Facilitation of web-based internet PBL: What is an adequate group size?

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Background: Development in internet technology enables e-learning at the higher education level. We have developed the Internet PBL-Tutorial System/Rakuichi that allows multi-directional communication among participants with web-based bulletin boards. Although this system has been successful in medical education at the undergraduate level, we sought to encourage "read-only members" to participate more fully in the program.

Methods: To this end, we compared the posting frequency among three strategies: (1) students and tutors had an off-site meeting to promote face-to-face communication during the course, (2) several classes were allowed to watch the discussion in other classes in the second half of the course, (3) three classes (5 – 6 students each) in one topic were combined into one class (16 students) in the second half.

Results: No meaningful effects were observed for strategies (1) or (2). However, the posting frequency increased 50 % for strategy (3).

Conclusion: Facilitation of communication among participants was achieved by increasing the number of student participants. We predicted that an optimal number of students in each class in internet-based PBL would be ~20 people.

IeJSME 2014 8(2): 4-11

Keywords: Web-based, PBL-tutorial, master course, facilitation, education method, group size

Introduction

To improve problem-solving ability of students, Problem Based Learning (PBL) / Tutorial is a useful system that employs group discussion and self-study to evaluate specific scenarios, such as clinical cases and vignettes. However, this system is dependent on providing a large number of tutors and PBL rooms, and has an additional limitation of requiring the participants to be present at specific times.

Internet technology enables students and teachers to communicate regardless of distance and time. Web-based Internet-PBL learning system was developed and conducted by the Medical Education Development Center (MEDC) of Gifu University for distance PBL as Rakuichi the Tutorial, to allow students anywhere in the world to participate at any time.[1-5] We had also tried a similar web-based learning system, GELATIN, and found students between UK and Japan could learn together on the web.[6] However, some students do not appear to participate actively in the discussion component of the Internet-PBL, i.e. they generated few, if any, message, although they seemed to be participating in the course by reading messages sent by other students.

Since we wanted to expand the application beyond undergraduate education, in cooperation with several departments at Gifu University, we designed and evaluated an Internet-PBL system for a Masters course. The aim of this trial was to develop a high quality postgraduate course designed to encourage problem-solving and communication skills, and to implement a graduate school education system that can be provided beyond the limits of a traditional brick and mortar university. A successful implementation of such a web-based system will provide invaluable information for future developments of a 'virtual university' graduate school education program.

Methodology

Outline of the Internet-PBL system

We have developed and evaluated the Internet-PBL system, which was planned, coordinated and managed by MEDC staff. Course director(s) and collaborators (resource specialists) prepared the curriculum which included learning objectives, case scenarios, assessment, and tutor's facilitation guide for each course. Course information was uploaded to the MEDC homepage (http://www.gifu-u.ac.jp/~medc/). Students and tutors made accounts for the access of the Internet-PBL system, and each student chose a course. The course

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director and MEDC staff arranged the structure of classes (groups) in each course, i.e., student number, tutor, and resource specialist. The course director and resource specialists could supervise all classes and send messages to a specific class or to multiple classes, whereas students and tutors usually are limited to sending and receiving messages within a class. Teacher's room is also prepared in which all teaching staff such as directors, resource specialists and tutors in different classes can exchange information about the facilitation of the course.

Before starting a course, course director prepared and uploaded all teaching and learning materials in collaboration with MEDC staff. Then an announcement of start was posted on the electronic discussion board, and members of classes were then notified by e-mail. Students read the case scenario, discussed about problems in the scenario, selected what to learn, started self-learning, reported back their learning outcomes on the discussion board, and discussed further in the class. Students may send questions to tutors or resource specialists via the board, and tutors may provide guidance on how to learn or sometimes even an answer; however, self-directed learning is the most important philosophy of this Internet-PBL. Students studied their own learning question at their own pace and reported back to their class when completed. The director and resource specialist also provided guidance on how to learn and give short lectures. This Internet-PBL system has the function to display URL links to subjects being taught or learning. The course scenario was usually divided into several parts and displayed once every week or two. The discussion and self-learning continued until the next part of the course scenario was uploaded. Finally, the course was summarized by the director and closed. Students' report could be uploaded on this system and teaching staff could review the reports on the web.

