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Collaborative Education Practice in a Data Structure E-Learning Course

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***Abstract*—**This paper presented a collaborative education model, which consists four parts: collaborative teaching, collaborative working, collaborative training and interaction. Supported by an e-learning platform, collaborative education was practiced in a data structure e-learning course. Data collected shows that most of students accept collaborative education. This paper goes one step attempting to determine which aspects appear to be most important or helpful in collaborative education.

***Keywords*—**Collaborative work, education, data structures.

I. Introduction

COLLABORATIVE work (CW) means that group works in a common task. It is used mainly in the business settings and is now aided by computers, which is known as computer supported collaborative work (CSCW). Its purpose is to facilitate group communication and productivity [1].

Applying CW in learning aspect, collaborative learning (CL) is proposed. Research studies on CL [2, 3, 4, 5] are often geared towards making students collaborate to study.

Applying CW in education, collaborative education (CE) comes into being. This paper brings out three collaborating patterns in CE: collaborative teaching, collaborative working and collaborative training. Its purpose is to support roles involved in education such as teachers, students to teach and learn effectively.

The paper is organized as follows. First collaborative education is introduced. Second the four parts in data structure course is designed. Third the supporting e-learning platform is shown. Then data are collected and analyzed. Last is conclusion and future work.

II. Collaborative Education

For e-learning, how to provide valuable contents or services to students is one of the principle problems [6]. For this reason, a methodology which combines collaborative theory [7, 8, 9] and constructivism [10, 11] is proposed. As Fig. 1 shows, collaborative education consists of four parts.

1) Collaborative teaching: teachers majored in different areas, from different schools, prepare teaching material together and give different views on the same topics.

2) Collaborative working: students in different roles collaborate with each other to work out assignments which make them learn to cooperate with others and build knowledge through activities closer to the real world.

3) Collaborative training: incumbents together with teachers give practical examples with connection of theories which makes students learn from real world problems.

4) Interaction: teachers, students and incumbents are encouraged to interact with each other both in class and after school.

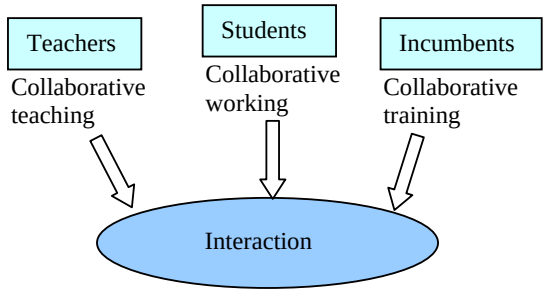

Fig. 1 Collaborative education

III. Course Design

Data structure is a basic subject in a computer engineering curriculum. It is one of the core courses which combine mathematic with computer hardware and software. It is also a fundamental course for program designing and coding.

Based on the above model of collaborative education, there should be four scenarios of collaborative education.

A. Collaborative Teaching

As information era comes, knowledge grows so fast that few teachers could master everything. Collaborative teaching may be a solution.

In this data structure course, two teachers work together to teach “Huffman tree”. One majors on computer engineering. The other one majors on communication and information systems. They prepare teaching materials such as PPT document together.

In the class “Is Huffman tree optimal tree or optimal binary tree” is first discussed. Then by questioning, teachers show an example of optimal judgment. Later Huffman coding is introduced by two different applications: telegram and video.

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Last efficiency and effect principle is introduced in summary.

This collaboration aims to make up one teacher's shortage and give students different ideas and views on the same topic "Huffman tree".

B. Collaborative Working

One main disadvantage of e-learning is that students often work too independently while studying via network. They discuss few and make few friends. Collaborative working may be a solution.

In this data structure course, students meet each other first and are grouped to work out assignments. Each group has 8 to 10 teammates. Each one plays a role in his group, such as a manager, a planner, a designer, a coder, a tester, a configuration management engineer. The assignments are "treasure prospect", "crossing a river" and so on.

This collaboration aims to give students a chance to be open-minded, to learn from others and to be cooperative.

C. Collaborative Training

One disadvantage of education system is that students often learn to say something, not to do something. They practise few and know few in real world. Collaborative training may be a solution.

