Web-based Tools to Sustain the Motivation of Students in Distance Education

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Abstract – **In distance education, students in a remote classroom tend not to sustain their motivation, mainly because of a lack of intensity due to non-physical presence of a lecturer. To address this issue, two software tools were developed for teachers and students, respectively. The tool for teachers is called eRoster. On the teacher's PC, the eRoster can display not only the student's name but also the student's attributes – id, future career, interest, club, faculty, and entrance time. Then, the teacher by name can call on the appropriate student whose attribute is related to the topics of the lecture. The tool for students is a so-called clicker and enables students to be more completely engaged in the interactivity of active learning. The developed system facilitates individually owned multi-devices of the students like PCs, cell phones, iPod Touches, and other PDAs as data entry systems.**

Index Terms – Distance Education, Instructional Technology, Student Learning, Faculty Development

INTRODUCTION

Hosei University in Japan has been conducting distance education programs with overseas institutions since 2003 [1], and from 2006 it has incorporated intercampus distance education. With *the Research Center for Computing and Multimedia Studies* which we authors belong to, it has been trying to improve and maintain the quality of the distance learning system and its support system. As a result, we have now established the stable distance learning system structure where picture images and audio are uninterrupted even for a second during a 90-minute lecture. And in the future we are planning to build a next-version system by using high-definition televisions which can display high-quality picture images and audio sound. Whoever knows our circumstances, we can provide the distance learning system enough for teachers to deliver their lectures to remote classrooms. However, we recognize that the distance education needs more than just a high-quality system. Unless a teacher pays careful and intentional attention to the remote classroom, the learner in the remote classroom where no teacher is present tends to end up "just watching or just listening" like learning by TV. Hence a high degree of learning benefit for students cannot be expected. From a different level of purpose besides making the system more stable and more highly functional, it is necessary to develop a system which can encourage students participating in remote classrooms.

In our university, at the second term of academic year 2006, the roster system with radio frequency identification (RFID) tags was introduced as a system to complement distance education. This is similar to the attendant managing system used in several business exhibition shows. The card-type RFID tags were distributed to students in advance. At the entrance in the remote classroom, the RFID cards are read by readers. Then the teacher can get the latest roster generated by the unique key of RFID assigned to each student. The system was developed in distance education for the students belonging to the Sport Science Institute course. The purpose of this system is to satisfy the teacher's desire to know the names and the clubs of the students in remote classrooms, not to monitor their attendances. Though high evaluation toward classroom management was received from the teachers using this system, it could not be applied to all distance education programs because this system must require operators.

At the same time, from the viewpoint of faculty development (FD), we have been trying to improve teaching methods using ICT in our university. One of our attempts, the trial run of active learning by clickers has been concurrently continued. Clickers were rapidly introduced in the United States and the effectiveness has been reported in numerous research results [2,3]. However, most of the clickers require the use of special hardware [4], and it is difficult to deploy clickers into the entire campus-wide system from the viewpoint of costing. Therefore we need to construct a system utilizing the terminals owned by our students. Fortunately, as we have distributed laptop PCs to all students in the science and technological faculties of our university, we have the environment for making use of the laptop PCs together with ubiquitous devices such as iPod Touch and SONY mylo[5], which have been experimentally introduced.

Also considering the environmental aspects around universities, the Basic Promotional Plan for Education [6] set up by *the Japanese Ministry of Education, Culture, Sports, Science and Technology*, requests universities to improve the "competency of bachelors". Under this national policy, our university is aiming to further fulfill the undergraduate education, which includes distance education as well.

Based on these backgrounds, we have developed the following systems with the aim to improve the quality of distance education.

- eRoster
- Web based clicker for multi-devices

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We would like to report the various findings and observations which we acquired through the development of these systems.

eROSTER

Goal

Our Research Center supports the distance education including the courses which are taken by students belonging to the Sports Science Institute course. Seven courses were offered in academic year 2008. As one of our supports for the teachers in charge of these courses, we have developed the system utilizing RFID tags and been experimentally operating it since the second term of academic year 2006. When students enter the remote classroom, the IDs of their RFID cards are read by a handy-type RFID tag reader. The IDs thus collected are used to make a roster by Microsoft Excel macro and the printed roster is delivered to the teacher within 30 minutes after his/her starting the lecture. This RFID card is made up by attaching an RFID tag on a business-card size card and is distributed to all the students taking the related courses at the beginning of the term. The purpose of this system is to present teachers the roster with the names of the students' sports clubs in the remote classroom, not to automate the student attendance administration. By referring to this roster, the teacher can choose and call on a student participating in the remote classroom, using the topic of his/her recent game/competition result etc. However, this system consisted of the following issues:

- As the RFID card had to be read by a handy-type reader, an operator was needed to assist the operation.
- As the data created in two separate classrooms had to be first edited before printing out, the roster lacks a real-time feature. Also the students who entered 30 minutes after the start of the lecture could not be included in the roster, and hence could not be called on.
- As a teaching assistant (TA) had to print out the roster and then hand it to the teacher, it was necessary to set up a printer in the classroom where the teacher was giving a lecture.

