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Tutor Support Evaluation of Online Co-Learning System via Learning Action Analysis

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***Abstract*—Online co-learning system plays a great role in undergraduate education recent years. Efficient and timely tutor support makes the co-learning more efficient. This paper is intends to present a method to evaluate the quality of tutor support for an online co-learning system. The online co-learning system is briefly introduced and the definition of the evaluation criteria is demonstrated. The algorithm of the evaluation is presented in detail.**

***Index Terms*—collaborative learning system; quality of education; criteria of education quality**

I. INTRODUCTION

Networked education originally provided the instructional courses to the country areas, but it moves at a very fast pace these years. There were only six universities provided networked courses in 1999, including Peking University, Tsinghua University, Beijing Posts and Telecommunications University, Zhejiang University, Hunan University and the Central Radio and Television University. During the summer vacation of 2000, nine institutions of higher learning in Beijing, including People's University of China and the Beijing Foreign Studies University, and 16 institutions in Heilongjiang, Shandong and Shanghai also established network schools. In 2005, there were a total of 31 network universities approved by the Ministry of Education and most of them were key institutions of higher learning and famous universities.

Vice Minister of Education Zhao Qinping said in March 2008, that the main form of modern distance education was networked education. Networked education would become the preferred form of lifelong learning in China and had an extremely bright future. Networked education had become an important approach for a busy person to gain high education. China had initially taken shape a good framework for high level education system with online education network. As of the end of 2007, there were 6700000 academic students enrolled in networked education systems, 299 different kinds of networked subjects had been established, added up to 1560 subjects in China, 20000 e-learning curriculum resources had been built, and 5935 networked colleges, universities and public service system had been set up [1].

Networked education has been popularly used in many environments because computer-based programs become more popular and distance education has some significant advantages, including better visualization, more personalization, easier accessing to extra source, widely interaction, less language barrier, more creativity and less cost [2, 3, and 4]. Student writing abilities should be enhanced since writing is a critical element in communicating online; further, lifelong learning abilities should be enhanced since online education should be available throughout graduates' lifetimes [5].

Enhancing collaborative learning in smaller groups of students is a significant way of building community online [6]. Several researchers have reported on case studies at several universities that collaborative learning increased a sense of community among online learners [7, 8, 9, and 10].

Though cost is important for the education, quality of the education cannot be compromised in achieving the goal of education. In 2002, 33 experts around the world in e-learning domain met each other in Netherlands to discuss how to improve the pedagogical quality of e-learning courses in an interoperable way, with user-friendly tools [11]. The quality of asynchronous interaction in web-based conferencing among pre-service teachers had been studied by Järvelä S. and Häkkinen P. in 2002[12]. Three different discussions in the learning were clarified from the study, namely higher-level discussion, progressive discussion and lower-level discussion and the results showed that higher-level perspective taking was related to higher-level discussion.

In order to evaluate and ensure the quality of a distance learning system, 6 scales questions has been brought forth, including relevance, reflection, interactivity, tutor support, peer support, and interpretation [13].

The faculty of our college established an online co-learning system to support networked education for computer technology [20, 21]. An open source tool named Moodle was used to build the course management system. On the basis of experience in the course management, an online co-learning system is being designed. The quality of education in co-learning environment is being evaluated and the college is to improve the education quality during the co-learning progress.

The main contribution of this paper is to present a learning action analysis method to evaluate the collaboration status in co-learning environment. The rest of this paper is organized as follows, course management practice will be briefly introduced in Section II, the criteria to evaluate the quality of education will be brought forth in Section III, and learning action analysis method will be introduced in Section IV. Section V

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introduces the case study. Section VI states the conclusion and the future work.

II. COURSE MANAGEMENT SYSTEM

Moodle is a course management system (CMS) - a free, open source software package. It is designed to help educators create online learning communities. It has a large and diverse user community with over 400,000 registered users; speaking over 75 languages in 193 countries.

The faculty of our college has built a course management system with Moodle package. There is a portal for the teachers and students to logon to the system. The main functions of the course management system in using are:

- Teacher uploads teaching material.
- Student downloads the related material.
- Student hand in their exercise and homework to the system.
- Teacher review the students' exercise and homework and score them.

There are several columns for each main course page in the courses management, including the glossary of the course, the public material of the course, the calendar & events, knowledge base, examination, and etc.

