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Balance Control of Question-Posing Focusing on Learning Target Words on the Self-Study Material Contribution and Sharing System

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Abstract: Recently, education and learning by using e-Learning style have become popular. We have developed a self-Study Material Contribution and Sharing System called "S-Quiz" wherein students can pose questions and share them. Through the educational practice with S-Quiz, we found that balance of posed questions was not suitable to use for learning after question-posing. This paper describes balance control of question posing in order to solve this problem of unbalanced questions. This balance control aims to increase questions of which posed number is a few by system-centered navigation to students on S-Quiz. In addition, we propose a control method which is not biased to a part of students.

Keywords: e-Learning, Self-Study Material Contribution and Sharing System, S-Quiz, Balance Control of Question-Posing

1. Introduction

Recently, education and learning by e-Learning have become popular in especially higher education, job training, and so on. We have developed a self-Study Material Contribution and Sharing System called "S-Quiz" wherein students can pose questions and share them(Mizuno *et al*, 2007, Hayashi *et al*, 2008). S-Quiz is categorized into educational system by using question-posing. There have been developed various kinds of such question-posing systems(Nakano *et al* 2002, Yu *et al* 2005, Takagi and Teshigawara 2006, Hirai and Hazeyama 2007, Denny *et al* 2008).

We used S-Quiz in home work for a special subject of university. In the home work, each student could freely pose questions about several important keywords which s/he understands well. We call the important keywords which can be selected in a lecture LTWs: Learning Target Words in this paper. In this educational practice, we found students posed many questions for several LTWs as a positive result but other several LTWs have no posed question as a negative result. We can think that the unbalance of question-posing can happen by allowing such style of question-posing mentioned-above.

Posed questions are expected to be shared and be used their learning after question-posing. Therefore, unbalanced question sets are not suitable for student to use for their learning. In order to avoid the unbalance of questions, we try to add a balance control function into S-Quiz. In this balance control function, "good balance of question posing" is defined that the number of questions about each LTW is bigger than the threshold value (for example, minimum number of posed-questions). Based on this idea, we set following conditions:

(1) Balance Control function navigates student to pose question about LTWs of which the number of posed questions is smaller than the threshold value, and
(2) The navigation is not concentrated to a part of students.

In this paper, we propose two balance control methods: basic method and improved method. Especially, explain about the simulation result of the improved method and show this method satisfy the conditions (1) and (2) on simulation level.

2. S-Quiz

S-Quiz provides a learning environment wherein students can pose questions freely and share the question with other students. Fig.1 shows a snapshot of question posing interface of S-Quiz. After choosing question category, students can make a question by inputting a question text, one correct answer, and three incorrect answers on the question posing interface and then post it. In addition, students can input hint information of questions by text and image data. In the case of Fig.1, the student poses a question about ENIAC. Generally, ENIAC becomes a LTW which can be selected in the genre about computer system. As for the genre, student can select a proper genre from the pull down menu. The set of genre is chosen by the teacher in advance.

Figure.1 Question posing interface of S-Quiz

Fig.2 shows a snapshot of question answering interface of S-Quiz. Students can also share all questions posed by other students and use them for students' free learning. Beside the multiple choice question, the genre, the maker (student) and the evaluations of the questions quality are displayed. As for the evaluation, students can vote three kinds of evaluations: "Good", "Average" and "Not good" to questions which the student has answered. Hint message and image can be also displayed if they are prepared. Basically, the student can answer the question by selecting a correct answer candidate from four choices, but s/he can select "Pass" to obviously inform that s/he does not know.