Internet PBL for Master students

An eight-week trial of Internet-PBL for Master students in The Graduate School of Applied Bioscience and Engineering was launched in 2004. Three courses, (1) Oxygen and Life, (2) Cross Talk of Food Science and Bioscience, and (3) Reproduction, Evolution and Ecology, were prepared by three directors. These courses were run concurrently and students chose one of three courses. In advance of the courses, orientation was held to give the purpose of this trial and explanation about the Internet- PBL to participants.

Forty-seven postgraduate students and 28 faculty members including course directors, resource persons, tutors and MEDC staff participated in three courses. The number of students in each course was different since the student chose their course based on their interests (Table 1). Course scenario was uploaded every two weeks, and students' discussions were evaluated. Four weeks after the beginning of the course, students and tutors had face-to-face meeting in each course. Then the structure of the course was modified in the second half of the courses to investigate what kind of strategy would be effective for the facilitation of group discussion. As shown in Table 2, we adopted three strategies: i) after the face-to-face meeting, students could read messages from the other classes within the same course; ii) no change after the face-to-face meeting; and iii) three small classes were combined to one bigger class after the face-to-face meeting. The number of messages on the discussion board by students was counted before (1st period) and after (2nd period) the meeting. A questionnaire was e-mailed to all participants at the end of the course. Post-course faculty meeting was held to discuss the results of this trial.

The main objective of this study was to determine which strategies enhance student participation, as measured by number of messages posted (see Table 2).

The course scenario used in each course.

See URL: http://www1.gifu-u.ac.jp/~medc/trial.pdf

Results

Figure 1 shows the change in the total number of

messages sent by students before (1st period) and after (2nd period) changing the course structure. The number of messages sent by students decreased in both Courses 1 and 2 during the 2nd period, whereas the number of messages in Course 3 increased 1.5 times during the 2nd period. The number of messages of individual students in Course 3 is shown in Figure 2, and it was obvious that four out of five students who sent 5 or more messages during the 1st period (two students from class A, one from class B, and two from class C) posted double the number of messages in the 2nd period in one larger combined class. Seven out of 16 students in Course 3 sent only one message, mainly their introductions to the group, during the 1st period, and then after the setting change (2nd period), six of these seven students sent no message. Two students in Course 3 did not send any message at any time.

The number of messages of individual students in Course 1 is shown in Figure 3-A. Three students (one in class A, and two in class B) sent more than 5 messages during the 1st period, however, the number of messages was decreased for two students during the 2nd period. Similarly, four students in Course 2 (one in class A, two in class B and one in class C) sent more than 5 messages to the discussion board during the 1st period. However, three of these four students sent fewer messages during the 2nd period (Figure 3-B). In total, 55.6% of students sent at least twice as many messages during the entire course (1st plus 2nd periods).

As shown in Table 3, responses to the questionnaire after the end of the course indicated that students thought that the group size was too small during the 1st period, whereas the size seemed to be adequate during the 2nd period for Course 3.

Discussion

First, we set up classes with a small student-faculty ratio, that is four to six students in each class, because we had expected a high response rate (messages) from Masters students who participated in this Internet-PBL courses that are directly related to their research field. However, during the 1st period in all of courses, students sent relatively few messages. Reasons and factors for this low message rates were discussed in the post-course faculty meeting. Some students did not have freely available Internet access in their laboratory. They had insufficient time to access the Internet-PBL, due to extra-curricular demands (e.g. research or job-hunting). Furthermore, many students had little or no experience with either an Internet-based PBL system or in a more conventional type of PBL. Students' motivation may have been somewhat muted since their participation was based on the strong recommendation of their teacher (Table 3), and the trial was neither part of the formal Master's program, nor evaluated by the tutor.

Next, we modified the Internet-PBL in an attempt to facilitate the discussion and to increase in the number of messages sent. Specifically, face-to-face meetings were held at the middle of the courses; then from the 2nd period, students were allowed to read the messages posted by other classes in Course 1; three small classes were combined into one bigger class in Course 3.

We thought that the reticence of the students was partly because they have not had face-to-face contact. This hypothesis was based on the previous experience of Internet-PBL for undergraduate students. They felt some psychological resistance for posting their messages to other participants whom they had never met (unpublished observation). We hypothesized that face-to-face meetings about the courses and observing real discussions of other classes, should encourage students to participate on the web either. However, in Courses 1 and 2, we observed a decrease in the total number of messages posted after the meeting, in contrast to an increase of messages in Course 3. This suggests that an increase of messages from students has less to do with simply meeting other students, but may be related to an increase in the number of students as observed in Course 3.

