Integration of Web Bulletin Board and Mobile Phone to Improve Teaching and Learning Process in Higher Education

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This paper describes practical research on the improvement of teaching and learning process by integrating Web Bulletin Board (WBB) and mobile phone. This paper addresses three topics; A) the interactive lecture with topics-based discussions using the Web Bulletin Board (WBB) as a tool for assisting discussion, B) the introduction of peer evaluation among students to develop their problem-solving and cognitive skills, C) the use of mobile phones for promoting interactive lectures, keeping class attendance, conducting assignments, and providing notices for the next class. Results indicated the following research-findings: (1) WBB plays a role in facilitating positive participation in classes. (2) In contrast to the scenario of the traditional mode of instruction (without the usage of WBB), students were able to deepen their understanding of the theme by accessing the WBB before and after classes. (3) Peer evaluation highly promoted students' motivation to learn, and was effective in cultivating meta-cognition through modeling. (4) Mobile phone was identified as a highly effective tool for keeping class attendance, realizing interactive classes by generating discussions, and managing assignments and homework.

Keywords : WBB(Web Bulletin Board), mobile phone, teaching and learning process, topic

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Introduction

Realizing interactive lectures at higher education level in Japan is a challenging task. Our experiences showed that faculties often encounter headaches in managing lecture-based classes in large classrooms of about one hundred students, as it is very hard to maintain an attentive and comfortable class-atmosphere. It is usually the case that after some time, students would often become tired of listening to the instructors' lectures, have difficulty in maintaining their attention, and hence, sometimes begin to talk among themselves. This tendency is not only common in higher education in Japan, but also in other countries like Germany for instance (Nicolai Scheele, et al., 2004). Many faculties, therefore, introduce a variety of teaching-learning strategies such as topics-based lectures, problem-based learning, as well as integrated some media, in order to solve these serious problems.

Under the above mentioned situation, the authors have been conducting practical research for the improvement of the teaching and learning process which would result in students' active participation, well-ordered classroom atmosphere, promotion of fruitful discussion, students' deep satisfaction at the end of the class, etc. The research focuses on the practices of interactive lectures with topics-based discussions by introducing WBB, peer evaluation of students' reports on the WBB, and the use of mobile phones. This paper describes these three practical studies as follows: (1) topics-based interactive lecture using WBB, (2) peer evaluation among students, and (3) use of mobile phones to improve lectures.

Topics-based interactive lecture using WBB

It has been pointed out that Japanese students do not favor discussion-based classes and they lack in discussion skills in general. Under the current educational setting, it is difficult to change the traditional lecture-based instruction style into the

discussion-based instruction style at the level of not only universities, but also primary and secondary schools. This paper seeks to confirm the assumption that the integration of the WBB in classes promotes advancement in discussion skills and positive attitudes towards classes. This assumption is supported by some papers which have addressed the advantages of Web-based instructions (Collins, 2000; Laffey, et.al., 1998).

Method of introducing WBB to class

The author provided lectures on "Educational Technology" for undergraduate students at a university in Tokyo. The WBB was implemented in the lectures as follows:

a) Textbook used: The author's book.

b) Discussion topics: Sixteen topics were selected by the author. Examples of topics are, "Problems in promoting ICT education" and "Making plans to promote instructors' ICT literacy."

c) Subjects: Sixty-two undergraduate students, of 16 groups.

d) Discussion method: The discussion began by each group choosing one topic and subsequently presenting their opinions and solutions to the topic on the WBB. Other students from the class participated in the discussion by responding to the initial opinions and solutions posted on the WBB.

e) Privacy protection on the Web Bulletin Board: Students accessed the WBB by entering a password to protect their privacy.

f) Period: Three months from April to June.

Statistical analysis of the log records from the WBB

The log was analyzed based on the following indexes (Akahori, K., 2001).

