A Web-Based Asynchronous Discussion System and Its Evaluation

Hisayoshi Kunimune[1], Kenzou Yokoyama[2], Takeshi Takizawa[2], Takuya Hiramatsu[1], and Yasushi Fuwa[2]

[1] Faculty of Engineering, Shinshu University
[2] Graduate School of Science and Technology, Shinshu University
4-17-1 Wakasato, Nagano City, Nagano, 380–8553 Japan
kunimune@cs.shinshu-u.ac.jp

Abstract. This paper describes the evaluation of an asynchronous discussion supporting system for web-based materials. The system, which is named "Writable Web," provides the features assisting asynchronous discussion by sharing annotations. We improve the features in order to support the annotation sharing of the system on the basis of the first trial experiment conducted in an experimental class. Then, we carry out the second experiment in an actual class. The system is evaluated from two aspects. One aspect is the effect of the asynchronous discussion, which is measured from the scores obtained in a written assignment, and other is the functionality of the features based on the result of a questionnaire survey carried out after the experiment.

Keywords: web-based training, e-Learning, collaborative learning, asynchronous discussion.

1 Introduction

Recently, web-based training courses have gained wide-spread popularity in educational facilities and companies. In these courses, the course materials are provided as web pages. The advantages of web-based materials over paper-based materials are as follows:

- Multimedia contents such as movies, audios, and images can be included.
- The contents can be updated anytime by lecturers.

On the other hand, learners prefer to write annotation texts and marks on paper-based materials for better understanding of the subject[6]. However, learners cannot benefit from the abovementioned features of the web-based materials if they take printouts of the same to write annotations, This is because the printouts do not include no multimedia contents, thus becoming outdated when the web pages are updated. Many learners who study by distance e-learning face several problems related to printed web-based materials[5].

I. Lovrek, R.J. Howlett, and L.C. Jain (Eds.): KES 2008, Part III, LNAI 5179, pp. 507–514, 2008.

In addition, online discussions during web-based training foster the learners' knowledge construction. In order to provide an online discussion environment in asynchronous distance-learning courses, many web-based learning materials include online forums[1,4]. In discussions regarding the learning materials, learners often need to quote related parts of the material because online forums are separated from the learning materials.

To solve these problems, several systems that allow the user to incorporate annotations into the web-based contents and to share these annotations have been proposed. Koivunen has proposed a system "Annotea," which requires each user to install the client software[3]. Cadis has offered an annotation sharing system that needs to prepare proprietary servers such as Microsoft SQL Servers and Office Server Extensions: this system works only on with Windows[2].

We have proposed an annotation sharing system called "Writable Web," which is implemented as a web server application: thus, users need not install any special client software. The result of the first trial experiment showed that learners mainly used this system for understanding the important parts of materials clearly and for organizing and improving their knowledge. Moreover, the experiment showed that learners are dissatisfied with the usability of this system. On the basis of these results, we improve the annotation sharing functions and user interface of this system to offer usefulness to help share annotations. Sharing annotations directly on learning materials will facilitate online asynchronous discussions.

In this paper, we introduce an overview of "Writable Web" and discuss the evaluation of the improved functions and usability from the results of the second trial experimental conducted with the improved system.

2 Overview of "Writable Web"

2.1 Main Features of the System

"Writable Web" has the following improved features over other annotation systems mentioned in the previous section[5]. The system works as a server-side web application between the users' web browser and web servers that provide web-based learning materials. Therefore, "Writable Web" works on commonly used web browsers, without the need for a particular client software. Figures 1 and 3 show the systems that run on Firefox and Internet Explorer, respectively.

Users can directly attach two types of annotations to a given part of the text on the web pages, namely, highlighting (called as marker) and attaching text (called as memo) by using the system.

The system allows multiple users to write and share annotations after authentication by their IDs and passwords. The annotations written by each user are stored in a database on the server: therefore, users can share their annotations online. The usability of this system is improved according to the result of the first trial experiment, and the system has an organized structure of frames and usable floating menu, which enables one to choose the desired type of annotation.

