How Mobile Interaction Motivates Students in a Class?

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Abstract. The purpose of this study is to show a way that students can become more active in the classroom. We tried to use a mobile phone as a teaching and learning tool. A mobile phone is a familiar device to Japanese students. Most of them have one and use it everyday. They write many e-mails, browse web pages, take pictures and make calls. This study showed statistically how the use of mobile phones as a teaching and learning tool affected motivation of students. As the result, we found that students' communication-charge plan did not affect the evaluation of this method. The most effective factors were "The effect on checking attendance" and "Remembering what students learned at the end of lecture". Thus, it is helps a teacher with two things - this method allows better use of lecture time by shortening attendance checking and allowing students to write comments during the lecture on their mobile phones. This saves time, as the teacher doesn't have to use lecture time for feedback. So not only traditional paper and pencil should be regarded as a school tool, but also a mobile phone.

Keywords: mobile phone, motivational model, anonymity, picture and LMS (Learning Management System).

1 Introduction

In Japan, there is more movement to improve higher education. In a recent report by Central Education Council, it is mentioned the necessity to do it. This report describes, "It is important for teachers of higher education to let students who have little desire to learn or lack a sense of purpose have motivation to actively engage themselves in systematic instruction. For example, interactive classrooms and active experience, it is necessary for every university to think back and re-check their ways of teaching." [1]. Today is not the time when it is enough for university teachers to convey just knowledge. A teacher expects students to ask questions and speak their own mind actively. However, in most cases, teachers' expectations are disappointed unfortunately.

Especially, even if Japanese students participate actively and positively in class, they seldom express their comments, questions and thoughts in a large classroom. It seems the "Japanese national character". It is not that students have no ideas, comments, questions or thoughts. In general, many Japanese students are so shy, so they find it hard to speak augustly in front of many people, and whisper and grain when a teacher calls on them.

Some previous studies address this. Students do not recognize the usefulness of expressing their comments in a class when many students are participating [2]. Therefore, if a teacher lets students write a handwritten report, they describe their thoughts more freely. Surely, this situation is not suitable for all students. However, to let students participate actively in class is needed. We think that there are two ways to accomplish this. Obviously, it is important to enhance the contents of teaching. Second, we have to establish methodology as the educational engineering. We understand that it is better to adopt game elements and involve students' experience in the contents of teaching from a traditional approach. Our study puts forward that the "Mobile phone" is one of the best tools to use to target university students.

In Japan, mobile phones penetration rate is 95%, in particular 99% of university students own one [3]. Today, all mobile phones have the functions of e-mail, web browser and digital camera. We can connect to the internet via only a mobile phone. It is so easy for every people to send an e-mail with an attached of a picture.

Some Japanese university teachers try to adopt the use of mobile phones in large classrooms. This aim has two points as follows. First, it is used to reduce a teacher's workload e.g. to confirm students' attendance and to record students' learning and performance [4]. Another aim is to help interaction with students in class. Dr. Tamura is the one of the teachers who has taken the usefulness of a mobile phone into account from an early date. He has practiced the way to combine e-mail data from a students' mobile phone with MS-Excel to manage students' attendance [5]. Dr.Miyata has suggested the use of the comment database system where students can write comments onto web pages via a mobile phone [6]. We have tried to actively use a mobile phone as a teaching tool since 2003 [2][4][7]. We have studied the way for a teacher and students to use a mobile device as a "school supplies (tools)" which were enhanced electronically.

The essential functions are four. These are described as follows:

First function is to collect and grasp electronically students' hand written reports and drawing. Until now, there is no way for a teacher to know and compare students working situations except when a teacher watches them directly. This function can allow us do it in a short time without special equipment. Second is to ask questions freely in class. Our teacher is asked some questions in front of a classroom after lecturing. Some of these questions, we would like to introduce them to all of the students. Third is to be able to make students to express their comments without feeling nervous. This function makes students express anonymously what they think via an e-mail. Depending on conditions, it might be better to know who expressed these thoughts. In such a case, a teacher could tell students to write their signature at the end of an e-mail. Using this function, we can collect and read comments immediately. Last function is LMS (Learning Management System) i.e. marking the absence and managing score.