A. Arrangement of the course management columns

The page for each course is not fixed and can be customized according to the characteristic of a certain course. Typically there will be 9 kinds of columns:

1. Activities, which contains the quick links to the other columns and some network resource.
2. Search, which enables the student to gather some information with a certain of password.
3. Communication channels, which contains the bullets and notifications, forums, FQA, and interactive chat system.
4. Public material, which contains the online courseware, teaching material, and some skill set introduction related to the course.
5. Knowledge base, which contains a serial of the knowledge references related to the course, including the wiki, special web site, and some web logs. Sometimes, the fundament, skill enhancement, and applications will be explicitly stated as items.
6. Exercise / Homework, which contains the exercise and homework for each phase of the course.
7. Glossary, which contains the glossary of the related subjects, which enables the student catch up with the step of the new concept teaching easily.
8. Calendar & events, which contains not only the class-room teaching notice but also some related lectures.
9. Tips, which shows some useful tips related to the progress of the course.

B. Deployment of Course Management System

A course management system was deployed in a Linux server. MySQL database, Apache server, and PHP server had already installed in the server before the deployment.

The Linux server is public published in campus network, which ensures the connections from the students and teachers will be stable and fast. The communication between the students and teachers is expected to be facilitated by the online chat-rooms or forums [Figure 1].

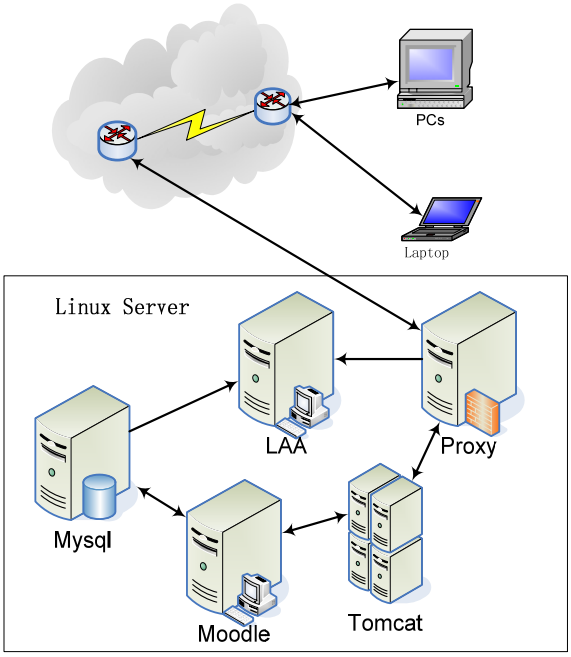

Figure 1. Co-learning system made with Moodle

III. DEFINITIONS FOR QUALITY EVALUATION

As stated by P. Taylor and D. Maor in [13], quality of distance learning system can be appraised with 24 questions were arranged into 6 scales. "*Tutor support*" shows how well tutors enable students to participate in online learning. The author believes that this feature is the most important characteristic in online co-learning and would like to present an evaluation method based on learning action analysis.

A. E-CARGO Model

Role-based collaboration model E-CARGO is introduced by Dr. Zhu in [14, 15] to establish the development/business environment as a role net. Each role provides a certain services and applies a certain services in the proposed role net.

Role based collaboration and its kernel mechanism were introduced in [16]. E-CARGO is helpful to build a more efficient collaborative system, e.g. roles can be regarded as agent dynamics in multi-agent systems [17]. Role transfer in emergency management systems [18] is also a regular activity in education management.

B. Related Definitions

The students were asked to finish the exercise and their homework in a determined schedule. The student should go over the course in class-room, read the related material from the notebook, present material, or event

networked education system, and think how to finish their work.

When they meet problem, they may use the online chat-room in the co-learning system to get instant help. Some fellow student may help them when available. However, sometimes they cannot get the sufficient help from the chat-room; they may put the problem in the forum. The teacher will trace the forum and will provide some help enough for the student to finish their work.

There are kinds of relationships in online co-learning, including the relationships among students, instructors and some assistant instructors. According to the E-CARGO model, all the personnel can be modeled as agents, positions (student, professor, assistant professor) can be modeled as roles, and innovation projects can be modeled as services, the equipment can be modeled as class/object data. The detail definitions are provided as follows.

Definition 1: Role. A role is the service template. A role is defined as *r*::=<*id, ca, S*> ,where:

- *id* is the identification of the role *r*;
- *ca* is the catalog of role, there are six different roles considered in this research work, including committee members, professional teachers, laboratory staff, graduated students, senior undergraduate students and junior ones;
- *S* is a set of services provided by role *r.*

As shown in Table 1, there are professional instructors, assistant instructors, and students. All these people's positions can be modeled as roles in the E-CARGO model, and the related responsibilities can be modeled as services.