2.2 Functions for Supporting Asynchronous Discussion

"Writable Web" has the following features that support asynchronous online discussions and communications:

- Making comments to shared memos.
- Organizing comments to thread structures.
- Notifying newly arriving comments to a user's memo or comment.
- Showing the rank of the web pages that are bookmarked and annotated by most of the users.

Though users can view the ideas of other users by sharing annotations, they cannot express or share their own ideas or opinions with other users. This system allows communications among users by making comments to shared memos. The existing web-based training courses have forums that enable communication among lecturers and learners. However, these forums are separated from the learning material texts, and users often need to quote a part of the text. On the other hand, our system facilitates communication directly on the texts of the learning materials. Therefore, users can clearly recognize that the discussion is related to the given part of the material. Figure 1 shows the form used to write a comment to a memo shared by another user. This system organizes the comments attached to a memo as a thread structure, as shown in Fig. 2.

This system provides a portal page to each user after the user logs into the system (Fig. 3). The portal page offers the users a form to input the URL and a bookmarking function to select web-based materials. The history of a user's annotations is also provided to the user on this page. Moreover, the portal page shows the users newly arrived comments attached to their memos or comments (Fig. 4) and displays the rank the web pages that are bookmarked and annotated by most of the users (Fig. 5). These functions show the user the summary of the memos and comments and the activities of the discussions on each page. Therefore, by using these functions, the users can easily follow the asynchronous discussions on many materials.