So far, our system and method has been held in high repute. In our class of 2007, 86% of students answered "Good" and in the remaining 14% of students, there were no bad remarks. Many of students told us this method allowed them to participate freely in class. Is this only a reason that they use a mobile phone? The purpose of this study is to show a way that students can become more active in class.

2   Aspect of the Practice and Theoretical Background

This "Using mobile phone" approach has already some clear advantages. The first point is the advantage of using a mobile phone. Although a personal computer diffusion rate is 85% in March 2008 in Japan, there aren't computers in every classroom [1]. Even if there were, students might say, "Teacher, I don't know the way to …", "Teacher, may I click 'YES' button on this dialog box?" and "Teacher, my PC has something wrong…Is this Freeze?" After all, we should teach operation and follow a procedure in a computer class. However, if a mobile phone class, a teacher simply tells a "purpose" e.g. "Please send an e-mail to me" or "Access a web page using your mobile phone". Perhaps, a student says, "My battery goes flat!" instead of asking a question. Therefore, we need the most basic alternative. That is paper.

The second point is that a mobile phone is a student's possession. So, students should pay communication charge. Many students are not concerned about the charge because they subscribe to "packet fixed-communication-charge". However, a minority of students are concerned because they do not subscribe to the packet fixed communication. It is therefore important for the students to understand why the mobile phones are to be used.

Next, we'd like to review the idea of anonymity. Of course, for some teachers, to use e-mail and BBS to express students' comments may bring discomfort. But unless we adopt this method, we can not process many comments in a short time. By reading these comments, a teacher can know what the students feel and think. If a teacher wants to know more, he/she only asks, "Who wrote this comment? Please explain in detail". Whereas a teacher may feel uncomfortable with this method, students feel "It is interesting in seeing many comments" and "I can express myself open-heartedly".

Finally, we'd like to describe the "Motivational Model". The "Motivational Model" is called "ARCS Model", which is advocate by Dr. J.Keller. According to Keller, there are four elements necessary required for a student to gain their motivation for learning. The first one is "Attention". The "Attention" makes the students excited and makes the students interested. The second one is "Relevance". If a student feels the contents of a lecture doesn't relate to him/her, a student loses interest. The third one is "Confidence". For example, if the content of a lecture is too difficult, students feel it is impossible to understand and they stop thinking about it. The last one is "Satisfaction". Students become satisfied when they are able to fully understand and utilize the content of a lecture. Thus, the ARCS motivational model comes from Attention, Relevance, Confidence and Satisfaction. This is one of the educational models employed in the field of educational engineering and instructional design.

3   System Architecture and Target Class

Figure 1 shows the outline of this system. Students can use five functions i.e. "Step of attendance", "Step of feedback today's lecture evaluation", "Confirm numbers of attendance", "Confirm test points" and "Real-time question". A teacher can control two functions i.e. "Anonymous Comments" and "Visual Presenter". More details are explained in the following sections.
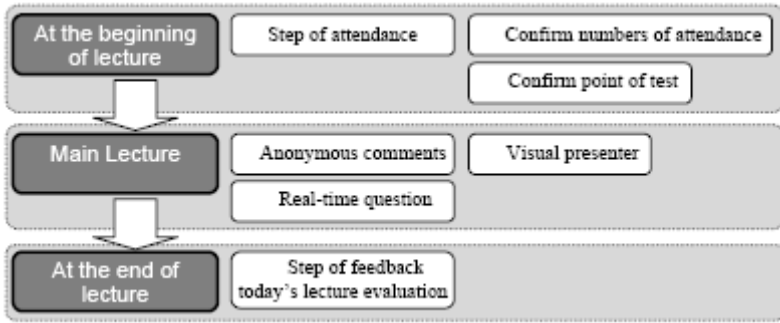
Fig. 1. Outline of this system

3.1   How to Use the Functions

At the beginning of this course, every student who wants to attend the class should submit their ID number, e-mail address, name and password via a mobile phone. This information remains private. The system server creates a database table based on this information. Using this data, a teacher can monitor every student's activity – attendance, performance, achievement and satisfaction.

Every class, a teacher gives "Today's special keyword" – attendance code – as "Step of attendance", when he/she begins the lecture. This keyword consists of five characters e.g. "Aj38#". This is a procedure to ensure correct attendance figures. Only students in a classroom will know the keyword and so students not in attendance will not be able to key in. Students are waiting to input "Today's special keyword" after they login into the system (see figure 2). The system will close 20 seconds after the teacher gives "Today's special keyword". We think 20 second is enough time for every student to input the keyword. After inputting the keyword, the system records the date of input and time. The teacher can monitor the recorded time on this system.