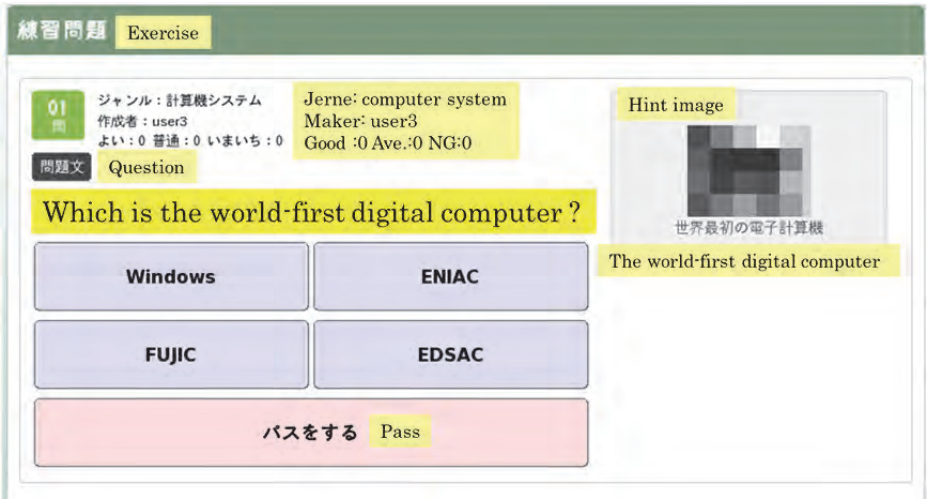

Figure.2 Question answering interface of S-Quiz

3. Balance control of question-posing

3.1 The reason of unbalance of question posing

In S-Quiz, student's actions are mainly classified into question-posing and question-answering. LTWs are important words in a lecture. Therefore, it is ideal style of question-posing in S-Quiz that all students make questions about all LTWs. However, we should consider the other factors: the number of students, understanding levels for each LTW, and so on. As for the number of students, if it is large number, the number of posed questions also becomes large. Sometimes it becomes exceed to use. In addition, the possibility of low quality of questions becomes high, because it is not guaranteed that all students can good quality of question for every LTW from the viewpoint of understanding levels for each LTW. Therefore, it is a realistic and loose solution for answering to the mentioned-above that each student poses questions about several LTWs which s/he understands well. In contrast, the unbalance of question-posing can happen by allowing such style of question-posing.

3.2 Conditions of Balance control

Balance control of question-posing is to increase question-posing about LTWs of which the posed number is smaller than the threshold value in order to avoid unbalance of question-posing. S-Quiz focuses on such LTW and navigate student to pose question about the LTW. This control makes question-posing balance good with satisfying the following conditions: (1) Balance Control function navigates student to pose question about LTW of which the number of posed questions is smaller than the threshold value, and (2) The navigation is not concentrated to a part of students.

3.3 Basic method

Considering only balance of question-posing, we can just focus on the condition (1). As for LTWs of which the number of posed questions is smaller than the threshold value, S-Quiz navigates students to pose questions about the LTW. We call this navigation as "basic method." The followings are concreate process of basic method:
(BM1) Estimation of the number of questions which students will pose from now,
(BM2) Calculation of probability that each LTW is included in questions, and
(BM3) Decision of LTWs that navigation of question-posing is needed by using results of the above mentioned (BM1) and (BM2).
The basic method is simple to be implemented. However, navigation based on the basic method tends to become frequent at the late stage of question-posing. In other words, the navigation is concentrated to a part of students who pose questions at such stage. Unless students accept the navigation, the balance of question-posing cannot be improved.

3.4 Improved method

Focusing on both conditions (1) and (2), we propose "improved method" for balance control of question-posing. This improved method positively navigates students even at early stage of question-posing. In order to realize this feature, the necessary number of posed question of each LTW is calculated automatically according to the situation. If the current number of posed question about a LTW is smaller than the necessary number, navigation works for question posing about the LTW. To fulfil the condition (2), the improved method activates navigation at early stage of question-posing even when navigation is not needed.

