trained many vocational students in two- to five-year courses. It now has only four-year college students, especially, since department receive 52 students in a 2+2 joint program between Meiho and the Foreign Trade University of Vietnam in September 2010.

To enhance the problem-solving capacity of students, the department designed the practical project subject into a four-year program. The goal of the practical project is to train students to understand the importance of teamwork, and to use the knowledge and skills learned during their four years of study. Therefore, the practical project has become an important subject in business colleges, especially in the vocational education of Taiwan.

Traditionally, teamwork is used as an Instructional Design (ID) in practical projects, and students are asked to select a suitable teacher as an adviser. The teacher should be able to assist them in finding a good topic and guide them on how to use theoretical methodologies to complete their project.

Therefore, traditional instruction has led to challenges for vocational education in Taiwan. These include difficulties in studying research methods, which cause students to feel pressure during the learning process, and difficulties in understanding the syllabi for solving practical problems.

According to the aforementioned reasons, thorough instruction design is necessary for long-term planning. Therefore, this article proposes an ontological instruction for practical projects - a case study of vocational education. The objectives of this article are as follows:

- Use an Ontological Engineering (OE) approach to construct the knowledge ontology of learning subjects;
- Based on the knowledge ontology, provide practical teaching contents into an e-learning system;
- Use an e-learning environment in which students can learn and practice through more structural knowledge and practical experiences.

ONTOLOGICAL ENGINEERING APPROACH AND E-LEARNING

According to Asunción and others, ontology aims to capture consensual knowledge in a generic manner, that they may be reused and shared across software applications and by groups of people [1]. They are usually built cooperatively by different groups of people in different locations. Bourdeau and Bates suggest an intrinsic link exists between ID and Distance Learning (DL) because of typical instructional conditions also appear in DL, including instructional planning, cost analysis, curriculum and course development, instructional materials development and maintenance, delivery plans, and detailed evaluation rules [2].

Based on the importance of ID learners on distance or on-line learning, providing a suitable instruction design for on-line learning is a challenge. Ullrich focused his studies on ID, and provided direction on building an ontology-aware authoring system [3]. According to Ullrich, task ontology provides an effective methodology and vocabulary for analysing and synthesising knowledge-based systems; research on the subject from an engineering point of view is called OE [3]. In the investigation, the idea of a roadmap was provided, which considered how a system communicates with human knowledge in Intelligent Instructional Systems (IISs).

OE is an effective methodology for building IISs. Bourdeau and Mizoguchi indicated that OE can be used as a collaborative process jointly conducted by OE and ID experts on a roadmap toward a theory-aware Intelligent Tutoring System (ITS) authoring system [4]. Inaba and Mizoguchi also introduced a Learning Design Palette, which is a cost-effective and ontology-aware authoring system for learning design [5]. Their study proposed a Learning Design Palette with international standards (such as Sharable Content Object Reference Model, SCORM) to enhance the sharing ability and reusability of learning design. Mizoguchi and Bourdeau described the ontology of instructional objects, which capture the educational *essence* of a learning resource [6]. This *essence* is from a teaching/learning perspective, from which the ontology can be mapped onto several knowledge representations in today's e-learning system, which also benefits educational Web services.

Chin et al developed an ontology-based knowledge organisation framework for information technology (IT), intended to design and develop of IT-related curriculum [7]. Their study used an integrated approach for an ontological view of IT pedagogical knowledge hierarchy and an ontological representation of a pedagogical system, and then mapped between competencies and layered IT pedagogical knowledge organisation. Instructional system design is a critical success factor in the learning process [8]. If e-learning cannot provide explicit knowledge more than traditional learning, it is considered a failure. An on-line e-learning system includes inputs from a system designer, instructor, students, Internet, software, hardware, syllabus and so on [9][10].

Some progress has been made in using an OE approach to improve ID for intelligent on-line e-learning community systems. Inaba et al identified that the ID process consisted of analysis, design, development, implementation and evaluation [11]. Lo proposed five phases of the ID process into the e-learning system design, which are input-output analysis, valve chain modelling, ontological instructional system design, e-learning Web site development, and quality evaluation [12].

E-LEARNING WITH ONTOLOGICAL KNOWLEDGE - A CASE STUDY

To provide an ontological instruction for practical projects in vocational education, three phases to explain this applied case study according to the objectives of this research were proposed, as shown below.

Phase 1: Using an OE Approach to Construct the Knowledge Ontology of Learning Subject

In the first phase, the original format of the syllabus will be constructed into a format of knowledge ontology using the OE approach. In summer 2009, the Department of Public Finance began industry-university cooperation with the China Productivity Center (CPC). In the cooperating contract, CPC provided six industrial teachers on practical topics. The original format for the syllabus of industry-university cooperation is shown in Table 1. The Department constructed the knowledge ontology of a learning subject, which is a practical project.

Table 1: Original format of syllabus for the industry-university cooperation with CPC.

