Internet-based E-learning Workflow Process

Jianming Yong

Department of information Systems
Faculty of Business
University of Southern Queensland
Toowoomba QLD 4350
AUSTRALIA
yongj@usq.edu.au

Abstract. More and more people are interested in Internet-based e-learning. Internet-based e-learning has become one very important arena of modern education system. This paper is based our Internet-based e-learning teaching experience which comes from one of the leading e-learning university, the University of Southern Queensland. The Internet-based e-learning system can effectively reach the expected achievement through a well-designed workflow mechanism. The whole e-learning environment is made of four sub-workflow systems, teaching, learning, administration and technology support. Through well-designed four sub-workflow systems, all key activities are identified from these sub-workflow systems. Through improving these key activities, the whole Internet-based e-learning process has got a significant improvement. The performance of learning and teaching through this new-designed e-learning workflow system has better satisfied all aspects of learning, teaching, administration and technology support.

1. Introduction

Internet-based e-learning has become one of most concerned paths for people to acquire their expected knowledge. More and more universities have been invested a huge amount of resources to implement their Internet-based e-learning platform or environment. Many developed countries have reserved a big proportion of education funding to support their Internet-based e-learning strategies to enhance the education exports. Under these circumstances, more and more researchers and industrial developers are much interested in Internet-based e-learning research and development. It is very important to design an efficient Internet-based e-learning platform for teaching, learning, research, and administration. This paper proposes a new method to design an efficient Internet-based e-learning platform by combining an Internet-based e-learning environment with the Internet-based workflow mechanism. Based on our teaching and implementation experience, we find this new method is more efficient and helpful than other methods and it enhances the efficiency of Internet-based e-learning from the perspective of teaching, learning and administration. This paper is organised as follows: In Section 2, learning and teaching environment is discussed; In Section 3, relevant workflow technologies are

introduced; In Section 4, some designing methods of Internet-based e-learning and their modellings are described for four separated sub-Internet-based e-learning systems; In Section 5, a new method of a combination of Internet-based e-learning design and Internet-based e-learning is proposed for overall Internet-based e-learning system; In Section 6, conclusions are drawn for this paper.

2. Teaching & Learning and Environment

Internet-based e-learning is seen as a future application worldwide as it promotes life long learning by enabling learners to learn anytime, anywhere and at the learner's pace [1]. It is necessary to understand the role changes for all participants from the traditional teaching classroom to online universal virtual teaching venues. Traditional teaching classrooms involve lecturers/instructors, students/learners, and supporting personnel for administration purpose. Internet-based e-learning classrooms have no meaning of traditional classrooms instead of various networked-computer platforms. All the activities are transacted by the universal network, usually the Internet. Likely the lecturers/instructors, students/learners, and administration personnel are needed to be involved. Because Internet-based e-learning environment is heavily relying on IT technology, experts/technicians of IT support are definitely needed to facilitate all processes of Internet-based e-learning.

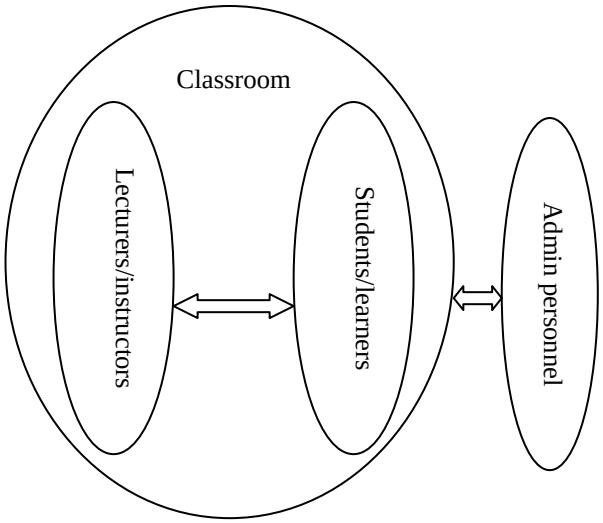

Fig. 1. Relationship between participants of traditional classrooms

Figure 1 shows the traditional relationships between lecturers/instructors, students/learners and admin personnel for traditional teaching classrooms. Figure 2 shows the relationships between lecturers/instructors, students/learners, admin personnel and technical experts in an Internet-based e-learning environment.

In Figure 1, lecturers/instructors go to the physical classrooms to delivery teaching contents to students and accept the students' questions during the teaching time. Students/learners also go to the classroom to attend the lectures or tutorials and at the same time ask questions if they feel puzzled. The admin personnel usually give reasonable support to the classrooms both for students/learners and for lecturers/instructors, such as student enrolment, assessment items reception and dispatch, etc.

