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# Concerto II: A Collaborative Learning Support System Based on Question Posing

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## 1. Introduction

With the rapid advance of information society, many Web-based learning support systems have been developed (Yu et al., 2005). Providing Web-based learning environments enables learners to learn at anytime at any places.

We focus on learning based on question posing and propose a Web-based learning support system for such a learning style. Some literature pointed out that question posing is a highly intelligent activity, and that it contributes to improve learners' problem solving ability. Learning effectiveness is also expected by learners (respondents) answering questions, which were posed by other learners (posers), and by collaborative learning (Brindley & Scoffield, 1998) such as inquiries and answers between posers and respondents or comments by respondents.

Many research projects with respect to a question posing based learning support system have been launched in recent years (Rafaeli et al., 2004), (Takagi et al., 2004), (Yu et al., 2005). While they have some common features, each study provides its unique features. We developed a question posing based collaborative learning support system called Concerto and applied it to an actual university course (Hirai & Hazeyama, 2007). As the result, we identified necessity that facilitated positive communication among learners and issues on quality of questions. We propose a collaborative learning support system based on question posing called Concerto II in this chapter.

The rest of this chapter is organized as follows: we start describing related work in the next section. Section 3 discusses some problems on communication support that emerged from the results of application of Concerto. We also describe requirements for communication support in Concerto II. Section 4 describes system design of Concerto II. We applied Concerto II to an actual university course. Section 5 presents some results and discussions. Finally we conclude this chapter.

## 2. Related Work

This section describes state-of-the-art of question posing based learning support systems. Some research projects have been conducted with respect to a question posing based

learning support system; QSIA (Rafaeli et al., 2004), CollabTest (Takagi et al., 2004), and QPPA (Yu et al., 2005).

QSIA is a Web-based learning environment, which provides question posing, knowledge sharing (recommendation of questions to learners), and assessment as major facilities. It mainly focuses on knowledge sharing and assessment. Questions are created by instructors in most cases. When they are created by learners, the instructors review them and then they are opened.

CollabTest supports the following learning process: (1) learners pose questions based on the course contents, and the posed questions are reviewed by groups which are composed of several learners, (2) the question posers register the questions that have finished review into the database, then the instructor reviews the registered questions, (3) the instructor prepares the online tests by extracting questions from the database and opens them, and (4) learners pose questions that are similar to the opened ones. Takagi et al. obtained results on learning effectiveness through group review and posing similar questions.

QPPA is a Web-based learning support environment which provides four major functions: (1) question posing, (2) assessment, (3) browsing of questions, and (4) exercises in the form of drill. In question posing, only the mode of multiple choices is supported. In order to validate the environment, it was applied to learners of the upper grades in an elementary school. The evaluation was carried out from the viewpoint of usability of major functions and difficulty (easiness) of question posing among subjects (the system was applied to mathematics, natural science, and social science) by questionnaire. The authors did not evaluate QPPA from an aspect of learning effectiveness.

We aim at constructing a Web-based collaborative learning support system of which goal is to improve understanding of what learners learned by learner-centered learning with not only question posing and assessment of questions posed among peers but also communications with respect to questions. Our approach is similar to that by CollabTest and by QPPA in that it focuses on question posing by learners. As we think assessment for questions from many learners and communications with many learners contribute to enhance effectiveness of learning, we suppose that the abovementioned activities are carried out not by groups but by the whole class. As for communication support, Takagi et al. describe group review by a face-to-face fashion for questions learners posed. QPPA and QSIA do not provide communication support. We develop a system, which emphasizes on collaborative learning such as modifications of questions based on the assessment results from peers and distributed asynchronous communications with them, and version management of questions. Table 1 shows summary of state-of-the-art of question posing based learning support systems.

### **3. Results of application of Concerto and some enhancement requests toward Concerto II**

We described state-of-the-art of question posing based learning systems in the previous section. As the result shows, CollabTest and our system provided communication support functions. Although CollabTest provided communication support, it only supported group review for posed questions in a face-to-face manner.