At the end of each lecture, students will login into the system again, inputting "Today's degree of satisfaction", "Today's achievement", "Important words" and "Feeling on the today's lecture". We expect students to remember about today's study. During a lecture, if students have questions, they can write it on "Anytime question BBS" at any time. If a teacher would like to know students' comments or students'
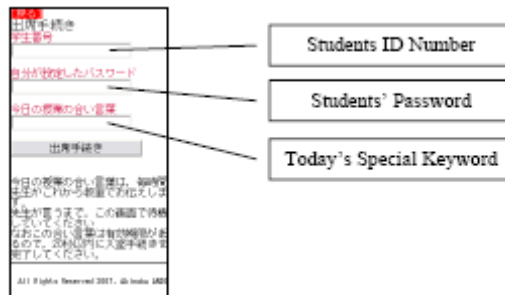

Fig. 2. Screenshot of the step of attendance

written e.g. pictorial notes, he/she may use the functions; "Correcting comments" and "Correcting pictures". We use e-mail to collect students' comments and pictures. On "Anonymous comments", the system can display only e-mails body text. Thus, all students' comments can be read anonymously. Only the teacher knows whose e-mail is on this system. On "Visual presenter", a teacher can also display pictures taken and sent via mobile phones the same way as the e-mail body text. Because this function can display not only pictures but also messages written in e-mail body part, students can add supplements to picture. In addition, the system can create web pages from these contents, a teacher and students can look at them after the class.

3.2 Learning Activity

A university first grade "Information Science" class was used to demonstrate the system. In the class, the teacher lectured about aspects of information technology using scientific language. Nearly a half of students had low motivation as this class is one of the most difficult. We used this system and method two years ago in a class of approximately 110 students. This paper is based on research carried out in 2007.

Every class, we let students use the functions - "Step of attendance", "Step of feedback today's lecture evaluation", "Confirm numbers of attendance". We told
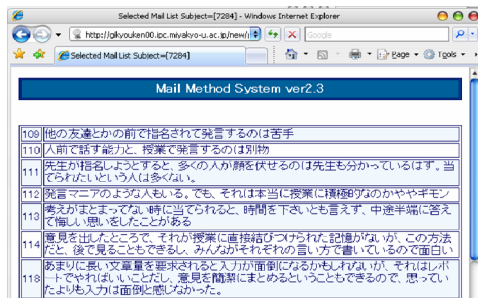

Fig. 3. Sample screen shot shows student' comment

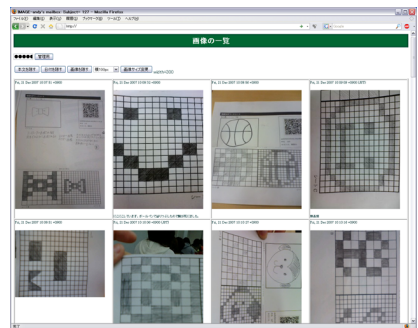**Fig. 4.** Students' works are shown into the screen

Fig. 5. Enlarged screen shot

students that if you have any questions, you should use the function of "Real-time question" at anytime. Sometimes during a lecture, we wanted to know comments anonymously, such as thought about their own experience of bullying, the question what impact do you think technology will have, or how do you feel about giving speeches (see Figure 3). The "Visual Presenter" was used for showing the pictures that were converted from analog picture to digital picture to all students. (See Figure 4 and Figure 5).

3.3   Examination Method

The questionnaire was done anonymously. Table 1 shows the content of the questionnaire. We asked students to evaluate three points: first the whole system, second individual function, and thirdly the ARCS motivational model.

Table 1. The contents of questionnaire

Total evaluation of this system
Have you subscribed to the"packet fixed-communication-charge"?
Did you mind paying the communication charge?
Are you a heavy user of a mobile phone?
Is using the mobile phone difficult?
Was the function of confirming attendance useful?
Was the function of confirming point of test useful?
Could you remember what you lerned at the end of the lecture?
Could this method shorten time for checking attendance?
Did you think that your comments had any effect on the lecture?
What is your total evaluation for this system?

