Self-Learning Support System to Increase Motivation for Learning

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Abstract: In higher education, a decline in the academic abilities of students has become a serious problem. In this paper, we propose a system to increase learning motivation with the ultimate aim to increase the academic ability of students. To achieve this aim, we provide an environment for students to facilitate self-e-learning system in classes using blended learning. We report the development of this environment and the results obtained.

Keywords: Motivation for Learning, Self-Learning, Support System, Academic Ability

1 INTRODUCTION

With the development of information technology (IT), the number of learning options is continually increasing for students in IT-related course studies (both in universities or other institutions). However, due to reduction in the enrollment of students and increases in the advancement rate from high schools to universities, students' motivation for learning decreases. As a result, many universities are facing the problem of students with low academic abilities[1].

For effective learning and efficient operation of courses, blended learning, which is a combination of face-to-face lectures and e-learning, is widely used[2].

This research aims to increase learning motivation and consequently the academic abilities of students by developing an environment that facilitates a self-e-learning system for classes using blended learning. students'

2 APPROACH

For blended learning using face-to-face lectures and a course or learning management system, we propose to facilitate self-learning by students by providing a self-learning environment in a course management system and applying it to an existing class framework. This paper shows an experimental application for basic programming using Moodle, which is an open-source course management system.

3 REQUIREMENTS

Self-learning involves scheduled reviews of materials presented in a previous class or preparation of materials for the next class.

What is needed to promote self-learning, particularly preparation, in students? In programing classes involving the use of exercise, it is important that students acquire or review the prerequisite knowledge and skills while preparing for the class.

To assist students in self-learning using a course management system, short questions and quizzes are believed to be necessary. However, if the order and the contents of quizzes is same for every time or for every students, it can lower willingness to study. Therefore, it is required that the order and the contents of of the same quiz will be changed for every time by preparing many questions for the same difficulty and for the same learning item and by random selection of them.

4 SYSTEM

To achieve the requirements described in section 3, we implemented new functions using Moodle, an open-source course management system. In section 4.1, we introduce Moodle functions related to our requirements, such as quizzes, question banks and random questions. In section 4.2, we describe the design of the newly implemented function.

4.1 Moodle functions: Quizzes and Questions

In Moodle, a *quiz* is constructed using *questions* registered in a *question bank*. Categories are used to create hierarchy of questions in a question bank. To provide quizzes to students, teachers are required to create questions into the question bank and create quiz pages using them. Students can therefore take a quiz created by their teacher.

Moodle has a feature named *random question* which is used to create a quiz by randomly selecting a specific number of unique questions from a particular category. For example, if a category has 20 questions and a teacher specifies that four questions should be selected from the category, they will be randomly selected when each student takes the quiz. Each attempt of a student will result in a new selection of questions. This feature is therefore useful for both preparation and reviews of materials already learnt. This feature also decreases the probability that a student may hear correct answers from other students who have already completed the quiz. However, to ensure that the difficulty level is consistent

for each attempt, teachers should develop sufficient number of questions with the same difficulty level in each category. Moreover, if a teacher wants to create a quiz with questions from different categories, many categories and many questions for each category should be created. Such situations cause inefficient maintenance and/or operation of the question bank.

4.2 Extended Random Question

To solve the problem mentioned in section 4.1, we have developed the feature of *extended random question* that allows *random questions* to be more easily managed and maintained. Random questions are selected according to question categories, whereas in extended random questions are selected according to a question category and the specified question tag. Extended random questions are as useful as random questions, and this feature allows maintenance of question banks.

Extended random questions also contain another feature. If a teacher wants to use random questions for a class examination instead of self-learning, the feature gives students belonging to a specific group the same selection of questions instead of giving different selections to each student. Hence, extended random questions allow question selection not only when each student attempts a quiz but also when a teacher creates a quiz. That is, all students who attempt the quiz get the same questions that were randomly selected when the teacher created the quiz.

To implement extended random questions, we add a *tags* field into the question table in the quiz module, in which teachers can specify a *tag* for each question. By using this extension, when a teacher creates a quiz, he/she can select an extended random question in the same manner as a random question and specify a tag for the qualified selection. Unless a teacher specifies a tag for an extended random question, questions are selected from the entire question bank of a specific question category, as in the case of the original random questions.

5 USAGE EXAMPLE

Moodle is used to implement the functions described previously in a real classroom.

5.1 Use case for basic programming

Basic programming classes do not usually involve classroom lectures and contain only practical session. Assume that there are six classes each containing 40 students. Normally, a class consists of seven practical sessions and one examination. We applied our system with the self-study quiz in a class comprising only repeater (35 students, 2 classes). Because the exercises in the class had already been implemented in the previous year, the students were graded on the basis of only three examination results.