	Syllabus, Fall Semester 2009, Meiho Institute of Technology					
Course	Chinese	實務專題 2/2	English	Practical Project 2/2		
Class	Program	4-year program	required/elective	required	Instructors	Wei-Shuo Lo
	Department	Dep. of PF	Credits	2		
	Class Name	P-4A	Period	1 semester		
Course Abstract	The successful establishment of a store requires employees' in-depth understanding of the operation of the store and service skills. To reinforce the ability to run a store, the program includes basic-level training of management talents. Course content includes store operation, store management, product planning, sales skills and service attitude in an effort to establish the systematic, standardised operating mode of a successful store.					
Course Outline	*Physical curricula*: Happiness in the service begins in the mind (service-gap checking, customer physiology and service, creating advanced services, approach satisfactions on capturing critical services, and human relationship and workplace ethic); enhance customer services from A to A+ (technology and international services etiquette image, language and communication skills, appearance in clothing and skills, display and sound management of physical); How to create successful sales - practice of practice sales structure; Grasp the important operational data and intelligence systems. *Digital curricula*: Paramount to open services (right attitude and practicing concepts, product knowledge, commodity management); Retail sales of good dispensers (retail security management jobs, retail store operation of the business, retail business operating environment); Customers responded to the crisis (responded on sales and services, response on services and selling technology, consumer directions and customer physiology). *Project Practice*: presentation of service store practices.					
Class Activities	Physical and digital curricula (e-learning).					
Grading Standard	Part of Credits: homework 40%, midterm exam 30%, final exam 30%. Part of Certification: follow the requirements of the Certified Program for Junior Manager • Rate of attendance: at least 30%; • Rate of examination: at least 70% (examined scope includes physical and digital curricula).					
Required Text	Book	Author	Publisher	Volume	Year	Edition
	China Productivity Centre - Certified Program for Junior Managers					
References	Book	Author	Publisher	Volume	Year	Edition
	Project Practice					

Phase 2: Based on Knowledge Ontology, Provide Practical Teaching Contents for the E-Learning System

After constructing the knowledge ontology of the practical project, practical teaching content are provided for the e-learning system based on the knowledge ontology. According to Lo the learning or teaching is valuable by itself, from inputs to processes of interaction, cooperation and communication, which then can create valuable outputs [9]. Thus, the original segmented parts of learning and teaching can be integrated together.

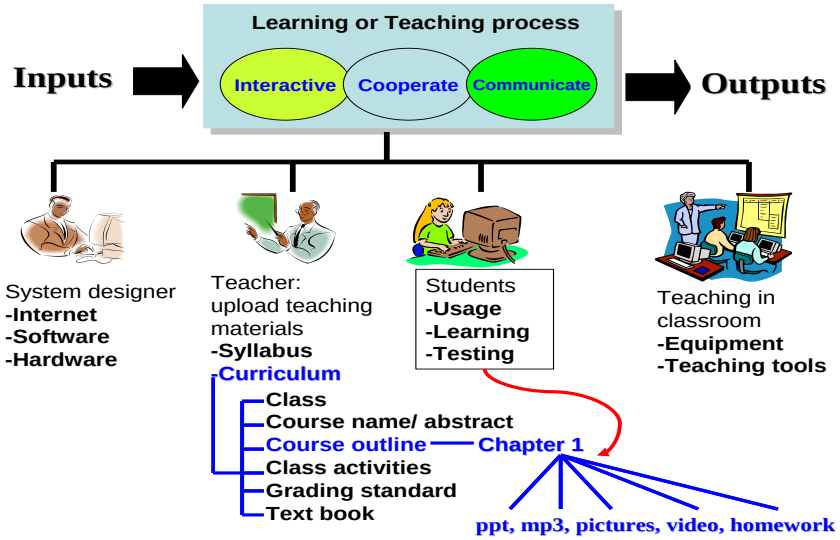

Figure 1: Knowledge ontology of practical project in e-learning and creating the relationship.

Figure 1 shows the knowledge ontology of practical projects, from e-learning and to the relationships created. The knowledge ontology of a practical project consists of a system designer, a teacher, students and classroom. The teacher uploads teaching materials such as the syllabus or curriculum; the latter provides relevant information on the class, course name or abstract (descriptions), course outlines, class activity, grading standard and textbooks. Industrial teachers provide their teaching materials according to each outline. For example, one chapter can include different teaching materials such as PowerPoint presentations, MP3s, pictures, videos, and homework. When teaching materials are completely uploaded, students can access the e-learning system to use, learn and test by themselves. Therefore, all related connections can be completely linked together and create a relationship with each other.

Phase 3: Students Learn and Practice in the E-Learning Environment through More Structural Knowledge and Practical Experiences

When all relationships are finished, students can easily use the e-learning environment to enhance their knowledge or improve on lacking practical experiences. The practical project subject used teaching materials uploaded to e-learning by industrial teachers. Then, students learn practical knowledge after face-to-face classroom teaching, increasing and enhancing practical knowledge by themselves. The proposed ontological e-learning environment also assists students in examinations on business certifications through more practices and testing of e-learning by students, which could decrease error rates and correct concepts, making them pass the certification.

CONCLUSIONS

The results of the case study show that the proposed three phases can be applied into vocational education. The traditional teaching method or material does not completely represent the instructions of practical projects. In this case, the research methods do not appear in the syllabus, and the redesigned curriculum added more practical teaching methods, such as industrial teachers providing practical experiences and teaching materials. The industry-university cooperation assisted students in passing their examinations on business certification.

This article proposed how to use an OE approach to construct the knowledge ontology of learning. Based on knowledge ontology, practical teaching contents are uploaded into an e-learning system. Students then learn and practice in an e-learning environment through more structural knowledge and practical experiences.

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