	QSIA	CollabTest	QPPA	Concerto
main question poser	instructors	learners	learners	learners
mode of posing	multiple-choice question	multiple-choice question (text base)	multiple-choice question (allow to use figures)	multiple-choice and story question (allow to use figures and tables)
assessment	*	-	*	*
communication support	-	group review (a face-to-face environment)	-	each question has BBS (a face-to-face environment) (a distributed asynchronous environment)
others	recommendation	online test (instructors' review)	drill-and-practice exercise	request comments for the instructors

Table 1. Comparison of question posing based learning support systems

We developed a question posing based learning support system called Concerto. It provided following major functions:

- \* Question posing
- \* Answering questions
- \* Assessment
- \* Communication support
- \* Data analysis

Please refer detail of Concerto to (Hirai & Hazeyama, 2007). We applied it to an actual university course. This section presents some results from its application with respect to communication support particularly. Based on the results, we describe the system design of Concerto II, which facilitates communication in question posing based learning.

### 3.1 Communication Support in Concerto

Each question had a Bulletin Board System (BBS) for it in Concerto. We provided a function of “request comment for the instructors” which was the function to receive assistance from the instructors when a question was not solved by discussions by learners. If a learner uses this function, an e-mail message is sent to the instructors that a learner requested for help from the instructors for the corresponding question. The learners may receive comments from the instructors in a prioritised manner. This function may lead to reduction of burden of the instructors.

### 3.2 Results of Application of Concerto

The course we applied Concerto was “Introduction to a computer system.” The objective of the course was to give lectures on principles of digital computers. The course was offered

for the first year undergraduate students of Department of Information Education at Tokyo Gakugei University. The period of application was during 22 May 2006 through 10 July 2006. Table 2 shows the results of its application. We analyse the results of application from both the data that were stored in the system and those from the questionnaire.

Item	Result
Number of users who registered to this system	51
Total number of login	637
Total number of questions registered	50
Total number of modifications of questions	16
Total number of answers to questions	1454
Total number of assessments registered	926
Total number of messages submitted to BBS	33
Total number of threads in BBS	11

Table 2. Usage results of Concerto

As we presented in the above table, fifty questions were posed and learners answered 1454 questions in total and wrote 926 assessment comments. However few discussions occurred (they were only eleven threads and thirty three messages were exchanged). "Request comment for the instructors" was not used. We analysed communication patterns from eleven threads in the BBS. We found the following four patterns:

- (A) Inquiries and/or comments from the learners who tackled the question, and responses to them by the question posers (seven threads)
- (B) Responses by the question poser to the comments written in the assessment field (two threads)
- (C) The question poser announced mistakes to the question he/she posed, then learners who answered it wrote the comments of agreement or encouragement, and finally the question poser appreciated peers' comments (one thread)
- (D) A learner requested peers for posing other questions that were similar to the question he/she answered because he/she was not good at the theme. Then another learner wrote a comment that he/she had posed a question that met the request (one thread)

Responses were written by question posers to the messages with respect to all inquiries or requests. In many threads, question posers finally appreciated to the comments or questions from peers. Some inquiries were written as the assessment comments. However question posers did not respond them except for only two cases (pattern (B)). As all communications were closed in the BBS, the learners who asked inquiries should have written them in the BBS.

As for pattern (D), we did not anticipate such a communication pattern in designing of the system. If such a message stays in a particular thread of a particular BBS, it may be buried. Such a message may become a hint for question posing. Therefore we will provide the

function, which allows a learner to request for question posing and to manage the follow-up in the next version of Concerto.

As a negative opinion from the questionnaire, a learner gave a comment, "as question posers are learners, posed questions are not accurate and reliable." We also tackle this problem in Concerto II.

### 3.3 Requirements toward Concerto II

From the results of analysis in the previous sub-section, we identified the following requirements for communication support in Concerto:

(R1) Request of question posing: in the pattern (D) we identified in the previous sub-section, a learner asked classmates for question posing with respect to a theme he/she was not good at. This request will become a hint for those who have intention to pose questions. It is also necessary to manage the status whether the request was achieved or not.

(R2) Disposition with respect to quality of questions created by learners: it is necessary to present information on who created the question as well as the question itself because some learners were anxious about accuracy and reliability of posed questions.

(R3) Support as a kind of SNS (Social Networking System): we can think Concerto has an aspect of SNS for individual learners. In recent years, many people use SNS. It is said that in SNS, especially Weblog, feedback comments from others accelerate motivation to write Weblog (Chika, 2006). In our application, the learners who received feedback comments from peers increased motivation to use Concerto. This led to good achievement of the subject. Therefore we will provide a portal page for each learner and users can browse feedbacks (comments, inquiries, and so on) from peers in the page. We expect this page gives motivation to learners.