In order to resolve these issues, an electronic roster system (eRoster) with the following improved features was developed.

- The reading process of the RFID tag is improved to be done by students themselves as a "touch & go" style just like the automatic ticket gates at train stations in Japan.
- The browser of the teacher's PC shows a real-time student list.

In our evaluation, we especially focused on the evaluation point of whether or not teachers can effectively carry out their lessons by calling on students in remote classrooms through the utilization of this system.

System Configuration

The main feature of this system is an inexpensive noncontact RFID chip with built-in 128-bit special ID called μ-Chip [7], which was used for admission tickets at the Nagoya Expo. We shape the RFID card by sticking RFID chip on the back of the card. The system is configured with a stationary reader for reading a μ-Chip ID, a client system for controlling the reader, and a server system for displaying on a browser the data read which was uploaded by the client.

1. RFID card reader system

It is composed of a noncontact reader and a laptop PC with a Windows XP operating system (Figure 1). The application was developed using Visual C# 2008 and SQL Server CE. With this application, RFID cards distributed to students in advance can be read by the reader. The μ-Chip ID read by the client system is stored into the SQL Server together with the read time. Then the ID is uploaded by the C# program incorporating WebClient class in the Microsoft .NET on the server at one minute intervals using HTTP.

Figure 1
RFID card Reader System

2. eRoster server

XAMPP for LINUX was installed on an Intel Xeon server with Red Hat LINUX. A server application was developed by PHP using MySQL as a database system. In order to minimize the volume of transmitted data, only μ-Chip ID and the time of entering classroom are uploaded from the RFID card reader system. The database of the server contains a pre-registered table which includes μ-Chip IDs, student ID numbers, student names, clubs, and faculties so that the transmitted date can be associated with the student information. Using the server's database function and the information transmitted from the RFID card reader system, the data will be generated on the browser in the tabular-style list shown in Figure 2. The student's attributes shown in Figure 2 are Student ID, Name, Club, Faculty, Site, and Entry Time (in order from the left). Teachers can sort out and display the information using each attribute as a sorting key. The attribute can be arbitrarily set up as we intend to use this for wide genres of lectures. At this time,

we have used his/her sports club as one of the student's attributes as we have conducted demonstration experiments for cross-sectional undergraduate courses which are intended for students belonging to the Sports Science Institute course.

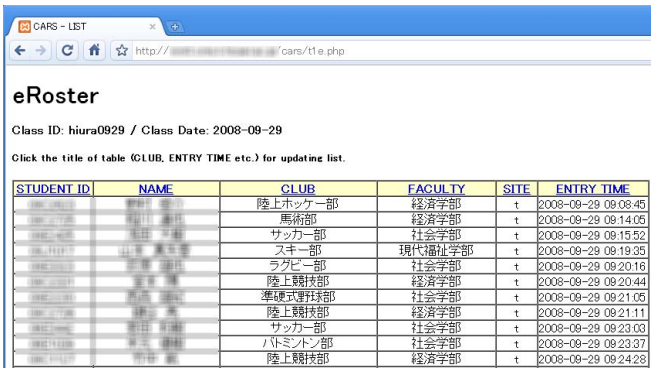

Figure 2
Sample Output of eRoster on Teacher's PC

Evaluation

We have carried out demonstration trials for three courses which are given in remote lecturing style connecting two classrooms. Each course was handled by different teachers, and a teacher gave a lecture in one of two classrooms and the lecture given was transmitted to the other classroom by using the distance learning system. It should be noted that three teachers in charge of the lectures have not been using a paper-base roster system.

In each classroom the RFID card reader system was set up and a PC was placed in the hands of the teacher to display the eRoster so that he/she could check the latest information at any time. The circumstances of the system used by teachers during 90-minute lessons are shown in Figure 3. The maximum number of times used was 13. These numbers are the total of two classrooms (local and remote). As calling on students was often done alternatively