3.5 Discussion

Generally, it can be useful for keeping the balance of numbers to use both upper and lower limits. However, both basic method and improved method use only a lower limit. If upper limit is set, it can occur that a student is not allowed to pose the question about LTWs on upper limit. This is a bad situation for motivation of the student and also reduces the possibility that the student can pose

questions. The root purpose of balance control is to guarantee the minimum number of posed questions about each LTW. If the root purpose is satisfied, there is no need to set the upper limit. In addition, lower limits control by both methods loosely restricts exceed question-posing for each LTW. Through these considerations, the basic and improved methods put focus on only lower limits.

4. Simulation experiment

We did simulation experiments for evaluating performance of the improved method. In this section, we describe the outline of experiment, the simulation results, and discussion about the results.

4.1 Outline of simulation

Based on various kinds of data about educational practice with S-quiz, we assume student behavior and tendency of question-posing as followings:
(a) Students pose the required number (for home work) questions at once,
(b) Students do not use LTW which they have used before, and
(c) Students pose a question by using a LTW.
In addition, the following feature is included for simplification of group level behavior of students:
(d) Question-posing tends to be distributed and to be not overlapped.
Fig.3 shows illustrated figure about the features (a) and (d).

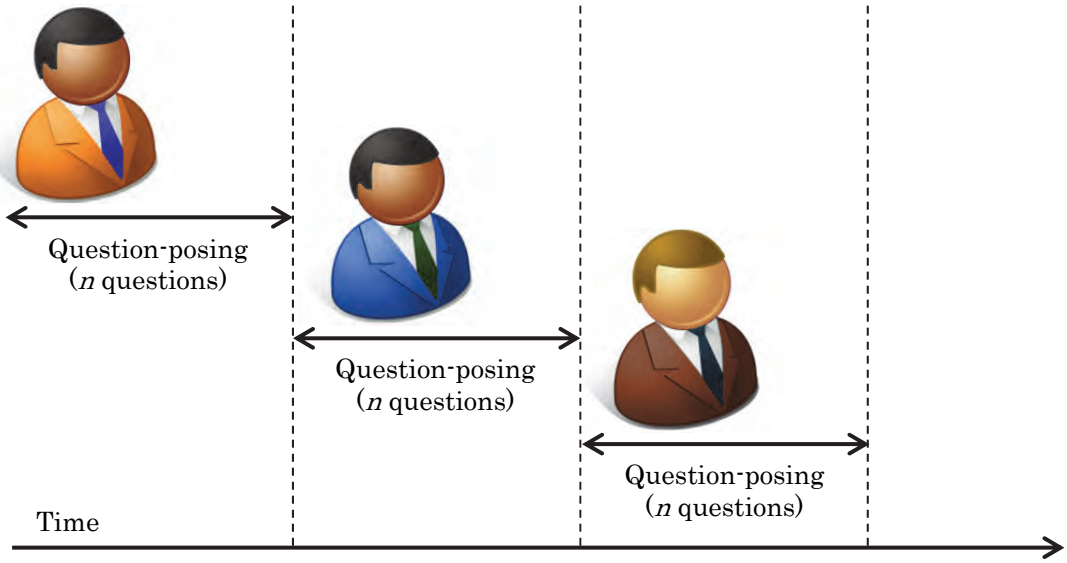

Figure 3 Question-posing tendencies of all students

4.2 Simulation results

In this simulation, we set parameters as Table 1. The threshold value means the minimum number for each LTW. We obtained the results from the large number of simulation with the parameters and calculated the average.

Table 1 Simulation parameters

Parameters	Simulation value
the number of students	80
the number of question posing per one student	10
the number of LTW	20
the threshold value	20
the probability of acceptance ratio to navigation	50%

Fig. 4 shows the number of posed questions about each LTW. The number of each LTW shows tendency of use. Small number means question of the LTW is easy to be posed. In contrast, big number means question of the LTW is hard to be posed. Therefore, it becomes high possibility that the number of posed question about LTW with big number is not over the threshold value without the navigation.