In this data structure course, an employee is invited to tell real stories to students. Topologic structures used in P2P (Peer to Peer) are introduced with some real cases. Then teacher connects the stories with theories in book.

This collaboration aims to give students a chance to find out what's going on in real world.

D. Interaction

One disadvantage of e-learning is that students are not easy to interact with teachers, or with others. They just sit and listen.

In this data structure course, a short message based interaction system as Fig. 2 shows and a web based interaction system are applied. Students can give feedbacks in real time by sending short messages, such as "You speak too fast", "Please speak clearly" and "I have a question". Students can also use web forum to interact with teachers, incumbents and other students.

Fig. 2 Short message based interaction

This interaction aims to give students a chance to give feedbacks and to interact with others.

IV. E-Learning Platform

This data structure course is supported by an e-learning platform. Fig. 3 shows architecture of the e-learning platform.

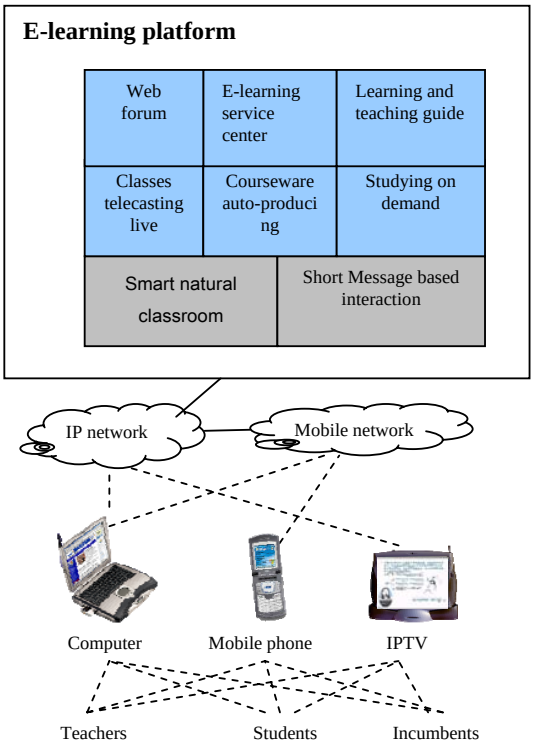

Fig. 3 Architecture of e-learning platform

In this implementation e-learning contents or services are provided to users' terminals including computers, mobile smart phones and IPTVs through IP network and mobile network such as CDMA/GPRS as Fig. 4 shows.

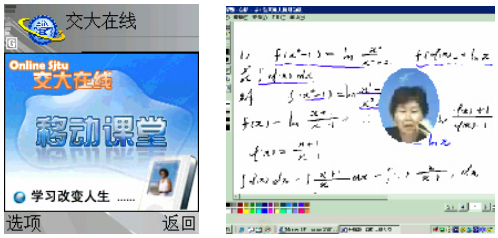

Fig. 4 Mobile learning demo

Please visit http://www.daydaymoblie.com.

Teachers and incumbents teach collaboratively in smart natural classrooms and classes are telecasting live (http://sjtu.online.sh.cn). Smart natural classroom is an intelligent space which supports teachers to teach in traditional ways freely, naturally and lively. In smart natural classroom, a

teacher tracking system based on multi-channel fusion helps to focus video on the moving teacher as Fig. 5 shows.

In smart natural classroom teachers can use a laser pen system to write on the screen when he/she walks as Fig. 6 shows the architecture of the system.

Students give feedbacks or ask questions by short messages in real time, which helps teachers to adjust teaching in real time. Also an attention detection system helps teachers to find out reaction of students in remote classrooms. Fig. 7 shows the architecture of the system.

