Collecting Students' Degree of Comprehension with Mobile Phones

Fujimura, Naomi
Faculty of Design, Kyushu University : Professor : Information Technology

Doi, Masahiro
Graduate School of Design, Kyushu University

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Naomi Fujimura
Faculty of Design, Kyushu University
4-9-1, Shiobaru, Minami-ku
Fukuoka, Japan
+81-92-553-4434
fujimura@design.kyushu-u.ac.jp

Masahiro Doi
Graduate School of Design, Kyushu University
4-9-1, Shiobaru, Minami-ku
Fukuoka, Japan
m-doi@gsd.design.kyushu-u.ac.jp

ABSTRACT
It is important for teachers to know how well students understand course content. It is possible for teachers to collect such data with a web interface in computer-equipped classrooms, but this is difficult for teachers in traditional classrooms. Mobile phones with Internet capability are very popular among students in Japan, so we implemented a classroom support system to collect students' degree of comprehension of course content using mobile phones. We devised this system to offer better ease of use for both students and teachers. Teachers who use this system can prepare a questionnaire with a web interface and edit the contents and structure very comfortably. The system uses the unique subscriber ID of mobile phones assigned by the communication vendor. After the lecture, teachers can get the summarized and detailed results of the questionnaire through a web interface. Teachers can now get feedback on student comprehension of lectures and use this information to improve future lectures. We are using this system in several classrooms. In this paper, we share our system design, user interface, and our experiences implementing this system in our classrooms.

Categories and Subject Descriptors

K.3.1 [**Computer Uses in Education**]: Computer-managed instruction (CMI)

General Terms
Management, Measurement, Human Factors.

Keywords
Faculty development, Mobile Phone, Students, Classroom

1. INTRODUCTION
Our faculty has been investigating the evaluation of lectures for faculty development every semester for several years. Lecture evaluations allow faculty to assess student comprehension and adjust lectures in future semesters. However, many teachers want to get information to improve their lectures right after each class.

Teachers traditionally provide students with a questionnaire on paper, and then they input the answers into spreadsheet programs such as Excel on their personal computers (PCs) to analyze them. This method is a burden for teachers. More recently, it is possible to provide students with a questionnaire in a web interface in PC classrooms. This method is comfortable for teachers because it does not require any time and cost to input the answers into PCs. However, using a web assessment is difficult in traditional classrooms because of the lack of PCs.

Many students in Japan have mobile phones that can access the Internet. We tried using mobile phones to access the Internet and to administer questionnaires in classrooms without PCs. We implemented a system to collect the students' degree of comprehension in traditional classrooms using mobile phones. It is very easy and comfortable for teachers and students to use them in classrooms. Teachers can know the latest status of students' degree of comprehension without any extra work.

There are some similar systems using mobile phones in classrooms, but they are different from our system in the intention and mechanism [1-4]. Our system offers teachers the ability to prepare a questionnaire for students and summarize the results in real-time. It has a better user interface and is able to collect precise responses from students.

2. SYSTEM IMPLEMENTATION
2.1 System Configuration
Figure 1 shows the total system configuration. The system consists of the server, a browser for teachers, and browsers or mobile phones for students. We use Apache for the WWW server, HTML and PHP for mark up, and MySQL for database in Red Hat Enterprise Linux ES V.4.

2.2 Subscriber ID in Mobile Phones
In the web interface, one person may repeatedly register multiple answers. Since this situation would corrupt assessment data, we wanted to register only one answer per student. Therefore, we needed some key to identify student answers individually. A student ID is useful for that purpose, but it is not easy to input a student ID into a mobile phone. If we were to force students to input their student IDs into every questionnaire, we assumed that students would not answer the questionnaire as fully and completely

as we would want because of the difficulty of inputting many characters on a mobile phone.

Our system solves that problem by retrieving the unique subscriber ID that is assigned by the communication vendor for each mobile phone. A set of subscriber IDs and matching student IDs are maintained in a database. Students are instructed to input their subscriber ID for the first time, and then the system displays the student's ID automatically, according to the subscriber ID of the mobile phone. The system can also identify answers by subscriber ID when student's ID is not required.
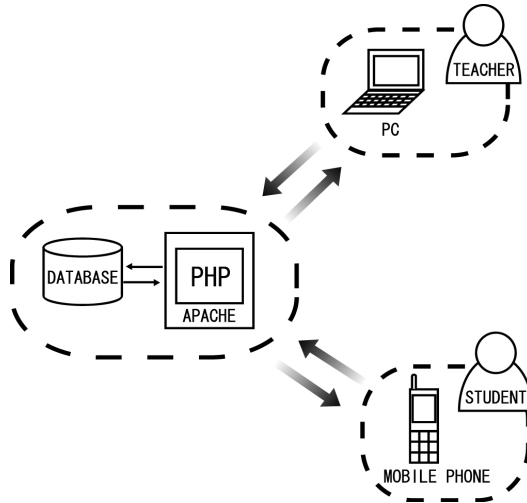