(1) Access frequency according to days of the week (Refer to Figure 1)

The classes were conducted from 8:50 to 10:20 in the morning on Wednesdays. Access frequency, including both reading and writing text on the WBB, showed a peak on Tuesdays. In other words, students accessed the WBB the most on Tuesdays to prepare for the class next day. In Figure 1, the gray bars show access frequencies (722 in total), the black bars written text only frequencies. It is often noted that normally Japanese students do not study during weekends. However, the results show that students studied even on Saturdays and Sundays with the implementation of the WBB. This suggests that the usage of WBB facilitated students' frequent participation.
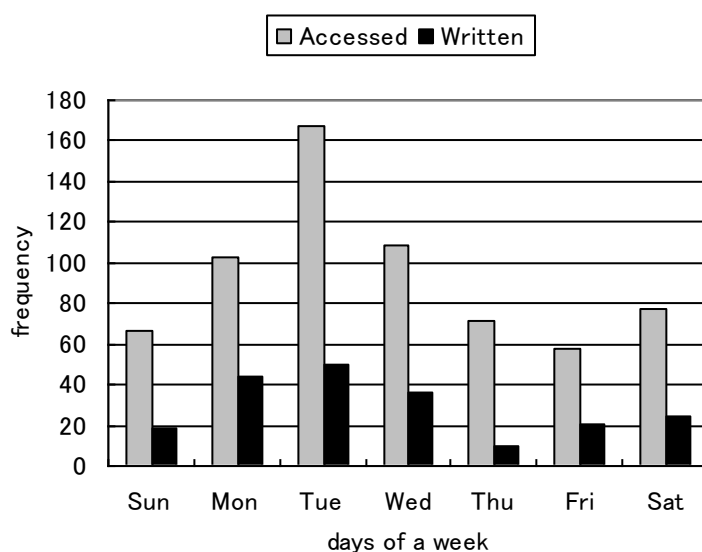

Figure 1. Access frequency by days of a week

(2) Access frequency according to hours within a day (Refer to Figure 2)

Figure 2 shows two peaks; one is from 10:00 to 16:00 another from 20:00 to 24:00. The two peaks correspond to 'after class' and 'studying time at home', respectively. This shows that students accessed the WBB frequently beyond the class time. This, therefore, suggests that students have high interest in the topics presented in class.
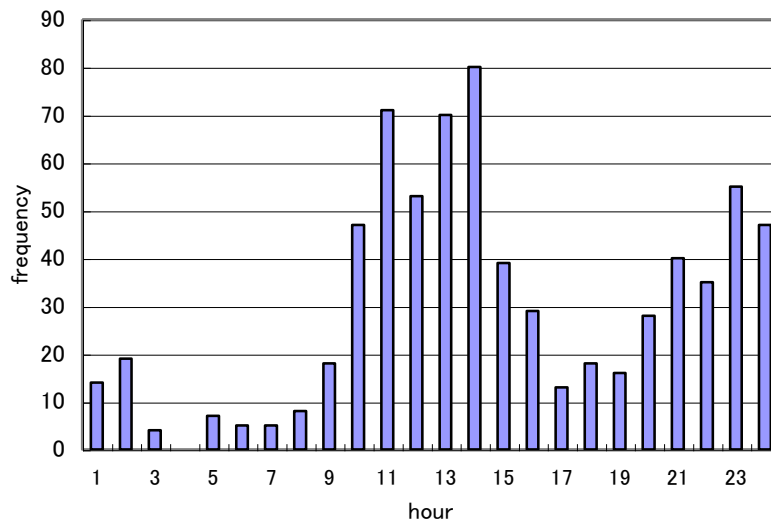
Figure 2. Access frequency by hours within a day

(3) Log records from the main host server

By examining the log records from the main host server, 339 counts (or 48%) were from the university server, and 373 counts (or 52%) were from commercial servers. This corresponds to the two peaks of access frequency according to hours within a day mentioned earlier.

Analysis of text content written on the WBB

The author analyzed features of text content written on the WBB using the following indexes; a) writing frequency for each student, b) text quantity (total byte) written by each student, c) depth of hierarchy tree structure, d) referred frequency (including accessing and quoting) by other students.