About the functions (From 1: worst to 7: greatest)
What do you think about "Anonymous Comment" function ?
What do you think about "Visual Presenter " function ?
What do you think about "Real-time question " function ?
What do you think about "Step of attendance (LMS: Learning management System)"?

About ARCS model (From 1: Weak to 7: Strong)
How would you rate your attention using the system?
How would you rate he relevance of the lecture?
How would you rate your confidence after using the system?
How would you rate your satisfaction after using the system?

4   Result

Figure 6 shows the result of this questionnaire 88% of students had subscribed to the "packet fixed-communication-charge". Figure 7 shows the cross-tabulation graph about "Charge plan" and "Students' comments about the communication charge".

Thus, we can see 71% of students (77persons) feel the system causes no problem. But students who subscribed to the "pays as you go plan" worried about the communication-charges. To investigate to see what the differences between these plans were, we analyzed the different plans using a nonparametric analysis. The result of this analysis showed no significant differences between the plans. Thus, there is not difference between the effectiveness of whatever plan students subscribed to.
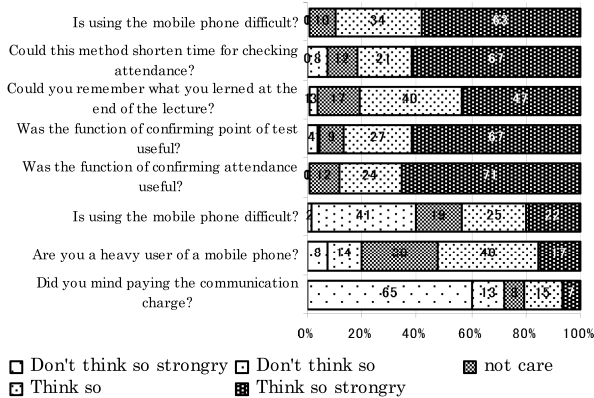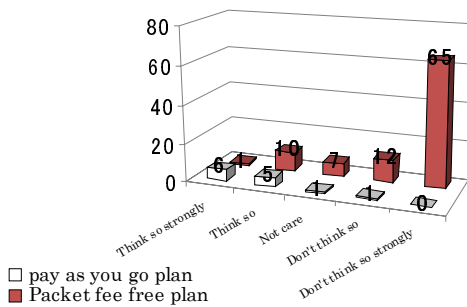

Fig. 6. The result of this questionnaire

Fig. 7. The cross-tabulation graph about "Charge plan" and "Students' comments about the communication charge"

Figure 8 shows total evaluation value of this system. This figure shows the system was highly evaluated. An average value is 8.3 (S.D=1.4). However, a few students did not evaluate it as "Good".

To understand what is different between students that evaluated it highly (average over (9 point)) and those who evaluated in lower (average under (8 point)), we using the Kruskal Wallis test. Table 2 shows this result.

It appears that the students that rated this high felt better about these three points – "Could you remember what you learned learning at the step of at the end of lecture?", "Could this method shorten time for check attendance?" and "Did you think that your comments have much effect on lecture?"
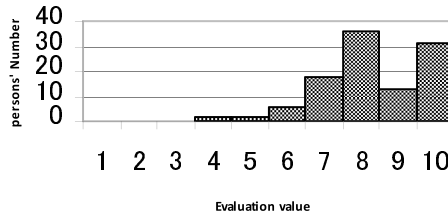

Fig. 8. Total evaluation for this system

Table 2. Compare by t-test

	Average under (8 point)	Average over (9 point)	t value	significance probability (p)
Did you care of communication charge?	4.0	4.2	0.949	n.s.
Are you a heavy user of a mobile phone?	3.4	3.5	0.430	n.s.
Is to use mobile phone troublesome?	3.2	3.2	0.036	n.s.
Was the function of confirming attendance useful?	3.9	4.6	1.615	n.s.
Was the function of confirming point of test useful?	4.3	4.5	1.038	n.s.
Could you remember about learning at the step of at the end of lecture?	3.9	4.6	3.948	***
Could this method shorten time for check attendance?	3.9	5.0	7.901	***
Did you think that your comments have much effect on lecture?	4.3	4.7	3.107	**

significance probability: $p<0.001$***, $0.001\leqq p<0.01$ **, $.0.01\leqq p<0.05$ *, $0.05\leqq p$ n.s.