Figure 1. Total system configuration

```
//identify carrier
$UA = $_SERVER['HTTP_USER_AGENT'];
$carrier = substr($UA, 0, 4);

//retrieve subscriber ID
if ($carrier == "KDDI"){
 $SN = $_SERVER['HTTP_X_UP_SUBNO'];
 $subno = substr($SN, 0, 29);
}elseif ($carrier == "J-PH"){
 $subno = substr(strstr($UA, "SN"), 0, 13);
}elseif ($carrier == "DoCo"){
 $strstr = strstr($UA, "ser");
 if($strstr==FALSE){ $subno="";}else{
  $subno = substr($strstr, 0, 18);}
}else{
 $subno = "";
}
```

Figure 2. Procedure to identify communication vendors

There are three major communication vendors for mobile phones in Japan: NTT DoCoMo, Inc., AU by KDDI CORPORATION, and Vodafone K.K. They each provide subscriber IDs in a slightly different syntax. We have to distinguish between the formats of the three communication vendors and retrieve the value of the subscriber ID. Figure 2 shows the procedure we use to retrieve the subscriber ID in PHP code. We can use the IP address to identify students in PC classrooms, and it is not troublesome for students to input the student ID in the web interface on the PCs.

2.3 QR Code

Because it is troublesome for students to input the whole URL (*e.g.,* http: //flab.aid.design.kyushu-u.ac.jp/Q/S/check.php?id=teacher 2006AMON1) to access our system quickly on mobile phones, the system provides the QR code as show in Figure 3. Teachers provide this QR code as a part of educational materials in class. A student takes a picture of the QR code with the embedded camera of the mobile phone, and then the mobile phone recognizes the URL completely. Students do not have to input the URL at all.

Figure 3 Sample for QR code

Our system would not work if students did not have mobile phones capable of accessing the Internet and recognizing QR codes. To determine whether we should use mobile phones for student feedback, prior to implementation we asked students whether they had mobile phones, and if their mobile phones had the features necessary to use our system. Our survey results were as follows:

- All students had mobile phones.
- All mobile phones had the function to access the Internet.
- Exactly 70 % of mobile phones had the function to recognize QR codes with the embedded camera.

Therefore, we concluded that our proposed system would be accessible to our students and could be used in our classrooms.

3. INTERFACE DESIGN

3.1 Interface for Teachers

The system authenticates teachers with a username and password, which are maintained in a database. Therefore, a teacher first inputs a username and password to use the system as shown in Figure 4. We prepared an English sample of screens only for this paper. The real design is slightly different from these sample screens as they were constructed in Japanese.
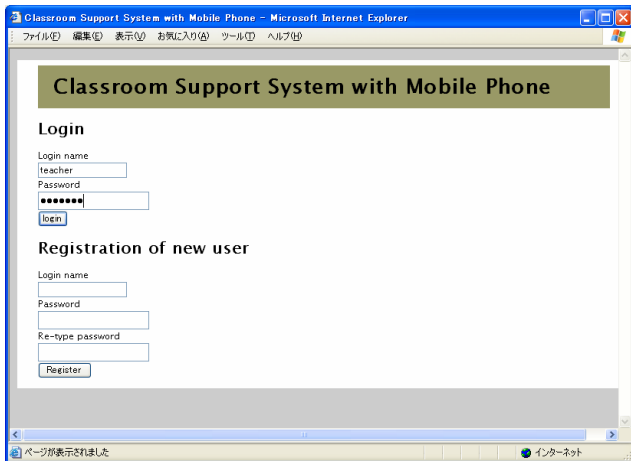
Figure 4. Sample screen for authentication for teachers