The quality of the written texts were also analyzed and scored (on a 5 point scale) from the following viewpoints; (a) awareness of understandings topics, (b) logical composition of text, (c) originality of ideas, and (d) references of related information

including other written texts. The analysis of text content produces the following results:

(1) Total frequency of written texts and text quantity written by students depended on the content of the topic. Students were more motivated to discuss reality-based contents such as authentic and realistic problems, planning and policy making, and contradictory topics for debate.

(2) The referred frequency was not related to the quality of the text content. It was due merely to the fact that students had to access the initial text more often than the new text as they had to read the initial text to understand the flow of the discussion.

(3) The texts leading to more depth of hierarchy tree structure could not be concluded as high quality content. The author analyzed relationship between text scores from the viewpoints of contents quality and depth of hierarchy tree structure, and could not find any clear correlations between them.

Peer evaluation among students

In the more traditional way of classroom evaluation, the task of evaluating is often done by the instructor alone. The instructor will then give the feedback to students by using only the grading score. However, in this course, students conduct peer evaluation of the reports.

In this course, various convincing examples were shown after a particular lecture. Students then submitted an assignment that showed the application and utilization of the problem solution process learned in the course. To be more specific, the assignment required students to demonstrate their understanding of the problem-solving process, ability to research, understand problems, select authentic criteria of analyzing and solution, provide possibilities of solution, etc. The assignments which students had submitted were placed in the Homepage of this course and posted on

the web. Students then performed peer evaluation of the assignments. The results of the evaluation were always posted online. This process was repeated as many times as needed throughout the course.

Assessment Method

The purpose of the assessment is to investigate the degree of influence on the score of each criterion and to explore the differences in ratings given by novices (students) and expert (instructor) on the evaluation criteria. 104 students were organized into 37 groups of 2 to 3 students. Each group submitted the final reports by e-mail. 37 reports were submitted and the instructor posted these reports on the web. All 104 university students and the instructor evaluated the reports. Each student assessed 5 to 6 reports while the instructor assessed all 37 reports. When posting the reports on the web, it was set that a student will not evaluate his or her own report.

Table 1. Proposed evaluation criteria for each stage of the problem-solving process

Stages of PBL process	Evaluation criterion
Selecting a real-life problem (Problem Proposal)	1) Are the problems similar to those encountered by students in the real world (authentic problems)? 2) Is it a valuable problem to be solved? (a useful problem)
Analysis of proposed problem	3) What are the criteria for problem analysis? (appropriate selection of learning theory and media as analysis criteria)
Proposal for problem solution	As problem solution criteria (appropriateness of solution method): 4) Reliability of solution criteria 5) Validity of solution criteria 6) Possibilities of solution 7) Creativity or Originality
Design of an assignment	8) How was the assignment designed? Was it comprehensible?
References	9) How many references via a bibliography, URL, Digital Materials.

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◇◇◇　最終Reportの評価ページ　◇◇◇

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下の欄には、今度、皆さんが提出したレポートがリンクされています。それをダウンロードして、よく読んで、それぞれのレポートについて、下の評価項目に従って評価を行なってください。

Group Number　1から12までは、6つのレポートを評価し、6回の「評価送信」を送ることになります。　それから、13から37までは、5つのレポートを評価し、各レポート毎に、5回の「評価送信」を送ってください。

下の表の最初の**行の数字はGroup Number**を示しており、2行目からの**ローマ字はレポート名**です。　例えば、Group Numberが1番から6番の人達は、その下の列にあるレポート、A, H, O, V, AC, AJを評価します。18番から22番までは、D, K, R, Y, AFを評価します

Group Number

1-6	7-12	13-17	18-22	23-27	28-32	33-37
A	B	C	D	E	F	G
H	I	J	K	L	M	N
O	P	Q	R	S	T	U
V	W	X	Y	Z	AA	AB
AC	AD	AE	AF	AG	AH	AI
AJ	AK					

The evaluation page has brief instructtions on the assessment

評価したレポート名　　　学籍番号　　　氏名　　　Group No

下記の評価項目について、それぞれ 「① 大変そうである」、「② そうである」、「③ どちらかというとそうである」、「④ どちらかというとそうではない」「⑤ そうでない」「⑥ 全然そうでない」の**6つの選択肢から1つ**を選んでください。