## 4. Development of Concerto II

This section describes enhancement items from Concerto to Concerto II.

### (1) Enhancement of question posing facility

In response to the requirement (R1), we provide a function that a learner can request the classmates for question posing. The posed questions that were responded to the request by the classmates are associated with the request. Also, communication space for discussions with respect to the requests between the requester and the classmates is given.

In response to the requirement (R2), we provide information on who posed what questions and how they were evaluated by peers like Amazon (Amazon). As another solution to the negative comments for question posing based learning by learners, we suppose learners make communications on the posed questions through the communication support function.

### (2) Portal page

Each learner has his/her own page (we call this page "my page"). This page presents feedback information for questions he/she posed (ranking points determined by level of difficulty and the number of answers to questions he/she posed, and contribution to the classmates). We expect such information improves learners' motivation. This is a solution to the requirement (R3). This page also presents all the questions by classmates, list of requests of question posing, and announcements from the instructors. Fig. 1 shows a screen shot of "my page" of Concerto II.

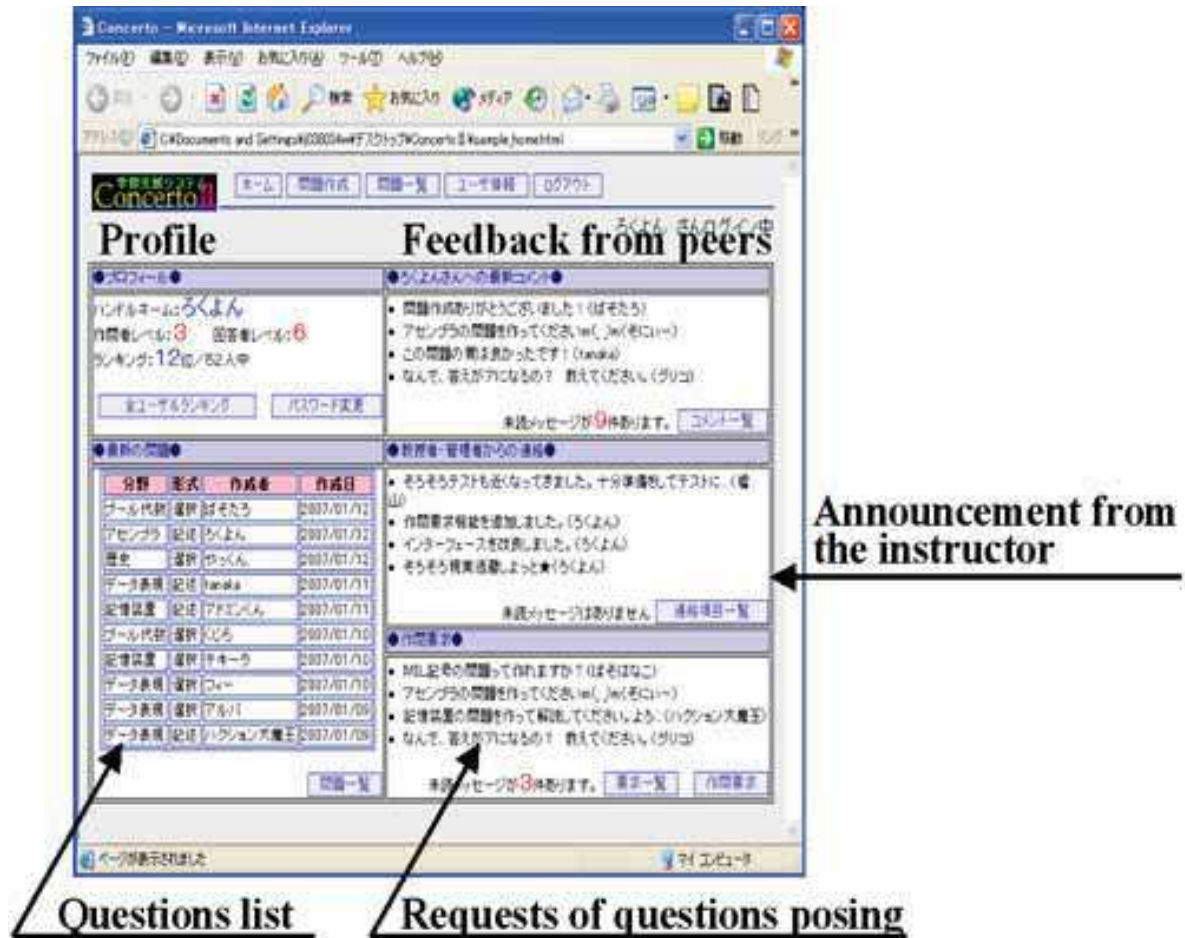


Fig. 1. Screen shot of “my page”