After the teacher is authenticated, the screen as shown in Figure 5 is displayed. On average, each teacher has several classes with a maximum of 15 lectures in one semester. Figure 5 shows the list of classes for one teacher. On this screen, a teacher can define a new class by specifying year, day of the week, and class hour. The unique ID for each class is defined by the course information; *e.g.*, teacher2006AMON1. "A" indicates first semester, "MON1" means Monday 1st class hour.
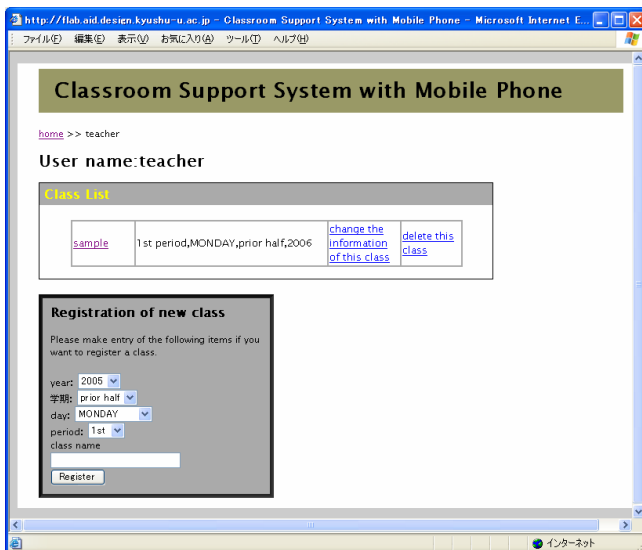
Figure 5. Sample screen for list of classes

A teacher selects one class, and then the screen as shown in Figure 6 is displayed. It contains the list of lectures for one class. A teacher prepares a questionnaire to ask students how well they understand the educational content in the class. Each questionnaire has a practicable date. Only on the specified day are students able to see the questionnaire via a browser or mobile phone.
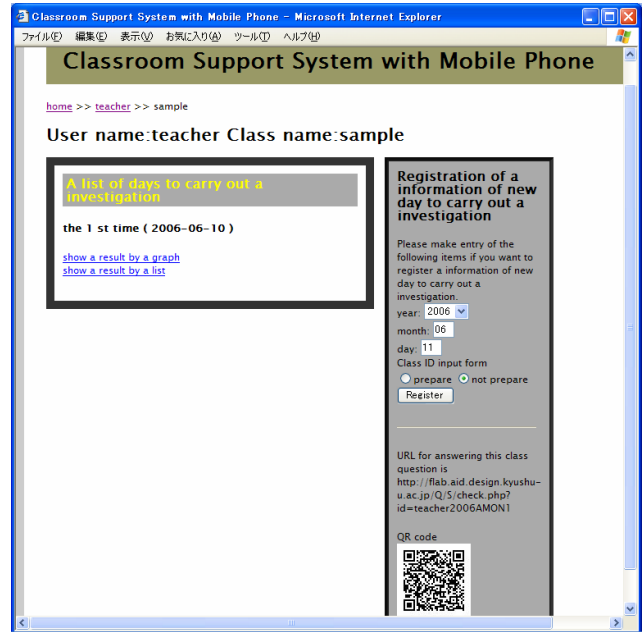
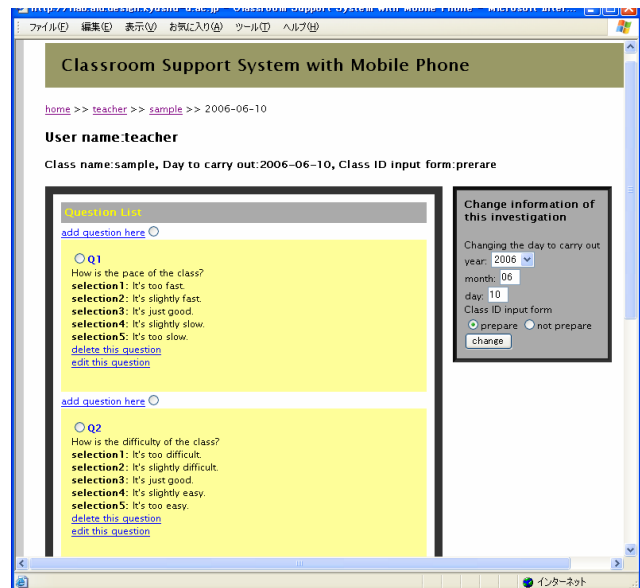**Figure 6. Sample screen for list of lectures in a class**

Figure 7. Sample screen for editing a questionnaire

Figure 7 shows the edit screen. In this screen, a teacher can do the following operations;

- Edit old question and answers
- Append or insert a new question
- Move one question to another position

The system provides teachers with the space for three questions as default. A teacher is expected to input a simple question in the question area, and the default answers such as very good, good, normal, bad, and very bad are already set as answers.

