Construction of a Collaborative Learning Environment through Sharing of a Single Desktop Screen

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Abstract - *In this study, we constructed an environment conducive to enhancing education efficacy through an improvement of collaborative learning in higher education. In the process of collaborative learning, one faces a variety of situations, for instance, "discussion on learning themes" and "work to draw up materials and reports pertaining to learning." One of the styles of collaborative learning is to proceed with discussion or work by exchanging opinions among participants while writing down figures and words on a single blackboard. In this manuscript, we propose to replace the blackboard with a tablet PC with the view of omitting complicated tasks involved in each process of learning to facilitate its progress, thereby creating a collaborative learning environment where the participants can concentrate on learning itself. Furthermore, this manuscript also refers to the results of a collaborative learning program that was actually implemented on computer programming. Lastly, we touch on some advantages and issues associated with such learning environments including application in cases where the participants of a learning program live separately in remote areas.*

Keywords: Group Learning, Communication, Collaboration, Support, Education

1 Introduction

In a typical collaborative learning program, learning activities are performed on a group basis, with each group consisting of several members. This is a form of learning in which members within a group cooperate with each other in order to achieve a shared goal. By undergoing a collaborative learning program of this kind, a participant can expect to gain educational effects more easily than by learning by him/herself. A collaborative learning program involves the participants influencing with one another in the process of proceeding with learning, such as sharing knowledge and exchanging opinions with others, as well as expressing themselves. It is certainly true that shortening the time required for resolving problems through sharing of knowledge is one of the attractions of collaborative learning, but what is also drawing attention is the fact that it enables the participants to have "experiences of constructing interhuman social relationships" such as the joy and difficulty of communicating with others in its process, which would be impossible just by learning alone. Consequently, collaborative learning is expected to bring about better educational results [1][2][3].

2 Conventional Learning

2.1 Conventional Collaborative Learning

In the field of education, from primary to higher levels, various forms of collaborative learning have been attempted thus far. In Japanese primary education, for example, pupils engage in group-based study projects, such as observation of living organisms, cooking practice, exploration of history, and investigation of their cities and towns, while cooperating and sometimes sharing tasks with each other. In higher education, on the other hand, efforts are being made to provide students with diverse collaborative learning experiences including language study, science experimentation, and development of computer application software and robots. In particular, educators involved in collaborative learning in higher education often serve as prompters of students' learning, only making a few comments on their presentations, whereby the students play a main role in classes so that their sense of independence can be nurtured. Although fields of study vary widely as described above, there have been an increasing number of instances of collaborative learning programs implemented under various circumstances as their effects to boost educational efficiency have been substantiated. In addition, starting from 2011, the Japanese Government is scheduled to extend full-fledged financial support to educational institutions that are actively engaged in collaborative learning.

2.2 Issues in Conventional Learning

Regardless of the content, collaborative learning has been practiced under various circumstances. However, it is possible that practicing collaborative learning becomes difficult depending on the content of study In the case of learning programming by using a computer language, for instance, if a group is required to develop one computer application, it is difficult to complete the application while consolidating the ideas of each member in the course of

learning since it is the norm in the recent education environment that everyone is provided with his/her own computer. If the application is developed under such an education environment, there will be more occasions on which each member studies on an individual basis, compiling and debugging the program on his/her own computer, than ones where the members cooperate with one another. As a result, the efficacy of collective learning will highly likely be compromised. Suppose that each group is asked to share a single computer in order to avoid such a situation, it may be feasible to work in collaboration if the group consists of only three members who will surround the computer, but if the number of the members exceeds that, chances are high that the development of the application will be impeded. The author understands empirically that even if the task is divided and shared separately by members in charge of programming and those in charge of inputting the program, it happens more often than not that the program conceived by the former is misinterpreted by the later after verbal explanation. Misinterpretations of the information conveyed from member to member necessitate corrections of the program, thereby leading to a waste of time. Moreover, the fact that they are unable to make themselves understood accurately can give rise to frustration among them, thus negatively affecting the progress of learning. Therefore, it is safe to conclude that implementing a study program for computer programming in the form of collective learning is difficult.

Meanwhile, an application development method called pair programming is similar to the aforementioned procedure in that it entails collaborative work in computer programming [4][5]. This method places emphasis on the aspect of complementary work in task sharing. If learners with a certain knowledge of computer programming work together in accordance with this methodology, improvement of programming efficiency can be expected. However, it is extremely difficult for beginners in programming, who lack in specialized knowledge, to carry on with their necessary work based on this technique. In one of the classes of which the author has taken charge, it was necessary to instruct law students with no knowledge of programming. After a series of experiments in instruction methodology, the author concluded that it is imperative to develop a system that supports collaborative learning as described below: a system in which multiple learners share a single desktop screen on a software basis and are permitted to input their ideas from the keyboard whenever they come up with good ones, which are in turn evaluated by other learners in order to advance the process of collaborative work. This system relies on an application of the function of UltraVNC, a program capable of displaying the desktop screen of a remote computer on your own computer screen, modified for the ease of use by students. The details of the system are explained in the following section.