評　価　項　目	①	②	③	④	⑤	⑥
1. 提起した問題は、私達が現実社会でよく出会う問題である。	○	○	○	○	○	○
2. 提起した問題は解決する価値がある。	○	○	○	○	○	○
3. 問題の要因を適切に表現している。	○	○	○	○	○	○
4. 提案する解決の仕方が信頼できる理論、資料などに基づいている。	○	○	○	○	○	○
5. 問題の提起から解決まで、論理的一貫性がある。	○	○	○	○	○	○
6. 提案する解決の仕方で、問題が実際に解決できる。	○	○	○	○	○	○
7. 解決方法の創意的及び独創性が高い。	○	○	○	○	○	○
8. 課題の構成(デザイン)がよくて、わかりやすい。	○	○	○	○	○	○
9. 課題を完成するのに適切でかつ文献、URL、などを参考にしている。	○	○	○	○	○	○

＊課題全体に対して、下記のどれかに点数をつけてください。
(総点)　○100　○90　○80　○70　○60　○50　○40　○30　○20　○10

その他、**評価項目**について、何かコメントがあれば、自由に書いてください。

This shows the 9 evaluation criteria with 6 levels of rating.

The total score selection buttons

Comment box

Figure 3. Online Evaluation Form

Figure 3 shows the web pages that students and the instructor used. Brief instructions on the assessment method are given at the top of the evaluation page. Below is an index of links for the reports to be assessed by each group. 9 evaluation criteria are displayed on the subsequent page (refer to Table 1 for a list of the evaluation criteria in English). Each evaluation criterion has 6 levels of rating: strongly agree, agree, slightly agree, slightly disagree, disagree and strongly disagree. At the bottom of this page, there is a range of selection of the total score for evaluators to choose from as well as a comment box. The total score button is provided to indicate one's overall evaluation of the report, with 100 points for the maximum. The same evaluation procedure was carried out by the instructor. Using the same online evaluation form, the instructor rated the reports based on the 9 evaluation criteria. Data from the instructor's evaluation was stored separately and used for data analysis.

Upper page: reports on the Web, letter-link to each report, reviewers can download each report by clicking on the letter-link. Lower page: The evaluation form. Reviewers evaluate the reposts by clicking the button which corresponds to the evaluation criteria.

506 sets of student data and 37 sets of instructor data were collected through the assessment method shown above. All data were submitted by clicking the Submit button, and then automatically sent and stored in the server. The data collected was then used for data analysis.

Findings from peer evaluation and students' comments

Comments submitted by students were analyzed and summarized as follows (Akahori, K, Kim S.M., 2003):

1. Most students showed high level of interest and concerns for peer evaluation. This was due to the unusual experiences of checking other students' report, by means of the evaluation criteria.

2. The average total score was about 70 points, which was a higher compared to the traditional score for reports. This could be due to the students' stronger motivation to produce high quality reports, encouraged by the new evaluation system.

3. Most students wrote comments on learning how to make better reports and how to distinguish between high and low quality reports. This is interpreted as a modeling effect.

4. Finally, it can be stated that experts assess of reports focused more on the proposal of solutions such as 'how to solve realistic problems' in comparison to novices. In addition, it is also believed that students can be encouraged to learn by modeling others through peer evaluation.

Use of mobile phone for improving lecture

In Japan, mobile learning (m-learning) is getting a lot of attention these days due to the limitations of e-learning via PC. This may also be supported by the fact that the rate of mobile phone ownership in Japan is very high. The rate of individual use is 84.4% in May 2003 (from 15 years old to 59 years old) (Nomura Research Institute Ltd. 2003). Therefore, the idea of m-learning in Japan is timely since we are in the situation where a mobile phone is very important part of life simply in anytime-anywhere. Three kinds of usages of mobile phones for m-learning have been identified (Nakahara, Yaegashi, Yamauchi and Hisamatsu 2004). They are:

- To send course evaluations and comments to a instructor
- To run applications such as drills and educational game applications for language study

● To inform of messages such as class change or cancellation.