TABLE I. ROLES AND RESPONSIBILITIES IN CO-LEARNING

Role	Responsibility
Professional instructors	1. Provide the class education, 2. Instruct the course, 3. Provide advice, or 4. Answer technique questions.
Assistant instructors	1. Provide direct technique instruction, and 2. Answer the online published questions as much as possible.
Students	1. Participate the course, and 2. Publish questions online.

Definition 2: Agent. An agent is a role player (i.e., people). It can refer to a profession instructors or students and it is defined as ag::=<*id, name, rid*>where:

- *id* is the identification of the agent *ag*;
- *name* is the name of the agent *ag*;
- *rid* is the role the agent belong to.

Definition 3: Service. A service is a responsibility of a role. It is defined as *s*::=<*id, r, c*>where:

- *id* is the identification of the service;
- *r* is the role who provide the service;
- *c* refers to the related course.

Definition 4: Course. A course is a special service, which refers to the collaboration of roles. It is defined as *c*::=<*id*, *Rpi*, *Rai*, *Rs*, *tp*> where

- *id* is the identification of the course *c*;
- *Rpi* is a set of professional instructor roles of the course;
- *Rai* is a set of assistant instructor roles of the course;
- *Rs* is a set of student roles of the course;
- *tp* is the topics offered by the course.

Definition 5: Action Message. An action message is the message caught by the proxy server. It is defined as *am*::=<*id, t*, *ip*, *mt*> where

- *id is* the identification of the action message *am;*
- *t* is the time when message *am* recorded;
- *ip* is IP address of the message *am* from;
- *mt* is type of the message.

TABLE II. ACTION MESSAGES FROM THE PROXY SERVER

Time	IP address	Message Type
2009-3-1 15:02:01	10.21.244.3	Password Checking
2009-3-1 15:02:12	10.21.244.3	Password Ok
2009-3-1 15:02:21	10.21.244.17	Password Checking
2009-3-1 15:02:25	10.21.244.3	Learning interface fetching
…	…	…
2009-3-1 15:04:02	10.21.244.3	Note add page fetching
2009-3-1 15:04:03	10.21.244.17	Password Ok
…	…	…
2009-3-1 15:05:02	10.21.244.17	Note add page fetching

Definition 6: Login Message. A login message is the message stored in MySQL database. It is defined as *lm*::=<*id, t*, *ip*, *mt, desc* > where

- *id is* the identification of the login message *lm;*
- *t* is the time when message *lm* recorded;
- *ip* is IP address of the message *lm* from;
- *mt* is type of the message;
- *desc* is description of the role, can be student, teacher or assistant instructor.

TABLE III. LOGIN MESSAGES IN MYSQL DATABASE

Time	IP address	Message Type	Description
2009-3-1 15:02:12	10.21.244.3	Logon	student
…	…	…	…
2009-3-1 15:04:03	10.21.244.17	Logon	Teacher
…	…	…	…

Definition 7: Online Co-learning System. The online co-learning system can be defined as *ocs=<ROLES, AGENTS, SERVICES, COURSES>,* where *ROLES refer to all the positions, AGENTS* refer to all involved personnel, and *COURSES* refer to all the related courses.

IV. ALGORITHMS OF TUTOR SUPPORT QUALITY EVALUATION

A. Role identification

Before analysis the detail learning actions, the role of the user should be identified so as to differentiate the teacher and student.

As shown in Figure 1, the access actions to the Linux will be recorded and stored in the application of learning action analysis (LAA in Figure 1). For example, when a student logon to the system, there will be at least a message of password checking via a IP address and there will be some fetch messages when the web pages appear on the students' or teachers' screens [Table 2]. However, these messages contain no information about the role of the users. Therefore, the role identification should be made with the log captured from the MySQL database of the course management system [Table 3].

When conjoin the Table 2 from Proxy server with Table 3 from Mysql server, the user from 10.21.244.3 at the time 2009-3-1 15:02:12 will be identified as a student and the user from 10.21.244.17 at the time 2009-3-1 15:04:03 will be identified as a teacher by the learning action analysis application deployed at LAA server as shown in Figure 1.

B. Tutor support evaluation

In the current co-learning framework, there will be support from tutor in the classroom. However, it's rather difficult to evaluate the tutor support online. Currently, we only evaluate the tutor support from two items: one is the mean time for an instructor to capture the problem which the student published and another is the mean time for the instructor to reply the problem. Figure 2 shows the procedure of the tutor support evaluation.