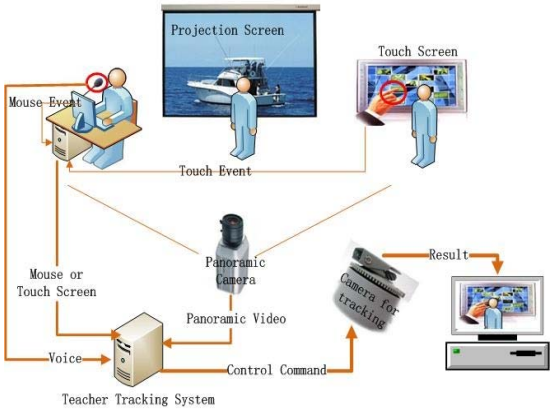

Fig. 5 Architecture of teacher tracking system

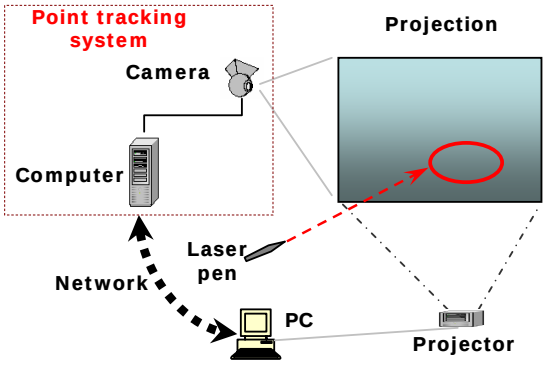

Fig. 6 Architecture of laser pen system

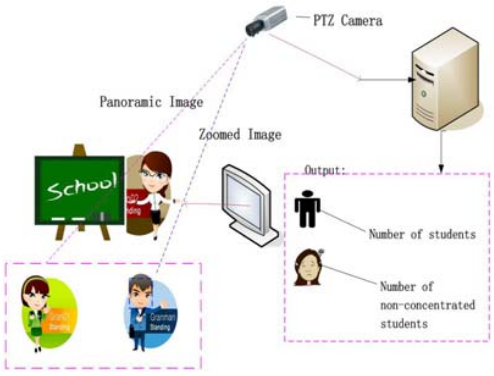

Fig. 7 Architecture of attention detection system

Multimedia coursewares are auto-produced at the same time for students' convenience: later review. Students use web forum to interact with teachers, incumbents and other students.

Based on knowledge point, learning guide and tutoring guide system encourages students to help each other and learn from others, which also lightens teachers' burden. Fig. 8 shows one page of the learning and teaching guide system.

Students meet each other first and are grouped. Then they collaborate with each other to work out assignments in different roles.

Students can ask questions by short message or email after class through e-learning service center. An answer machine automatically finds out answers of questions and gives them to students by short message or email. If it cannot find an answer, answer machine redirects questions to teachers. Fig. 9 shows the architecture of e-learning service center.

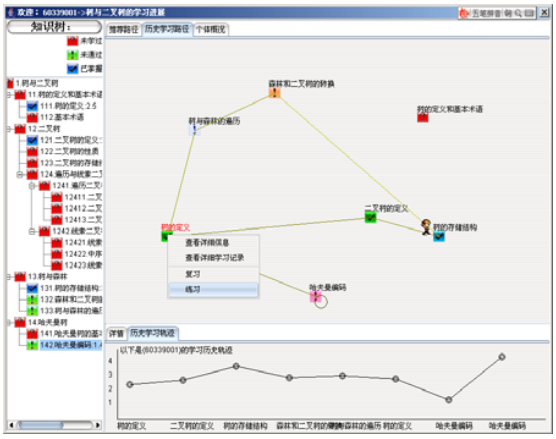

Fig. 8 Learning and teaching guide system

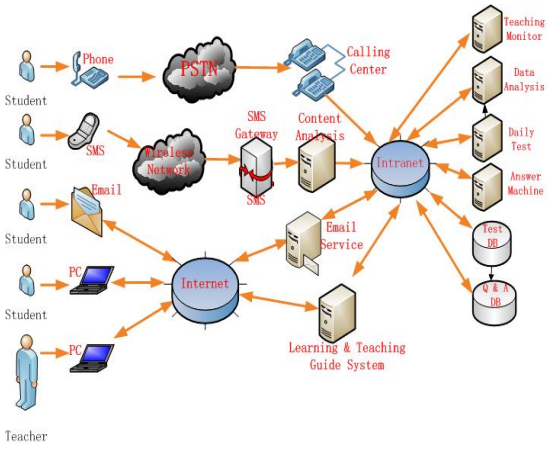

Fig. 9 Architecture of e-learning service center

V. Results

This collaborative education was introduced to 268 students in a data structure e-learning course of network education college of Shanghai Jiao Tong University (NEC of SJTU) in 2008.