It can be concluded from the above that in Japan, mobile phones have mainly been used independently by students or during classes. Although the portable use of mobile phones for e-learning has been considered, it did not include the mobile user and mobile device (Goh, Kinshuk and Lin 2003). Therefore, we considered a mobile direction which complements an actual class, and this includes the utilization of mobile phones in e-learning for students to prepare for class (Salter, Filipovic, 2004, Goh, Kinshuk, 2004).

Development the system for mobile phones

The purpose of this system is two-fold (refer Figure 4). Firstly, the system helps to improve interactivity in the classroom that would result in the enhancement of students' motivation in learning. This system improves interactivity between students and the instructor by allowing communication of the content of classes as well as gathering of students' opinions. Secondly, the system simplifies the task of classroom management. One example is in the application of the class attendance function which allows students to register their attendance via their mobile phones in class. This helps the instructor to get accurate information on attendance which is attached high importance in Japan. Another example is the use of the opinion gathering function which makes online poll without using paper and also faster.

Functions of the mobile phone

A mobile phone has three functions: E-mail, Web and Java application. The system mentioned above was developed based on E-mail and Web, because both functions are available in almost all mobile phones. The operation and starting time for the application, however, differ by model. Java application is not included as it is

difficult for a Java application made for specifications that is different for every mobile phone company, to accommodate all models. In contrast, Web and E-mail are simple functions which can be readily used by all.

There are various functions in this system as explained below. The system was developed to accommodate these functions and was created using Perl.
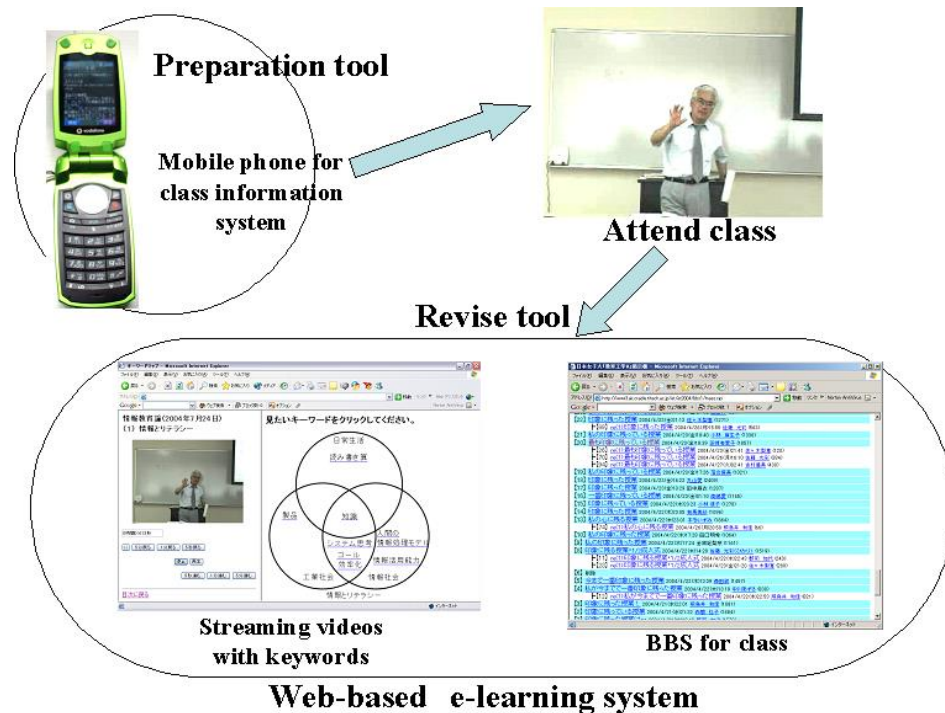

Figure 4. Web-based e-learning system with mobile phone

Class attendance function

The system checks students' attendance in class from the e-mails sent by the students. Students are requested to send e-mail to the system using a password given to them only during the class to avoid false attendance. This method can definitely keep accurate class attendance records in Photo 2.

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Comment function

The instructor requests students to send their comments to the system at the end of the class using this function. The comments are focused on means to improve the teaching and learning process. It also includes the important concepts which students have learnt in class and needs to remember, by which the instructor gages the students' understanding.