Our analysis of messages from individual students also indicated that the number of messages varied among students, and the activity of students in the 1st period was predictive of the activity in the 2nd period. Face-to-face meeting did not seem to contribute to facilitation of the course. During the 1st period, active students were only 1 or 2 in each class, however, when we combined three small classes into one bigger class, several active students could discuss within a class. That might activate discussion between these active students in the 2nd period in Course 3. This hypothesis is supported by the response that size of the class in the 2nd period was adequate in Course 3. There were also free comments given in the questionnaire, such as "The response was too slow, and there was a lack of response". Activation of discussion in the 2nd period in Course 3 was due to further activation of previously active students, rather than the activation of previously inactive students.

It should be noted, however, that the change in number of messages between 1st and 2nd period was not always consistent. Therefore, it does not appear that simply being able to view the content of messages of other classes contributes to an increase in the number of messages. In addition to Course 3, if classes were combined in Courses 1 and 2 in the 2nd period, the possibility of producing an increase in the number of sent messages per student was considered because one or two active students was in each class in both course 1 and course 2.

During the trial, 55.6% of the students sent messages; only the students who sent 2 or more messages were counted because each student sent one introductory message. This contrasts with our earlier experiences over the last 3 years using an Internet-PBL system, in which we observed >90% of students sending 2 or more messages. It is likely that the significantly lower response rate in the current Masters version of the Internet-PBL system may be attributed to the fact that participation in this course was only at the recommendation of the teacher, and the student had no obligation to send messages to the discussion board. It is likely that the number of messages from students would significantly increase if the Internet-PBL was a formal component of the Masters course.

The optimal number of students per class in PBL/tutorial education is not well established, although these teaching systems have been evaluated in small groups.[7] Excellent results, with small-group classes (8 students), have been obtained over the last 10 years by studies performed at Gifu University School of Medicine, as well as other Japanese universities, in evaluations of PBL/Tutorial education for grades 2 – 4.[8, 9]

The current study serves as an important pilot programme to evaluate the appropriate student organization for Internet-PBL, with the number of students assigned to specific classes determined empirically, based on our previous experience in running such Internet-PBL courses for undergraduate students on three previous occasions. These previous Internet-PBL studies differed in some respects, such as the number of universities participating and the specific curriculum used, but other aspects, such as course duration and grade of students, were similar. While the courses cannot be directly compared, the numbers of messages and students (given in parenthesis) in each class of each fiscal year were: 5.56±0.34 (22, 3 classes), 7.44±1.72 (20, 11 classes) and 5.62±1.02 (33, 10 classes) in 2002, 2003 and 2004, respectively. In the Masters course, the number of messages, in a class of about six students, was about 4 on average, and significantly increased when the classes were combined to have 16 students per class. From these results, we predict that an optimal number of the students in each class in Internet-PBL would be ~20 people. Evans *et al.* also reported the appropriate number of students in the web-based PBL education system, GELATIN.[6] In this trial, not only Japanese but also English students attended as members, and the results indicated that discussion had been worked well when the number of student in the discussion group was 16 rather than 8. Therefore, it may be a universal phenomenon that the increase of the number of group

members leads to the activation of the discussion in the web-based PBL education.

In conclusion, we suggest that there is a minimum 'critical mass' of students per class to optimize the active student participation (indicated by number of sent messages) of the Internet-PBL. We estimate the appropriate number of student to be about 20. This is a larger number than that previously used in PBL/tutorial systems, and this difference is likely due to specific differences in course structure and execution.