Table 1. Category of quizzes

category
variable type and operator
array
input and output
conditional branch
loop
function
structure
string
file i/o

It was optional for the students to take a quiz and there were no restrictions on the number of attempts. Quizzes contained questions belonging to each of the nine categories listed in Table 1. Each quiz contained four questions: the question for confirming materials, the basic question, and the applied questions for each category. For example, a quiz covering the category "structure" contained four questions randomly chosen from each of the following categories: a set of questions for confirming materials covering the category "structure", a set of questions related to definitions of data structures and data access, a set of questions related to data structures and functions, and a set of questions related to data arrays.

Detailed explanations of answers are provided for all questions. The explanation for each question is displayed after the exam irrespective of whether a student's answer to the question is correct. Our aim is to ensure that even if students do not understand the topic covered by a question, they can obtain a sufficiently high score in the next attempt by understanding the explanation.

6 EVALUATION AND CONSIDERATION

6.1 Usage Results of Quizzes

We prepared a quiz for each of the categories described in section 5. A total of nine quizzes were prepared. Table 2 shows the total number of attempts for all nine quizzes for 70 repeaters. Thirteen students had never used quizzes and the total number of attempts for nine students was less than five, even though there were nine quizzes. In contrast, more than half the students had attempted the quizzes 15 or more times. In particular, the top seven high scorers had attempted 40 times or more.

6.2 Results of Certification Exams

Certification examinations are held three times per semester. Each examination is worth 30 points, with a total of 90 points. At the time of writing this paper, the scoring of all examinations was not completed. Table 3 shows the temporary scores by autoscoring. Although the scores are

Table 2.　Distribution of number of attempts in all nine quizzes

number of attempts	head-count
40+	7
35 - 39	1
30 - 34	4
25 - 29	8
20 - 24	6
15 - 19	4
10 - 14	8
5 - 9	10
1 - 4	9
0	13

Table 3.　Distribution of temporary score in certification exams

total score	head-count
70	1
60	2
50	8
40	7
30	11
20	14
10	14
0	13

generally low, they are considered to be satisfactory given that all the subjects failed this course in the previous year.

6.3　Questionnaire Survey

After the third certification exam, we carried out a survey pertaining to the quizzes. Responses were received from 59 out of the 70 students.

In the questionnaire, we asked "How often do you use quizzes for preparation?" The results indicate that over 70% students used the quizzes often (Table 4).

Because each quiz has randomly selected questions for each attempt, it is expected that each student would have taken the same quiz more than once. Hence, we asked "How many times did you take the same quiz?" The results obtained indicated that over 70% students had taken the same

Table 4.　Result of "How often do you use quizzes for preparation?"

head-count		answer
17	(29%)	usually
26	(44%)	often
15	(25%)	sometimes
1	(2%)	never
0	(0%)	I don't know

Table 5. Distribution of the results of "How many times did you take the same quiz?"

head-count		answer
17	(29%)	4+
14	(24%)	3
10	(17%)	twice
15	(25%)	once
3	(5%)	I don't know

Table 6. Results of "How useful are the quizzes for preparation?"

head-count		answer
18	(31%)	very useful
28	(47%)	useful
3	(5%)	less helpful
3	(5%)	useless
7	(12%)	I don't know

quiz more than once (Table 5).

We also asked the usefulness of the quizzes for preparation, reviews, and exams (Tables 6, 7, and 8, respectively). The results indicated that approximately 80% students found them to be very useful or useful for preparation, reviews and exams (Tables 6, 7, and 8). These results shows the usefulness of quizzes for the entire course.

We also asked the students about the usefulness of random selection of questions provided by extended random questions. Many students answered that it was very useful or useful (Table 9).

To increase understanding of a topic, we prepared explanations for each question. The explanations were displayed after each student took a quiz. In our survey, we asked about the ease of understanding of these explanations, and 70% of students indicate that they were very easy to understand or comprehensible (Table 10).