3 Support for Collaborative Learning through Sharing of a Desktop Screen

3.1 Overview

The system which we developed is working as a part of "FUTURE (Fukuoka University Telecommunication Utilities for Research and Education)" built by Fukuoka University. The system developed in this study has a very simple configuration, in which one group is supposed to comprise five students. For each group, five tablet computers are prepared, with one allocated to each of the members. These five tablet computers are interlinked via an IP network for communication. Table 1 shows the hardware and software configuration of the computers.

In addition, the roles of the five tablet computers are divided into two: one functions as a server, and the other four serve as clients. The tablet computer functioning as a server provides its desktop screen for multiple users, whereas the other client computers access the server and display its desktop screen on their screens, whereby one desktop screen is shared by multiple users. Fig.1 shows the schematic image of this process.

Table 1 Hardware and software configuration

Hardware	
Vendor:	Lenovo
Model:	X200 Tablet
CPU:	Intel Core2 Duo 1.86GHz
Memory:	4GByte
HDD:	256GByte
Software	
OS:	Microsoft Windows 7 Enterprise
Other:	UltraVNC Ver. 1.0.9.5 CWSS (Collaborative Working Support System)

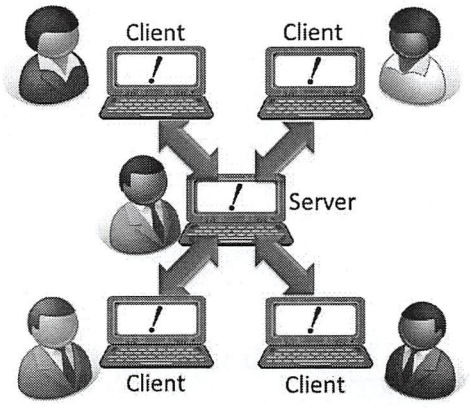

Fig.1 Schematic image

3.2 Sharing Procedure

Fig. 2 shows the procedure for sharing a desktop with multiple users. In principle, server and client programs of UltraVNC are run on each tablet. However, since simply starting such programs is not friendly for students, this system utilizes "CWSS (Collaborative Working Support System)," a supportive application developed by the author that consists of two programs: "CWSSS (Collaborative Working Support System Server)" and "CWSSC (Collaborative Working Support System Client)." First, the CWSSS is executed on the server to activate the UltraVNC server, during which process the CWSSS generates a password for accessing the UltraVNC server and associates it with the UltraVNC. Following the completion of the password setup, the CWSSS displays the IP address and access password of the tablet on which the UltraVNC server is in operation. After the server is ready, the CWSSC is executed on the client computers to launch the UltraVNC clients. At this point, the CWSSC prompts the users to input the IP address and access password of the UltraVNC server. Therefore, the client users need to be apprised of the information necessary for accessing the UltraVNC server by the user of the tablet on which the server is in operation. The input of the necessary details by the users on the CWSSC screens allows the UltraVNC clients to receive information for accessing the UltraVNC server, and the clients then start displaying the desktop screen of the server on their own screens, thereby realizing the sharing of the desktop. Access passwords are generated in order to prevent unauthorized persons from gaining access to the UltraVNC server without permission. Accordingly, the passwords must not be disclosed to any outside party if the confidentiality of collaborative learning needs to be maintained. The passwords set up on the UltraVNC server are changed forcibly every time the CWSSS is launched. This makes it impossible to reuse the same passwords, thus guaranteeing a high level of security.

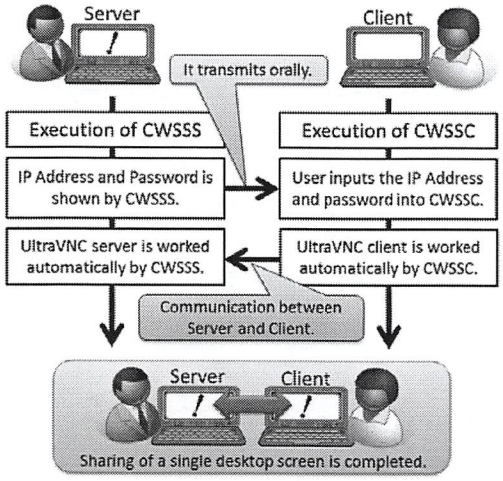

Fig.2 Procedure for sharing a desktop

3.3 Actual Practice of Collaborative Learning through Sharing of a Desktop Screen

We actually implemented a collaborative learning program in which desktop screens were shared. Table 2 shows the details of class.

Table 2 Details of class

Subject:
computer programming
Number of participants:
30 (divided into 6 groups)
Class duration:
90 minutes
Class frequency:
14 times
Implementation period:
October 2010 to January 2011 (4 months)
Participants' capabilities and knowledge:
Internet surfing Document creation on Microsoft Word
Used computer language:
HSP (Hot Soup Processor)
Class participants:
Law students in their sophomore and junior year
Class objective:
Develop a simple program
Example of the program to develop:
Image file viewer program Movie player program Webpage downloader program

The computer language used in the classes is called HSP (Hot Soup Processor), a BASIC-like language developed in Japan. With its simple grammar, the language is less overwhelming to students who study a computer language for the first time and easier for them to learn. In the classes, the students, using HSP, developed programs for displaying still images, playing movies, downloading HTML files by accessing websites, etc. Fig.3 and Fig.4 show how the students were working on their tasks.