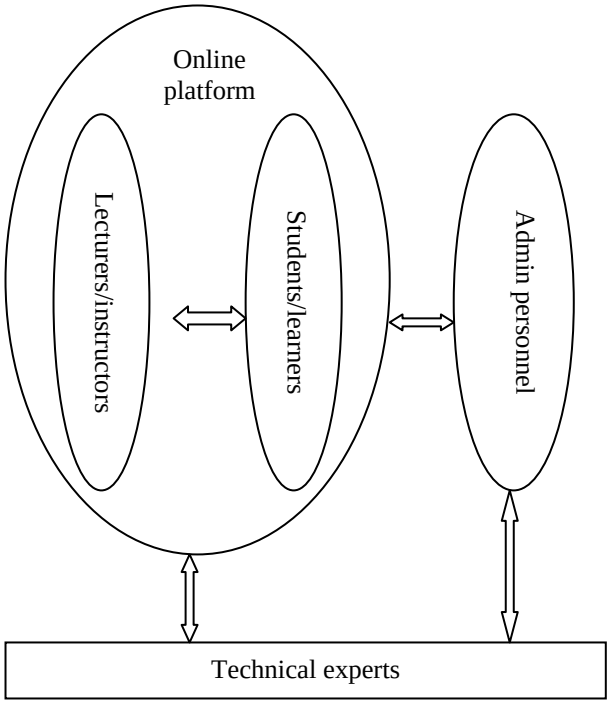

Fig. 2. Relationship between participants of e-learning environment

In Figure 2, the lecturers/instructors access a server computer to upload teaching materials, including lecture slides, tutorial questions and answers etc, according to pre-set teaching schedule instead of going to a physical classroom by a fixed time period. It is very flexible for the lecturers/instructors to upload the teaching contents upon their convenience. The students/learners also access that server computer to get the teaching contents and to involve online discussion board with their instructors and peers upon their own convenience. For the admin personnel, they need to act on administration roles of online matters via the online environment. In the Internet-based e-learning environment, the technical experts give the technical support by building an effective platform and a user-friendly running environment. The technical experts should supply their support to the lecturers/instructors, students/learners, administration personnel. Thus it is very important for the technical experts to design

a better Internet-based e-learning platform and environment so that the whole Internet-based e-learning procedures can be smoothly conducted and implemented. Some design rules/methods are introduced as follows. ASP model [2] classifies an Internet-based e-learning environment as the following tasks: application development, hosting, network access, marketing, customer support, user support, hardware delivery, and software delivery. To link these tasks, the following roles are defined as: customer, user, solution partner, software partner, infrastructure partner, network service partner, support partner, marketing partner, hardware vendor, and software vendor. MDA model [3] discusses how to use existing middleware and component platforms, like CORBA, DCOM, Java RMI, CCM, EJB, .NET, etc. Learner-centred model [1, 4] emphases on that the Internet-based e-learning environment design should more focus on the learners/students who are the main body of Internet-based e-learning. Context-based model [5, 6, 7] focuses on how to deliver better contents to students/learners via Internet-based e-learning design and how to facilitate the learning process, including learning needs analysis, curriculum design, curriculum delivery and curriculum evaluation. This design places the lecturers/instructors as the main body, because only lecturers/instructors can have the knowledge and authority to upload the contents.

These models are effective in certain aspects, such as ASP and MDA models that focus on technical platform design, which usually neglects the users' roles, context-based and learner-centred models more focus on either the students/learners or the lecturers/instructors. Actually an effective Internet-based e-learning design has to consider all roles of students/learners, lecturers/learners, admin personnel and technical experts. Because the learning process is very dynamic, the design of Internet-based e-learning environment has to be adjusted according to any changes from all participants during the procedure of Internet-based e-learning. In order to challenge the dynamic Internet-based e-learning, an effective Internet-based e-learning design methodology has to be found to support this requirement. In the latter sections, a workflow-based e-learning design method is proposed to meet this dynamic requirement for Internet-based e-learning.