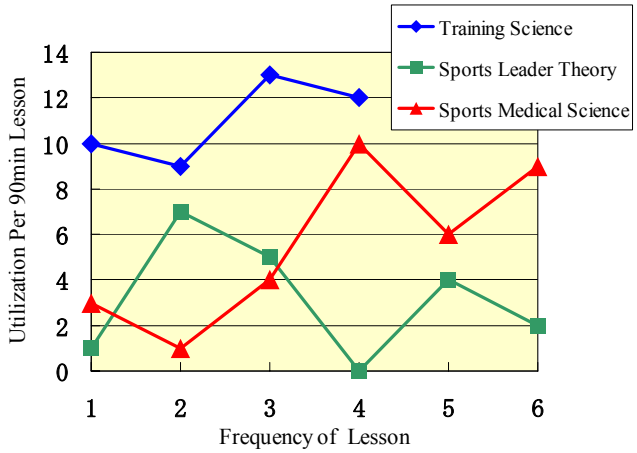

Figure 3
Utilization of eRoster per 90 min. Lesson

using the eRoster, the number of times for calling on students in a remote classroom was most likely to be half that of the total numbers. As the lecture subjects were intended for the students belonging to sports clubs, most teachers used the attribute of club in calling on students. These teachers previously did not have the means to call on students who were in remote classrooms, but with the introduction of this system, the chance for being called on is now extended to all students in remote classrooms. This is a definitive change and we can conclude that our initial goal has been achieved.

WEB BASED CLICKER FOR MULTI-DEVICES

Goal

The number of students is very limited for a teacher to call on by name during a 90-minite lesson using eRoster. When there are more than 30 students, students have understood that involvement or participation in the lessons is less likely if the teacher makes use of eRoster well. Also the effectiveness of clickers, which had been experimentally introduced, was well noticed in a lecture attended by more than 30 students, yet basically considered to be a closed system within a classroom.

As a result, there are few open architecture systems intended for multiple classrooms including remote classrooms, which enable the use of devices besides special terminals, and which are scalable in the future. In Hosei University, all the students majoring in science and technology have already received on-loan laptop PCs, and the possibilities of using devices such as iPod Touch or SONY mylo in educational fields has also been considered.

Thus we have developed the open architecture *Web based Clicker for multi-devices* which can realize the following functions.

- It can be used in distance education.
- It can not only be used with PCs and PDAs but also with cellular phones.
- It can be embedded in a course management system.

Just as with the evaluation of the eRoster system, we specifically focused on the evaluation point of whether teachers can carry out effective lessons by engaging the students in remote classrooms by utilizing this system.

System Configuration

This system is configured in the same server system environment as with the eRoster. That is, on an Intel Xeon server with Red Hat LINUX, XAMPP for LINUX was introduced and a server application was developed by PHP using MySQL as a database system. Also, even though any type of terminal devices with Web browser can be used, the objective devices were limited to iPod Touch, SONY mylo and PC for the time being.

1. System for students

Figure 4 shows the examples of devices used for evaluation, displaying a sample question for choosing one out of 10 choices. The middle left device is iPod Touch, the upper left SONY mylo, and the PC shown is HP's Mini Note. The device on the bottom left is Turning Technologies' clicker (for reference).

Figure 4
Question using choice of 10 by the Web Based Clicker on Multi-devices

2. Module for teachers

A teacher operates this system using the PC at his/her fingertips. First the teacher launches any arbitrary Web browser. Then after setting unique class ID, the teacher must choose an appropriate question from the following questions which were prepared in advance for this system, and wait for the students' answer.

- YES/NO
- Likert Scale (3 level, 4 level, 5level)
- Generic Answer (Choice of 3, Choice of 5, Choice of 7, Choice of 10)

As soon as the teacher receives the answers from the students, he/she starts the operation for displaying the results in a graph. The system is kept simple enough for any teachers to easily use and with minimal operation. The operation of obtaining results can be completed by inputting the class ID and five-time clicks only. Figure 5 shows the example of the students' answer for the question with choices of 7. The horizontal axis means the number selected by the students and the vertical axis means the total number of the students for the number selected.

Evaluation

The demonstration trial was carried out for "Decision Making Theory", a course which is intended for the students of Faculty of Engineering and Design, and of which one of us authors is in charge. The experiment was done using the testers of 30 students who were present in a classroom in a wireless LAN environment and using the laptop PCs brought in by each student. Though this demonstration trial was not conducted in a remote lecture style but in a

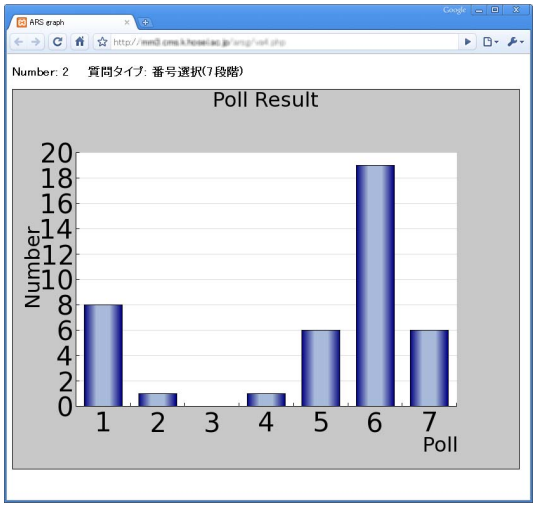

Figure 5
Sample Output of Web Based Clicker on Teacher's PC

conventional face-to-face lecture style, we have assumed that an equal conclusion could be drawn from either lecture style as a system evaluation for improving lecture methods. Also we have separately confirmed that the answers can be transmitted from a remote classroom using iPod Touch, SONY mylo and PC.