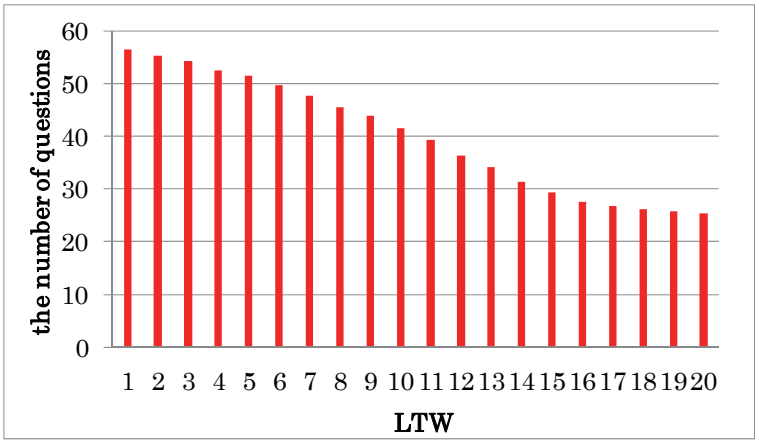

Figure 4 The number of posed questions about each LTW (by Improved method)

In addition, Fig.5 shows the number of navigation to each student. The number of student ID shows order of question-posing. For example, student 2 poses questions after student 1 poses questions (refer to Fig.3). This means that students with big number pose questions at late stage. Such students have to pose questions under frequent navigation.

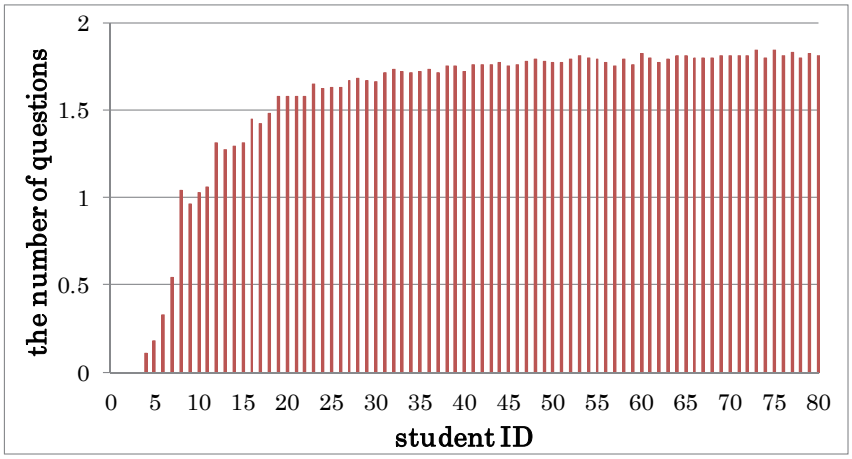

Figure 5 The number of navigation to each student (by Improved method)

4.3 Discussion

As for simulation results, we can find the every number of posed-questions for each LTW is over the threshold value (the minimum number) from Fig.3. In addition, we can find the number of navigation is under two times and there is no big difference of navigation among all students from Fig. 4. We can say the improved method satisfies the condition (1) and (2). We also did simulation experiments with various parameter settings and obtained good results for the improved method. However, we omit those results because of paper length limitation.

5. Summary

In this paper, we explained about development and the educational practice issue of S-Quiz: a self-Study Material Contribution and Sharing System wherein students can pose questions and share them. In S-Quiz, each student is allowed to pose questions about several LTWs which s/he understands

well. S/he does not have to pose questions about every LTW. In contrast, the unbalance of question-posing can happen by allowing such style of question-posing. Then, we proposed two methods for balance control of question-posing focusing on LTWs and simulation experiments. From the experiment we found our proposed method fulfil the following conditions: (1) Balance Control function navigates student to pose question about LTW of which the number of posed questions is smaller than the threshold value, and (2) The navigation is not concentrated to a part of students. The performance evaluation at real educational practice is remained.

Acknowledgements

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