Opinion gathering function

The instructor requests students to send their opinions to the system during class using this function. The opinions are then displayed on the screen as a feedback. By pointing out these opinions on the screen, the instructor provides comments and asks some questions to students who posted the opinions. This function leads to an interactive class (refer to Photo 1).

Simple homework function

The instructor can assign simple homework to students, and they submit the homework to the system.

Peer consultation function

With the implementation of the mailing list function, the system actualizes a peer consulting function. This function supports collaborative work and promotes deeper discussion.

Class information delivering function

The system automatically sends the class information to students at the time when they reserved to get it. The information includes outline of contents, task assignment, reports requirement, and other announcements.

Combination with BBS

The mobile phone system is combined with the BBS. Therefore, students can confirm all information on the Web, such as class attendance frequency, posted past comments, the class information, and homework assignments.

Photo 1. Feedback of students' comments

Photo 2. Photo of students' sending e-mail

The system was applied in the 'Education Technology' class. The flow of use is as follows:

Before the class

1) Students receive an e-mail concerning class information by their mobile phones.

2) Students send in their homework through their mobile phone's email. Prior to the homework, each student is asked to select a particular theme from a few themes given by the instructor. Once the theme has been selected, the student then discusses with other students and inquires about their opinions on the selected theme. Finally, the student puts in her own opinion on the theme and sends it to the instructor by e-mail.

In the class (90 minutes, once a week)

3) The instructor displays the submitted homework on a projector and consolidates opinions of the students. This marks the beginning of the class. As the different opinions engage the students, their attention is focused on the screen. This reduces talking or whispering on irrelevant issues in class.

4) The instructor introduces the class.

5) The instructor takes students' attendance via the mobile phone's e-mail. Each student sends in an e-mail that includes a keyword exclusive to each class within the specified time. This e-mail becomes the attendance receipt, and the system then replied to the students back as a confirmation of attendance.

6) The class continues where the instructor proceeds with his lecture.

7) Students send in their opinions based on a particular theme using the mobile phone's e-mail. For instance, they send in their opinions on issues that need to be considered in e-learning. The instructor then discusses the students' opinions face-to-face in the classroom.

8) The instructor confirms the points of the class again.

9) Students send in their comments concerning the class via e-mail through their mobile phones.

After the class

10) The instructor checks the comments and homework on the web, and confirms students' understanding of the class content. With this information, the instructor then proceeds to prepare for the next class.

Findings

Experiences concerning the use of mobile phones during lectures

The system was utilized for one semester. Most of the students possess a mobile phone each, therefore, they were able to use the system and did not have to rely on paper and PC e-mails. For the first few classes, there was anxiety with regards to the class attendance registration through the mobile phones. As a result, a lot of students registered using paper. However, once the students became accustomed to registering their attendance through the mobile phone's e-mail, they did so for the following classes. The only students who registered using paper were those who did not possess or had forgotten their mobile phones (refer to Figure 5).
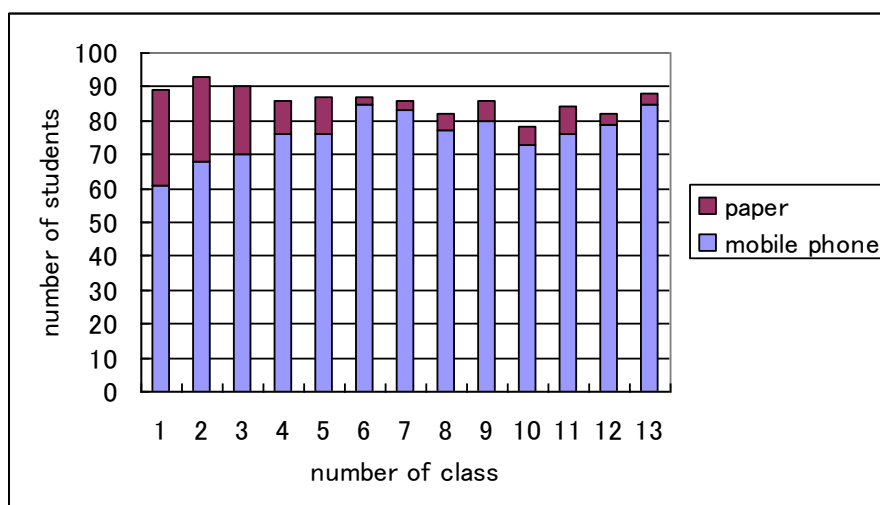
Figure 5. Number of classroom attendance and means of registration