3.2 Interface for Students

Students can answer the questionnaire with the web browser in PC classrooms or with mobile phones in traditional classrooms. There are no problems in PC classrooms. The process of answering the questionnaire with mobile phones is as follows. When a student accesses the system for the first time, a screen as shown in Figure 8 is displayed to confirm use of the subscriber ID in NTT DoCoMo. We cannot skip this process in NTT DoCoMo. We can skip it in AU and Vodafone.
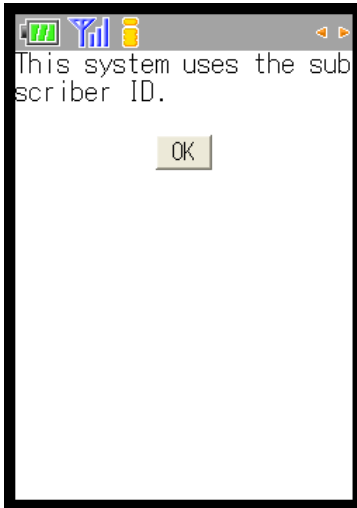
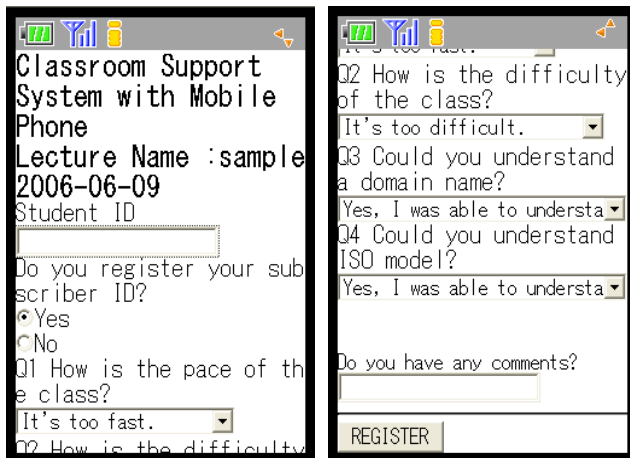

Figure 8. First screen in mobile phone

Figure 9. Screen to answer the questionnaire

Figure 9 shows the screen to answer the questionnaire. The left image shows the upper part of the screen, and the right image shows the remaining part of the mobile phone. When a student has already registered the subscriber ID and student ID, the student ID is automatically displayed in the screen. Students can answer the questionnaire with pull down menu in this screen. We arrange a space for free comment on the last part of screen. The

question is displayed only on the day of class. Students cannot see and answer it on other days. It is possible for students to register the URL as a bookmark and they can access the system with the same URL every time.

We want to identify the students because it is possible for them to click the "register" button repeatedly. To avoid multiple answers by one student, we use the subscriber ID of mobile phones, as previously mentioned. It makes it possible to identify the students even when we do not require the students ID in our system. The student response system only allows one answer to each question per student.

4. EXPERIENCE

We used the system in three classes in PC classrooms and one class in a traditional classroom. Table 1 shows the results from PC classrooms. We can get many responses from PC classrooms because teachers provide students with the URL link in the educational materials. Students click the link and answer the questionnaire. In the "Tue 4th" class, the teacher sometimes did not use the prepared HTML materials, and the students did not pay any attention to the questionnaire.

Table 1. Status of usage in three classes

No.	Mon 1 (62)	Tue 1 (63)	Tue 4 (54)
1	53	63	51
2	49	48	32
3	52	53	1
4	47	5	48
5	37	48	0
6	49	51	9
7	26	43	44
8	52	44	41

We show the results from a traditional classroom in Table 2. In this case, most students did not answer the questionnaire the first time because they had to input all the characters for the URL. We added the function of the QR code and provided students with a printout including the QR code image in the next class. As a result, many students answered the questionnaire, e.g. 23 students from 40. We used this system several times, and had good results. The percentage of students who answered the questionnaire was 58% (23/40), nearly the percentage of students with mobile phones that recognize QR codes (70%). This means almost all students who have mobile phones capable of recognizing QR codes answered the questionnaire in the traditional classroom.

We did not force students to identify themselves the first time because we thought that students did not want to be identified.

However, students would not give answers anonymously. We incorrectly thought forcing students to answer the questionnaire was necessary to get as many answers as possible. We required the student IDs in every questionnaire after that time, and since then most students tried to answer them.

Table 2 Result in a traditional classroom

Mon 4 (40)
2
23
15

5. CONCLUSION

Using the mobile phone class response system, teachers can get questionnaire responses just after they finish their class lecture. This feedback allows teachers to improve future lectures. Our system cuts the time and cost of distribution and collection of paper questionnaires and manual data analysis. We thought that students would not answer the questionnaire if they were required to input their student ID because they would reveal their identity. However, students still didn't answer the questionnaire when student IDs were not required. We have been using this system in several classes, and getting enough information to grasp the students' degree of comprehension to improve the lectures. We are planning to improve the facility of the system and extend the system usage to the Faculty of Design, Kyushu University.

6. REFERENCES

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