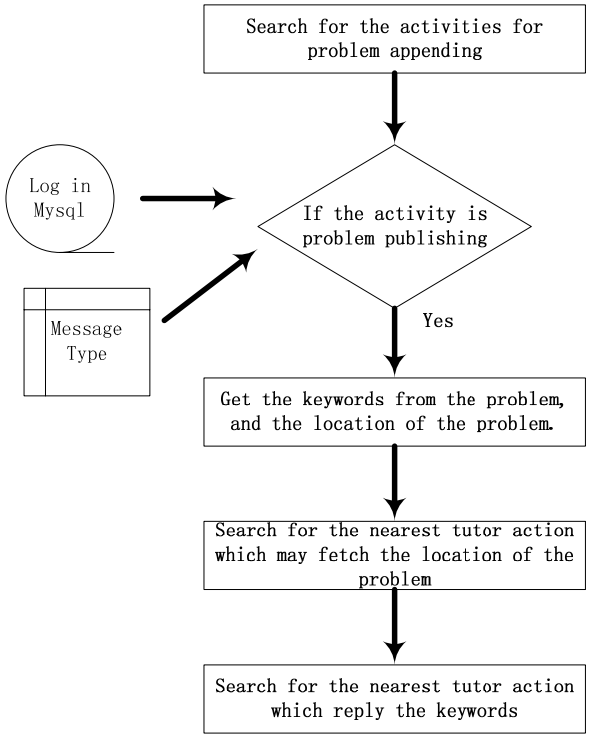

Figure 2. Procedure of tutor support evaluation

There will be a thread continues to search the activity of problem publishing. When it find such activity, it will keep the current location in MySQL database for the next searching and then get the keywords of the problem and the location of the problem. It analyzes the following log and find out the nearest action from the instructor which may possible capture the location of the problem and the nearest action from the instructor which reply the problem with the same keywords. The total problems published (*NoP*), the time for the instructor to capture the problems (*T2C*) and reply the problem (*T2R*) will be updated. The mean time for the instructor to capture the problem which the student published and then the mean time for the instructor to reply the problem can be calculated as,

$$MT2C = \sum T2C / NoP,$$

$$MT2R = \sum T2R / NoP.$$

MT2C indicates how fast will an instructor capture the problems and *MT2R* indicates how fast will an instructor bring forth their answer.

V. CASE STUDY AND DISCUSSION

The course management system in our college currently covers 35 courses and 2 contests. It has been used for 3 terms and more than 500 students have used this system. The students appraised the system very much, and they are willing to hand in their homework in time via the online system. The teachers were happy to find the students were more willing to learn the knowledge in the class-room, and the final score was a little improved with such enhancement. The system will try to cover the students from other majors including e-business and e-logistics management majors. The courses will then include not only the computer science but also software engineering, e-commercial, and information technology. Some research projects mainly performed by the students will also be managed in this system.

There is a portal for the teachers and students to logon to the system. The main functions of the course management system in using are:

- Teachers upload teaching material.
- Students download the related material.
- Students hand in their exercise and homework to the system.
- Teachers review the students' exercise and homework and score them.

Having established the course management system using Moodle, the faculty started to design the framework of co-learning system. The co-learning system not only cover the scope of course management but also cover the students' learning path. Such system should enhance the students' critical thinking capability, benefit the students' professional practices, and facilitate the communication between teachers and students.

The course manage system provides the web site as a tool for the student to navigate the course. While the co-learning system should carefully design the content, activities, and resources in the web site so as to ensure the quality of education. The participation and support of the students and the teachers are also very important and co-

learning system is an integrated solution for the connection.

Currently, the co-learning system is deployed in campus environment, the connection speed to network is quite fast, and the teacher may get some rich material online to enhance the interactivity. But if we want to expand the scope to the internet, the connection speed will be reduced significantly, the facility is now thinking a way to deal with some problem. If succeed, distance education can be realized on this co-learning system.

VI. Conclusion and Future Work

A course management system has been established using Moodle. The cost was very low as it only used the open source software including Linux, Apache2, Php, and MySQL. An online co-learning system is being designed and the learning path of the students is focused currently. Tutor support, which is the most important criteria to evaluate the quality of education has been introduced and analyzed. E-CARGO model is used to model the online co-learning and related algorithms are demonstrated.

The courses are high coupling in the university, however the relationship between these courses is not considered in current proposed quality of education. This should be researched in our future studies. Besides, in order to better sharing the education resource, the network scope should be expanded so as to gain more value. The network connection speed will become the bottleneck for such online learning system and rich online content turns out to be obstacle for the efficient learning. A potential solution is to dynamically reduce the rich online content when the connection speed is slow.

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