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Table 1: Class composition

	Number of students			
	Class A	Class B	Class C	Total
Course 1	6	4	–	10
Course 2	7	9	6	22
Course 3	6	5	5	16

Course 1: Oxygen and Life
Course 2: Cross Talk of Food Science and Bioscience
Course 3: Reproduction, Evolution and Ecology

Table 2: Strategies for facilitation in each course

	Face-to-face meetings	View messages from other classes	Combine classes
Course 1	+	+	–
Course 2	+	–	–
Course 3	+	+	+

Course 1: Oxygen and Life
Course 2: Cross Talk of Food Science and Bioscience
Course 3: Reproduction, Evolution and Ecology

Table 3: Result of the questionnaire to student (Excerpted)

For all students	Number of answers
• In which course did you participate?	
a. Course 1 Oxygen and life	5
b. Course 2 Crosstalk of food science and life science	7
c. Course 3 Evolutionary Ecology	7
• How did you know about the Internet-PBL trial?	
a. recommended by your teacher	15
b. from MEDC staff	1
c. recommended by teacher in other university	1
d. from a friend	1
• How would you rate the face-to-face meeting held during the course?	
a. good	9
b. bad	2
c. other	6
For students in Courses 1 and 2	
• Were the number of student in your class	
a. adequate	3
b. too many	1
c. too few	7
For students in Course 3	
• Were the number of student in your class during the 1st period	
a. adequate	2
b. too many	0
c. too few	3
• Were the number of student in your class during the 2nd period	
a. adequate	4
b. too many	1
c. too few	0

Number of valid responses: 17 (Collection rate: 34.7 %)

Figure 1: Total number of student messages of each course. Open column: 1st period; closed column: 2nd period. Numbers in figure are number of messages

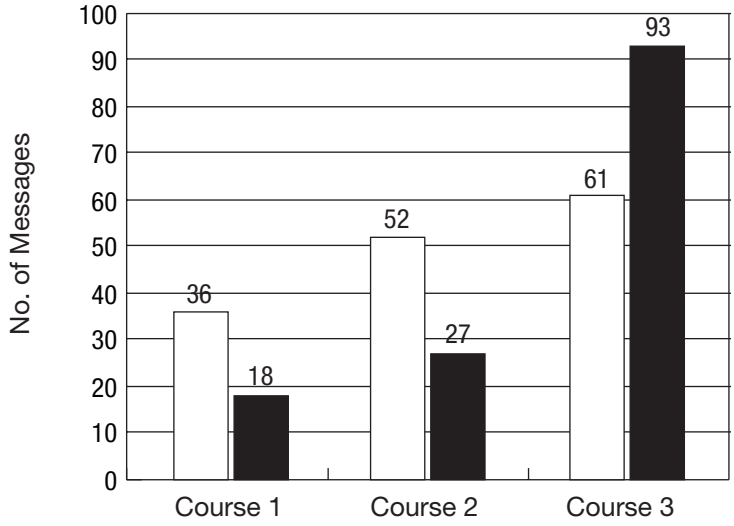

Figure 2: Number of messages in each student in Course 3. Open column, 1st period; closed column, 2nd period. Numbers in figure are number of messages.

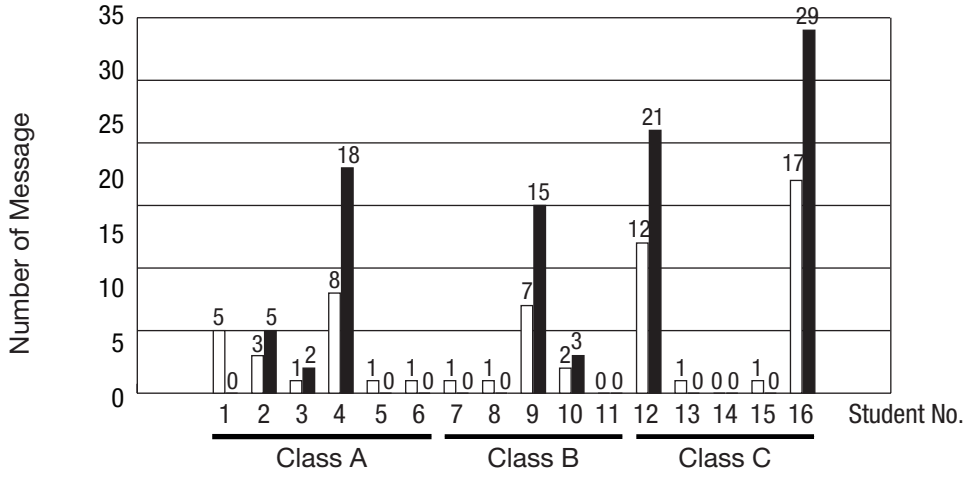

Figure 3: Number of messages in each student in Course 1 (A) and Course 2 (B). Open column, 1st period; closed column, 2nd period. Numbers in figures are number of messages.