A free-description question asked students for ideas concerning how the quizzes could be improved. Three students suggested that the number of questions be increased, four students suggested that the difficulty level be changed, seven students suggested that more practical questions than fill in the blank questions be included, two students suggested other

Table 7. Results of "How useful are the quizzes for reviews?"

head-count		answer
22	(37%)	very useful
28	(47%)	useful
5	(8%)	less helpful
1	(2%)	useless
3	(5%)	I don't know

Table 11. Relationship between quiz attempts and temporary score of exam

total attempts	head-count	average score	max score	min score
30+	12	22.5	40	10
20-29	14	36.4	60	10
10-19	12	31.7	60	10
1-9	19	20.5	70	0
0	13	5.4	20	0

Table 8. Results of "How useful are the quizzes for exams?"

head-count		answer
16	(27%)	very useful
30	(51%)	useful
5	(8%)	less helpful
3	(5%)	useless
5	(8%)	I don't know

Table 9. Results of "How useful is the random selection of questions?"

head-count		answer
26	(44%)	very useful
23	(39%)	useful
7	(12%)	less helpful
1	(2%)	useless
2	(3%)	I don't know

Table 10. Results of "How comprehensible are the explanations?"

head-count		answer
18	(31%)	very easy to understand
23	(39%)	comprehensible
12	(20%)	somewhat cofusing
4	(7%)	difficult to understand
2	(3%)	I don't know

ideas, and the remaining 43 students did not provide any answer or saw no need to improve the quizzes.

We also asked for ideas to improve the explanations for each questions. Seven students wanted the explanation to be more comprehensible, five students wanted the answer for each question, as opposed to its explanation, two students had other ideas, and the remaining 45 students did not provide any answer or saw no need to improve the explanations.

The general feedback received in our survey was that the responses had high subjective evaluation.

6.4 Consideration of motivation for learning

The results of the usage of the quizzes and the accompanying survey show that many students took these quizzes although it was optional to take them.

It is believed that continued use of the quizzes will provide an environment that will assist students in maintaining their motivation for learning. However, a fair evaluation could not be achieved because all subjects were repeaters.

Furthermore, students who attempt the quizzes many times without reading and understanding explanations displayed after their attempts may continue to repeat their course until they earn full points. A detailed analysis of quiz attempts may be required.

6.5 Consideration of academic ability

Table 11 shows the distribution of then number of quiz attempts and the average temporary score of the certification exam for each distribution range. These results show that students who attempt quizzes multiple times may not necessarily obtain a good score on exams. It is therefore difficult to infer whether the introduction of quizzes for self-learning directly increases the academic ability of students. As already mentioned in section 6.4, students who attempt quizzes many times do not always read the explanation displayed. It is estimated that after taking a quiz two or three times, students who read and understand the explanations comprehend the contents in each category. It is thought that the advisable maximum number of quiz attempts is two or three for each quiz, that is, the total number of attempts for all quizzes ranges 18-27. As shown in Table 11, students who attempted the quiz 20-29 times had the highest average score.

Table 12. Relationship between quiz score and temporary score of exam

quiz score	head-count	average score	max score	min score
100	5	22.00	30	10
90-99	5	34.00	50	20
80-89	8	35.00	60	10
70-79	11	33.64	70	0
60-69	11	24.55	60	0
50-59	4	30.00	50	10
40-49	4	30.00	30	30
30-39	2	15.00	20	10
20-29	4	10.00	20	0
10-19	2	15.00	20	10
0-9	14	5.71	20	0

Table 12 shows the distribution of the score of quizzes and the average of temporary score of the certification exam for each distribution range Quiz score is the average of the highest scores in each quiz for each student. One hundred indicates that the student continues to take the quiz until he/she attains a score 100. This result also shows that students who achieve high quiz scores do not always achieve high certification exam scores. It has already been mentioned that some students repeatedly take quizzes without understanding the explanations displayed after quiz attempts. Because the number of prepared questions is limited, it is possible that some students who memorize correct answers after frequent quiz attempts without understanding the concepts involved get high quiz scores despite the random selection of questions.

7 CONCLUSION

We analyzed the required features of course management systems for increasing learning motivation and facilitating self-learning. On the basis of our analysis, we developed the required feature using Moodle, which is an open-source course management system. We introduced the feature into an actual course for learning programming and evaluated the use of the feature by a survey. We provided an environment that assists students in maintaining their motivation for learning by providing interesting system features and developing educational materials that utilize this feature. However, the features and materials do not always have the effect of increasing the academic ability of students. Therefore, a detailed analysis of the results and improvement of both features and educational materials is required. Finally, we express sincerely thank Version2, Inc. for its cooperation in the development of the Moodle feature.

REFERENCES

[1] Ui Tetsuo, "Problem on Decreasing Academic Ability of University Students and Its Solutions (in Japanese)", Operations Research, 54(5), pp243-248, Operations Research Society of Japan, 2009

[2] Miyaji Isao, Adachi Kazuhisa, Uchida Minoru et al., "Toward Blended Learning from E-learning (in Japanese)", Kyoritsu Shuppan, 2009