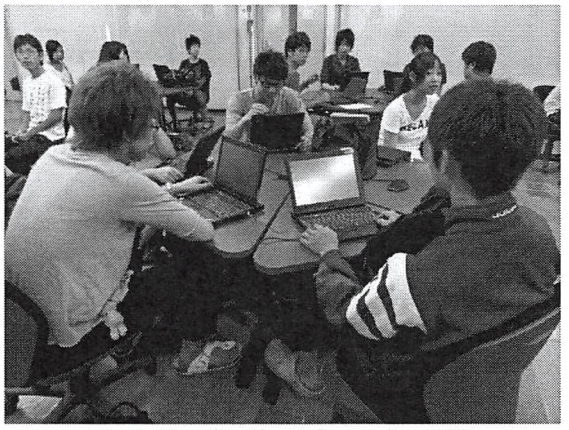

Fig.3 The situation of exercise (1/2)

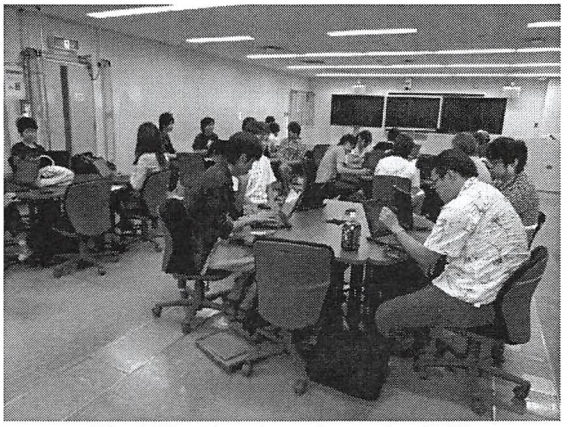

Fig.4 The situation of exercise (2/2)

4 Results Obtained by Using the System

The evaluation of the results of this study was done in terms of the following three aspects: "work efficiency," "communication efficiency of among the students," and "comprehension of the course." The sections below compare the instances where desktop screens were shared and those where they were not in the actual collaborative learning program. The students were presented with a task to develop a program in every class.

4.1 Work Efficiency

Although an accurate comparison is impossible as we did not measure the exact time, more than half the groups whose members did not share a desktop screen could not complete their programming work even past the finish time. By contrast, almost all the groups whose members shared a desktop screen were able to finish their programming by the end of a class. It has therefore been demonstrated that sharing a desktop screen contributes to improvement of work efficiency.

4.2 Communication Efficiency among the Students

When a desktop screen was not shared, the students found it difficult to understand the opinions and ideas of others. This difficulty was attributable to their inability to convey necessary information both thoroughly and accurately, as well as to the tardiness of communication. When a desktop screen was shared, the students realized that it was easier to accurately convey their opinions to others through verbal explanation and at the same time by describing or depicting their conceptions with keyboards and mouse devices in a concrete and precise manner. Furthermore, in the "questionnaire survey on the course" conducted at a later date, more than half the students commented that they "felt the joy and efficacy of collaborative work making use of this system and would like to see this applied to collaborative learning in other subjects as well."

4.3 Comprehension of the Course

When a desktop screen was not shared, the students had to deal with a host of complicated and time-consuming chores in the course of program development, thus resulting in a squandering of time that could have been spent on doing more essential tasks. Consequently, it was pretty hard to heighten the understanding of the classes. When a desktop screen was shared, on the other hand, the burdens of such complicated chores were mitigated, thus enabling the students to expend more of their resources on the study itself. Moreover, with the communication among the students facilitated, they were able to hold in-depth discussions, which improved their comprehension of the course.

5 Conclusions

In this manuscript, the author has discussed the actual practice of collaborative learning in computer programming and its efficacy. An advantage of the environment proposed in this manuscript is the extreme simplicity of its system in which generic personal computers are interlinked with each other via an IP network, which enables implementation of collaborative learning programs not only in a single classroom but also between remote areas. Combining this system with multi-point connection teleconference systems, which have been seeing widespread use recently, is expected to allow the construction of a more powerful environment for collaborative learning; therefore, there is still room for advancement in this research field. Since the system entails multiple users sharing the same desktop screen, they need to be careful not to interfere with the operations by the others so that this does not presents a disadvantage. It may be necessary to take some sort of measures to prevent a simultaneous operation by multiple users, e.g. developing a

technology or establishing rules with the intention of suppressing or preventing such interference. Fukuoka University, to which the author belong, has introduced a "Meeting Perfe" [6] paperless meeting system, which enables the sharing of PowerPoint and PDF files by multiple persons through the synchronization and simultaneous display of file pages. We are now cogitating on how our system can be utilized effectively in parallel with this one.

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