## 5. Evaluation

### 5.1 Overview of the experiment

We applied Concerto II to a university course “Introduction to computer systems” in the 2007 academic year. We provided it during 21 May 2007 through 9 July 2007 and then asked the learners in the course for responding to questionnaire. The questionnaire is composed of some items in the form of Lickert Scale (four ranks; 1: disagree, ..., 4: agree) and qualitative comments that corroborate the evaluation of the items by Lickert Scale.

### 5.2 Results

Table 3 shows the usage results of Concerto II.

### 5.3 Discussions

We discuss effectiveness of enhancement of communication function and that of the function “request of question posing.”

(1) Enhancement of communication support

Table 3 shows the number of questions increased 6.2 times, the number of threads 10 times from Concerto (Table 2) to Concerto II respectively. In Concerto, learners could use BBS only in a window to select a question. In Concerto II, as “my page” presents various types of awareness information including in which questions messages are exchanged, we think this information contributed to high usage frequency of BBS.

Item	Result
Number of users who registered to this system	91
Total number of login	3291
Total number of questions registered	311
Total number of modifications of questions	187
Total number of answers to questions	7239
Total number of assessments registered	4196
Total number of threads in BBS	110
Total number of request of question posing	6

Table 3. Usage results of Concerto II

#### (2) Effectiveness of request of question posing

Six requests of question posing were submitted during the experiment as shown in Table 3. Questions were posed for four out of them. The average score of Lickert Scale for the item “Did the function of request of question posing give you a chance to pose questions?” in the questionnaire was 3.07. This result suggests the function gave a chance to pose questions. This function also enables learners to answer questions they would like to tackle.

On the other hand, some learners pointed out drawbacks for this function as follows: “I think requesters should pose questions by themselves before requesting others.” However, from the data that was stored in the system, the learners who requested for question posing posed at least four questions. This means they were not free riders, and collaborative learning by posing questions in an interdependent manner was observed.

Another learner wrote, “I could not respond a request because it was too ambiguous.” For example, the following request was submitted: “please pose questions on storage devices”. There are various learning topics on storage devices, for example, terminology, characteristics of devices, performance calculation, and so on. He/She could not grasp what the requester wanted. We provided communication space for discussions with respect to request of question posing, but it was not used in this experiment.

In our study, question posing and a series of discussions were done outside of the classroom. That is, collaborative learning based on question posing was accomplished under a distributed and asynchronous environment.

#### (3) Effectiveness of a metric to measure quality of questions

The average score of Lickert Scale for the item “Did the ranking points function for you to select questions to answer?” in the questionnaire was 2.83. Seven students gave comments



for the item “Which questions did you answer?” as follows: “I tried to answer questions that colleagues who got higher ranking points posed, in particular when I just started to use the system.” These results suggest the ranking points were metrics to measure quality of questions.

## 6. Conclusion

We have proposed a collaborative learning support system based on question posing that solved the problems detected from the results of application of the initial version of our question posing based learning support system called Concerto. Concerto II enhances communication support, provides a solution to a problem that posed questions are not accurate and reliable because posers are novice learners, and a mechanism for motivation improvement similar to Social Networking Systems (SNS).

We will show usefulness of the system by its application to university courses in longer terms.

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The education industry has obviously been influenced by the Internet revolution. Teaching and learning methods have changed significantly since the coming of the Web and it is very likely they will keep evolving many years to come thanks to it. A good example of this changing reality is the spectacular development of e-Learning. In a more particular way, the Web 2.0 has offered to the teaching industry a set of tools and practices that are modifying the learning systems and knowledge transmission methods. Teachers and students can use these tools in a variety of ways aimed to the general purpose of promoting collaborative work. The editor would like to thank the authors, who have committed so much effort to the publication of this work. She is sure that this volume will certainly be of great help for students, teachers and researchers. This was, at least, the main aim of the authors.

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