Evaluation concerning students' motivation

We evaluated the students' motivation using a questionnaire survey. The question item is based on John M. Keller's ARCS categories and sub-categories, as well as the Japanese version of the reaction questionnaire used to identify motivational characteristics of instruction using 12 items of the 9-point Likert scale, as developed by Kogo and Suzuki (Kogo and Suzuki 2000). After the submission of the final report, the survey question was posted on the Web where 48 out of 92 students who attended the lecture answered. The question was, "Compare this class with the other classes that do not utilize mobile phones in teaching and learning. What are the differences that you can identify?" The results showed that under the A part, the sub-categories C1 and S were highly appraised by the students. Specifically, it showed that students felt 'interested', 'curious', 'not stereotyped', 'has a clear goal' and 'satisfied' in the class.
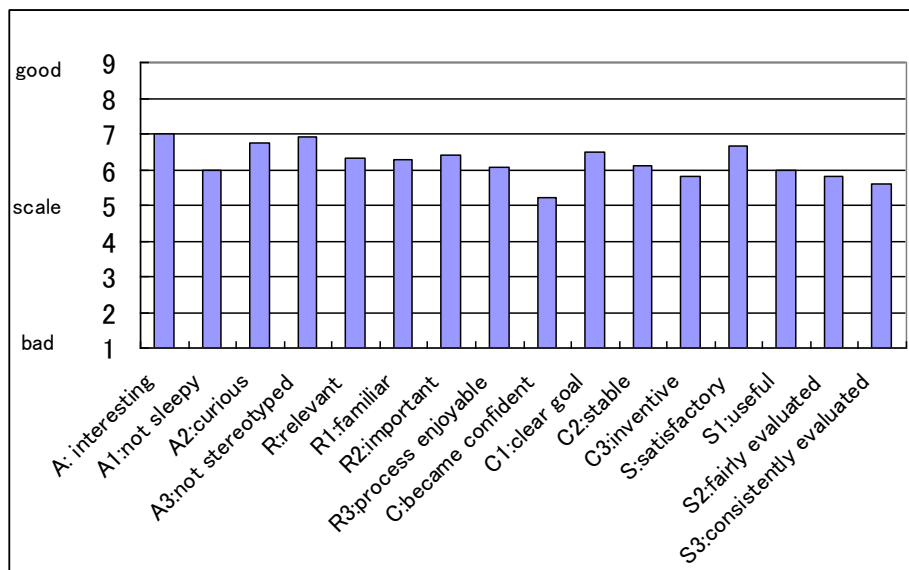

Figure 6. Evaluation concerning student's motivation

Evaluation concerning class information and homework

We evaluated the system's functions of 'dispersing class information' and 'sending in homework' by e-mail. This evaluation question was posed in the final class. 85 out of 92 students attended the class and answered the question. The findings showed that about 85% of the students assessed the class information mail every time or some times. The students answered that receiving class information prior to a class is very important to help them prepare for the class. One of the opinions given when students were asked to freely describe their experiences is that, "The class information allows students to organize and get ready for the coming class as it provides the related information beforehand." This illustrates the effectiveness of this classroom information function on students' interest and motivation.

75% of the students gave their opinions regarding the simple homework function. According to them, they were able to do their homework even when there is very little free time. When asked to freely describe their experiences, one student wrote, "The good point about this is that we can do our homework as soon as we read the class information. This is because the information can be accessed anywhere as we always have the mobile phones with us everywhere." In a gist, this summarizes the idea of mobility in learning and its advantages where learning can take place "Anytime, Anywhere, Anyone".

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