Figure 6 shows how the experimental lesson proceeded that day. In Figure 6, the lecture proceeds vertically from top to bottom. And ■ indicates where the teacher applied the clicker in his lecture. This system was used nine times during lessons and the breakdown of questions used is shown in Table 1.

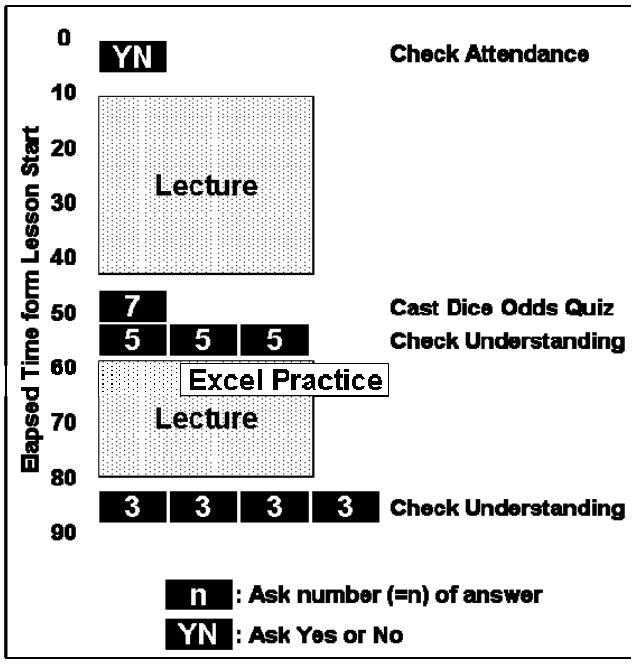

Figure 6
Uses of the Web Based Clicker at 90 min. Lesson

Table 1
Type of Question Uses

Type of Question	Number of times used	Contents
Y or N choice	1 time	Confirm number in attendance
Choice of 7	1 time	Quiz
Choice of 5	3 times	Check their understanding
Choice of 3	4 times	Check their understanding

The system was developed with the goal that both teachers and students easily managed to use it and in the demonstration trial the students used the system by simply showing them the URL without any detailed explanations. The teacher was also not troubled by complicated operations when he showed the questions to the students and received their answers. During this term we did not have a chance to use the system in the area of distance learning. But with the introduction of this system, the teachers who did not have any methods to involve remote classroom students in their lessons, are now ready to give interactive lectures to all of them in local and remote classrooms.

CONCLUSION

With the aim of improving the quality of learning in distance education, we have developed the following systems.

- eRoster
- Web based clicker for multi-devices

In both systems, the server sides can be implemented with open-source LINUX, PHP, MySQL etc., which makes it expandable in the future. Also in the demonstration trial done in an actual lesson, in accordance with original plans, the teacher used these tools in order to establish interactive communication with the students in a remote classroom, and they confirmed that those students were engaged in active learning.

We have been evaluating each system separately up to this section, but we have to add that in fact it is possible to integrate two systems as shown in Figure 7. More interaction will be expected by combined use of both systems in distance education.

As an RFID card used in eRoster systems can be produced for pennies, it can be introduced without cost constraints compared to expensive IC cards. Therefore we believe that this research result can be used in many other universities. In this research, these supportive tools were developed to sustain the motivation of students in distance education, but they can also be utilized as FD tools to realize active learning in conventional classrooms and not only in the area of distance education. We believe that they can be effective tools for raising the abilities of undergraduate students.

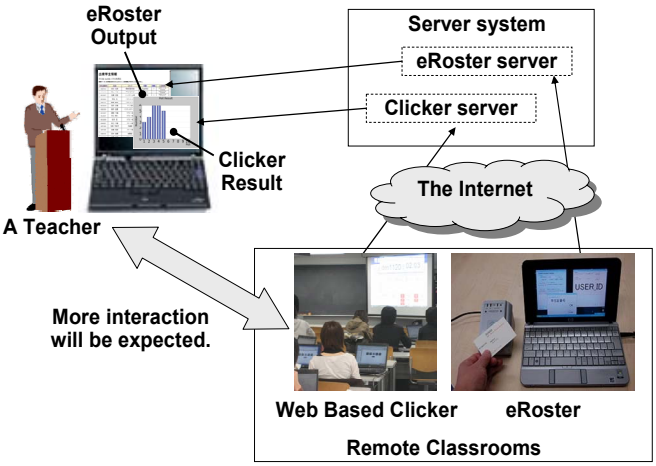

Figure 7
Combined Use of Both Systems

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