At the start and the end of the course, online surveys were

carried out. For conciseness, we list only the questions for collaborative teaching in Table I. The raw data collected by after class survey is shown in Table II.

TABLE I
SURVEY QUESTIONS

1. Collaborative teaching

Collaborative teaching means that teachers prepare teaching material together and give different views on the same topics.

1.1 How much do you think that collaborative teaching will help or helps you in your study?

A. A lot.

B. Some.

C. None.

D. I don't know.

1.2 How much do you think that collaborative teaching will help or helps you to think in multi-views?

A. A lot.

B. Some.

C. None.

D. Don't know.

1.3 What do you think is the most helpful in collaborative teaching?

A. Teaching in multi-views.

B. Teaching by debate.

C. Teaching by figuring as students and teachers.

D. _____

1.4 What do you think is the least helpful in collaborative teaching?

A. Teaching in multi-views.

B. Teaching by debate.

C. Teaching by figuring as students and teachers.

D. _____

1.5 How many teachers do you think is good in collaborative teaching?

A. 2.

B. 3.

C. 4.

D. More than 4.

1.6 Do you want to interact with teachers in collaborative teaching?

A. Yes and I want to do.

B. Yes, but I don't want to do.

C. No and I don't want to do.

D. No, but I want to do.

1.7 Do you think that collaborative teaching should be applied in other courses?

A. Yes.

B. Yes, but some improvements should be made.

C. No.

D. I don't know.

1.8 What is your suggestion as to collaborative teaching?

A. _____

There were 42 (16%) before class surveys returned and 173 (65%) after class surveys returned. It shows that students were activated after class.

TABLE II
RAW DATA COLLECTED BY AFTER CLASS SURVEY

	1.1	1.2	1.3	1.4	1.5	1.6	1.7
A	83	70	112	38	70	101	81
B	83	92	45	50	55	37	58
C	3	8	11	65	20	17	9
D	4	3	5	20	28	18	25

	2.1	2.2	2.3	2.4	2.5	2.6	2.7
A	66	81	44	59	106	81	69
B	85	73	105	25	12	34	62
C	12	12	21	49	42	52	15
D	10	7	3	40	13	6	27

	3.1	3.2	3.3	3.4	3.5	3.6	3.7
A	86	81	109	34	96	113	80
B	74	76	44	65	44	39	67
C	8	13	16	42	16	8	7
D	5	3	4	32	17	13	19

From these surveys returned, we found out:

1) 96% (after class) agree that collaborative teaching helps them.

2) 87% (after class) agree that collaborative working helps them.

3) 92% (after class) agree that collaborative training helps them.

So most of students accept collaborative education and in the following order: first collaborative teaching, then collaborative training and the last collaborative working.

4) Only 34% (after class) agree that working in different roles is the least helpful.

It's a surprise that a lot of students do not like to work in different roles as real world does.

Feedbacks from students show that different working and resting schedule is a big problem for collaborative working. It's also not easy for students to cooperate with those lazy ones.

5) 72% (after class) agree that 2-3 teachers would be good in collaborative teaching.

6) 80% (after class) agree that they want to interact with teachers in collaborative teaching.

These show that most of students are tired of listening to only one teacher, but are interested in different views, and are tired of just listening but hope to interact with teachers.

7) 73% (after class) would like to share their work experience.

Feedbacks from students show that real world cases are greatly welcomed. They like those practical knowledge. Some of them even would like to tell their stories.

VI. CONCLUSION

This paper presented a collaborative education model, which consists four parts: collaborative teaching, collaborative working, collaborative training and interaction.

Supported by the e-learning platform, collaborative education was practiced in a data structure e-learning course in NEC of SJTU.

Data collected showed that collaborative education is accepted by a lot of students. Students finished their

assignments with greater motivation. Students would like to interact with teachers and greatly welcome real world cases.

Following are several questions that might profitably be explored by the results of this study.

1) Could computer supported collaborative work (CSCW) become computer supported collaborative education (CSCE)? Teachers, incumbents can teach collaboratively while actually being far away.

2) How to assign roles to every student in a team? Should everyone play all of the roles once?

3) How to solve the big problem in collaborative working: different working and resting schedule?

4) How to involve students in classes sharing their ideas or stories?

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