3. Workflow Technology

Workflow [8-16] has been used in big organisations to control their business processes and work re-engineering. According to Workflow Management Coalition (WfMC), workflow focuses on handing business processes. It is concerned with the automation of procedures where information and tasks are passed between participants according to a defined set of rules to achieve, or contribute to, an overall business goal. It is often associated with business process re-engineering, which is concerned with the assessment, modeling, definition and subsequent operational implementation of the core business process of an organization (or other business entity). In order to implement an effective workflow system, WfMC has published its reference model of the workflow system. In April, 2000, Object Management Group (OMG) also published its workflow management facility specification in order to use

its CORBA and relevant technologies to implement workflow systems. For the Internet-based e-learning environment, workflow mechanism can be used to plan and to design the process of all aspects of Internet-based e-learning. There is a teaching workflow for the lecturers/instructors. There is a learning workflow for the students/learners. There is an admin workflow for the admin personnel. There is an infrastructure workflow for technical experts/technicians to support a user-friendly environment for all participants. All these four sub-workflows interact to each other to form an overall Internet-based e-learning workflow system to facilitate all the processes and actions of Internet-based e-learning. The following section will show the details of four sub-workflow systems and an overall view of Internet-based e-learning system.

4. Sub-Workflow Systems of Internet-based E-learning

It is a very convenient way to describe an Internet-based e-learning system based on its functions respectively. We define four main functions for Internet-based e-learning systems based on four participants, lecturers /instructors, students/learners, admin personnel, and technical experts/technicians. In this case the Internet-based e-learning system is sub-classified as teaching workflow system, learning workflow system, admin workflow system, and infrastructure workflow system.

Teaching Workflow System (T)

In this Internet-based e-learning environment, the main teaching activities include teaching plan (T1), material preparation (T2), material delivery (T3), assessment (T4), student involvement (T5), and student learning service and support (T6). The teaching workflow is demonstrated in Figure 3.

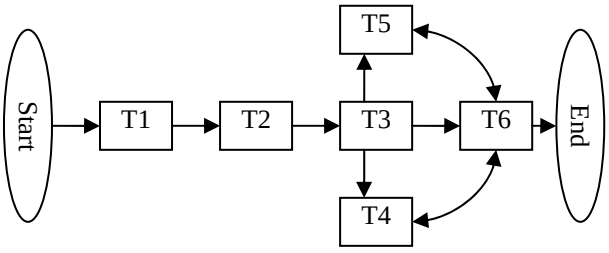

Fig. 3. Teaching workflow

Learning Workflow System (L)

In the Internet-based e-learning environment, the main learning activities are study plan (L1), acceptance of materials (L2), self-learning (L3), assignments (L4), discussion (L5), evaluation (L6), and examination (L7). The learning workflow is shown in Figure 4.

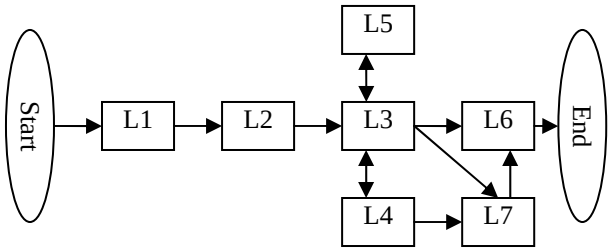

Fig. 4. Learning workflow

Admin Workflow System (A)

In the Internet-based e-learning environment, the main learning actives are teaching support (A1), learning support (A2), assessment result publication and notification (A3), student record management (A4), enrolment and withdraw management (A5), and other administration functions (A6). The admin workflow is shown in Figure 5.

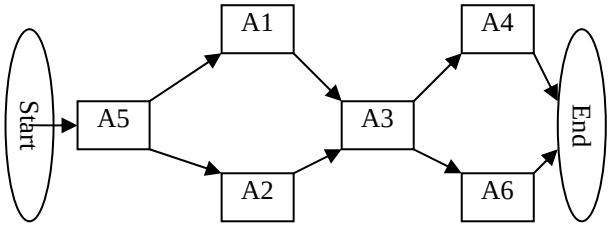

Fig. 5. Admin workflow

Infrastructure Workflow System (I)

In this Internet-based e-learning environment, the main activities of technical experts include Internet-based e-learning platform plan and design (I1), initial installation of Internet-based e-learning system (I2), supporting tools for teaching, learning and

administration (I3) , system maintenance and upgrade (I4), user training (I5), daily technical support to all users (I6). The infrastructure workflow is described in Figure 6.

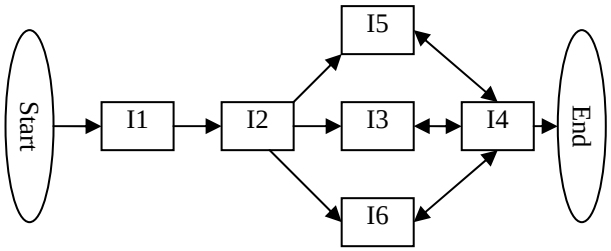

Fig. 6. Infrastructure workflow

5. Overall Internet-based E-learning Workflow

In the previous sections, four separate sub-workflow systems are discussed in details. Now we need to know how these sub-workflow systems to work together so that an effective overall workflow for Internet-based e-learning can be formed. It is important to identify a proper order for four sub-workflow systems to form an overall workflow of Internet-based e-learning. In order to decide the sequence of four sub-workflow systems, we must have a method to decide which sub-system should be run firstly and which one is the follow-up. We denote the overall Internet-based e-learning workflow as F. Thus F equals the transactions and connections of T, L, A and I. We denote this relationship as:

$$F=f(T, L, A, I) \quad (1)$$

Suppose four sub-workflow systems (T, L, A, I) can work well separately. In order to organise them into an overall workflow, the inter-relationship has to be identified. All possible co-relationships are T&L, T&A, T&I, L&A, L&I, and A&I. We denote the relationships and connections of T & L as F1; T & A as F2; T & I as F3; L & A as F4; L & I as F5; A & I as F6. Then we can have the following equations:

$$F1=f(T, L) \quad (2)$$

$$F2=f(T, A) \quad (3)$$

$$F3=f(T, I) \quad (4)$$

$$F4=f(L, A) \quad (5)$$

$$F5=f(L, I) \quad (6)$$

$$F6=(A, I) \quad (7)$$

Obviously we can have the following equation:

$$F=F1 \bigcup F2 \bigcup F3 \bigcup F4 \bigcup F5 \bigcup F6 \quad (8)$$

As shown in Fig.3, teaching workflow system consists of T1, T2, T3, T4, T5 and T6 tasks. Thus T sub-workflow can be expressed as T(T1, T2, T3, T4, T5, T6). In the same, L can be expressed as L(L1, L2, L3, L4, L5, L6, L7); A can be expressed as A(A1, A2, A3, A4, A5, A6); I can be expressed as I(I1, I2, I3, I4, I5, I6). These co-relationships will be addressed in details as the follows.

5.1 F1 Expression

As shown in equation (2), there are the following sub-relationships: F11=f(T1, L); F12=f(T2, L); F13=f(T3, L); F14=f(T4, L); F15=f(T5, L) and F16=(T6, L). Through a thorough mathematic modelling (For the space limitation the details are omitted here), T6 and L5 are identified as two most important tasks in the transaction between teaching and learning sub-workflow systems.

5.2 F2 Expression

As shown in equation (3), there are the following sub-relationships: F21=f(T1, A); F22=f(T2, A); F23=f(T3, A); F24=f(T4, A); F25=f(T5, A) and F26=f(T6, A). In the same way, T4 is identified as a key task in the transaction between T and A sub-workflow systems

5.3 F3 Expression

As shown in equation (4), there are sub-relationships: F31=f(T1, I); F32=f(T2, I); F33=f(T3, I); F34=f(T4, I); F35=f(T5, I) and F36=f(T6, I). We use the same method to identify a key task, I3, as the most important node in the transaction between T and I sub-workflow systems.

5.4 F4 Expression

As shown in equation (5), There are the following sub-relationships: F41=f(L1, A), F42=f(L2, A); F43=f(L3, A); F44=(L4, A); F45=f(L5, A); F46=f(L6, A) and F47=f(L7, A). Through the same process L4 and L7 are identified as two most important tasks in the transaction between L and A sub-workflow systems.

5.5 F5 Expression

As shown in equation (6), there are the sub relationships: F51=f(L1, A); F52=f(L2, A); F53=f(L3, A); F54=f(L4, A); F55=f(L5, A); F56=(L6, A) and F57=f(L7, A). Consequently I3 is identified as the most important task in the transaction between L and I sub-workflow systems.

5.6 F6 Expression

As shown in equation (7), there are the following sub-relationships: F61=f(A1, I); F62=f(A2, I); F63=f(A3, I); F64=f(A4, I); F65=f(A5, I) and F66=(A6, I). In the same way, I3 and I6 are sorted out as two most important tasks in the transaction between A and I sub-workflow systems.

6. Conclusions

This paper illustrates how Internet-based e-learning workflow system works for teaching, learning, administration and system development. In the Internet-based e-learning environment, four basic sub-workflow systems work together to present dynamic Internet-based e-learning activities. Through a detailed analysis of the co-relationship of four sub-workflow systems by a mathematic modelling, some key activities, T4, T6, L4, L5, L7, I3, and I6, are identified for Internet-based e-learning. Through the enhancement of these key activities in each sub-workflow system, the overall Internet-based e-learning workflow gets a better performance. We applied this in our e-learning practice. It is obvious that workflow-based Internet-based e-learning system can provide a better strategy and understanding for teaching, learning, administration and system development. We believe that Internet-based e-learning will become one of most important means for the future education, especially for the universities.

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