In order to consider the evaluation of this system, we carried out a multiple regression analysis of the evaluation point of this system, using each question. We calculated the standard partial regression coefficient (β).

Table 3 shows this result. "Advantage for usefulness to check attendance" and "Remember what you learned at the end of lecture" related to evaluation point of this system. This means literacy with mobile phones did not affect the system evaluation.

Table 4 shows an average of each factor of the ARCS model which students answered. Each evaluation answer was chosen from "1: disagree strongly" to "7: agree strongly". This table shows students highly evaluated "Attention" and "Confidence".

Finally, we analyzed the relation between each function of this system and each factor of the ARCS model. We used a multiple regression analysis method to do this. Table 5 shows this result.

Table 3. Multiple regression analysis of the evaluation point of this system

Explantory variable	Standerd partial regression coefficient(β)	
Advatage for usefulness to confirm attendance	0.503	***
Reflection of commnets to improve lecture	0.257	**

Contribution rate: 0.39 ***

significance probability: p<0.001***, 0.001≦p<0.01 **, .0.01≦p<0.05 *

Table 4. Average of each factor of ARCS model

	average	standard diviation
Attention	5.6	1.6
Relevance	4.6	1.6
Confidence	5.1	1.2
Satisfaction	4.4	1.4

Table 5. Multiple regression analysis toward each function

Function	Contribution rate	Explantory variable	Standerd partial regression coefficient(β)
Anonymous Comments	0.84 ***	Attention	0.77***
		Relevance	0.08 n.s.
		Confidence	0.35**
		Satisfaction	0.06 n.s.
Visual Presenter	0.31 ***	Attention	0.89***
		Relevance	0.33**
		Confidence	0.11 n.s.
		Satisfaction	0.14 n.s.
Learning Management System(LMS)	0.45 ***	Attention	-0.03 n.s.
		Relevance	0.12 n.s.
		Confidence	-0.26 n.s.
		Satisfaction	0.43**

significance probability: p<0.001***, 0.001≦p<0.01 **, .0.01≦p<0.05 *

The function of "Anonymous Comment" related to A (Attention) and C (Confidence). A (Attention) was valued 2.2 times as much as C (Confidence) was valued. The function of "Visual Presenter" related to A (Attention) and R (Relevance). A (Attention) was valued 2.7 times as much as R (Relevance) was valued. The

function of "Real-time Question" did not seem to relate to the ARCS model directly. Finally, the function of "Mobile-LMS" related to S (Satisfaction).

From these results, we could conclude that our system included all the ARCS factor that effected student motivation.

5   Conclusion

We have tried to use a mobile phone as a teaching and learning tool in class. In particular, a mobile phone is a familiar device for Japanese students. Most of them have one and use it everyday. They write many e-mails, browse web pages, take pictures and make calls. This study showed statistically how our method affected students' motivate.

As the result, we found that types of students' communication-charge plans did not affect the evaluation of this method. The most effective factors were "Advantage for shortening to check attendance" and "Remember what was learned at the end of lecture". It means that students felt that these two factors were valuable. Moreover, we showed the relationship between our method and the "motivational model". According to our result, it is better for a teacher to tell two things - this method can use well lecture time by shortening time of checking attendance and not only listen to lecture but also students' comments affect to the contents of lecture. The "Attention" factor of the ARCS model relates to the "Anonymous Comment" and the "Visual Presenter" functions. It means that it is better for a teacher to use the "Attention factor" at the beginning of each lecture. For example, a teacher may confirm students' knowledge. The "Confidence" factor was affected by the "Anonymous Comment" function. By viewing many comments, students can know other ideas. So students can understand their comment objectively. The previous study said that Japanese students were averse to making mistakes in front of many people [7]. Students felt uncomfortable to speak their voice. If there are students who are afraid to speak, a teacher can use the "Anonymous Comment" function. The "Relevance" factor had a great effect on "Visual Presenter". It may be a good chance to remember matters relevant to the lecture by using a writing task. The "Satisfaction" factor had an effect on "LMS (Learning Management System)". It is waste that precious time is spent by checking attendance. And it seems useful for students to confirm easily how often they attended and their test point.

Obviously, mobile phones can be used in every classroom without special equipment. Not only a traditional paper and pencil, but also a mobile phone should be regarded as a school tool. We expect that this method will establish new interaction.

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