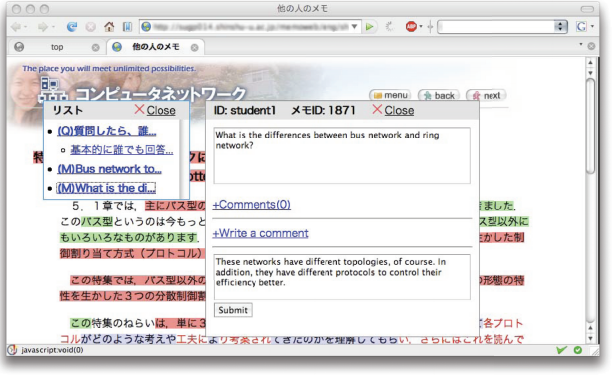

Fig. 1. Writing a comment to a memo

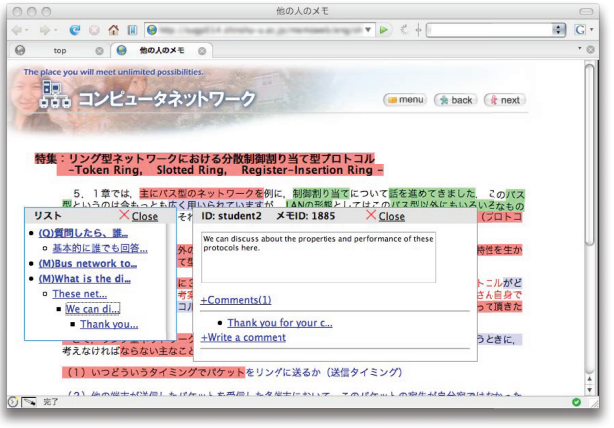

Fig. 2. The thread structure of comments

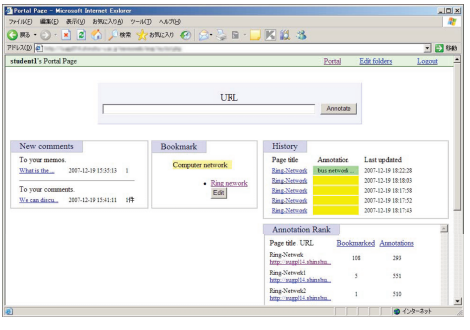

Fig. 3. An example of portal page

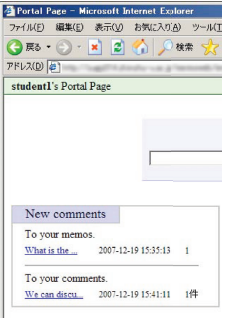

Fig. 4. The list of newly arrived comments

Fig. 5. The ranks of bookmarks and annotations

3 Trial and Evaluation

We conducted a week-long second trial experiment in order to evaluate the abovementioned features and user interface of the system with 88 undergraduate students. The students participated in a blended learning program called "Computer network," where they used "Writable Web" to annotate on the web pages in four rounds of face-to-face lectures and to have online asynchronous discussions on the web material during the lectures. The material consists of five web pages. The first page describes the introduction of the material. The second, third, and fourth pages describe first page describes the characteristics of the three types of network topologies, and the last pages describes the comparison between them. Therefore, students can discuss the overview of these network topologies on the first page, the features of each network topology from the

second page to the fourth page, and the differences between these topologies on the fifth page. We believe that in order to participate in the discussions, each student must understand the contents of the material: furthermore, viewing other students' opinions helps him/her understand the concepts in a better manner.

3.1 Evaluation of Asynchronous Discussions

All the annotations, including memos and markers, are shared among all the students in this experiment. Thus, students can attach comments to other students' memos and comments. In this experiment, the students annotated 735 markers (avg. 8.5 markers for each student), 1030 memos (avg. 12.0 memos), and 133 comments (avg. 1.5 comments) to 113 memos (avg. 1.2 comments for each memo).

After this experiment, the lecturer gave an assignment to the students. In this assignment, the students had to summarize the differences in the characteristics between several network topologies with valid reasons. The same assignment was given to 84 undergraduate students from the previous year's class who had not participated in the asynchronous discussions. We discuss the difference in the assignment scores between these two sets of students for the evaluation of the asynchronous discussions. The lecturer of the class grades the assignment papers on the basis of the following nine viewpoints on a scale of zero (not understood) to two (understood well).

(1) states that the throughputs of token-ring and slotted-ring networks are almost the same.
(2) states that the throughputs of token-ring and slotted-ring networks always are higher than those of register-insertion ring networks.
(3) describes the reasons for (1) and (2).
(4) states that the highest throughput of token-ring networks is less than 100%.
(5) describes the reasons for (4).
(6) states that the delays in communication encountered in token-ring and slotted-ring networks are shorter than those in register-insertion ring networks under low load conditions.
(7) describes the reasons for (6).
(8) states that the delay in register-insertion ring networks is shorter than that in the token-ring and slotted-ring networks under high load conditions.
(9) describes the reasons for (8).

A paper that includes the summary of the web-based materials is highly graded from the viewpoints of (1), (2), (4), (6), and (8) because the materials are based on the same. On the other hand, the other viewpoints serve to confirm a student's understanding of the mechanism of these networks. Therefore, we can separate these viewpoints into two groups —"viewpoints A" and "viewpoints B"— depending on their properties mentioned above.

Table 1 shows the scores obtained in the assignment held in 2006 and 2007. The mean scores based on viewpoints A are 7.42 (standard deviation (S.D.)= 1.51) in 2006 and 7.76 (S.D.= 2.26) in 2007. The mean scores are based on

Table 1. The scores of the assignments.

	2006 ($N = 84$) Mean (S.D.)	2007 ($N = 88$) Mean (S.D.)	t-test for equality of means
Viewpoints A	7.42	7.76	$t(152.8) = 1.17$
	(1.51)	(2.26)	$p = 0.121$
Viewpoints B	4.05	4.89	$t(170) = 2.24^*$
	(2.33)	(2.57)	$p = 0.014$
Total score	11.5	12.6	$t(160.6) = 1.99^*$
	(3.29)	(4.42)	$p = 0.024$

Note: N implies the number of students in the given year's class. $* : p < .05$.

viewpoints B are 4.05 (S.D.= 2.33) in 2006 and 4.89 (S.D.= 2.57) in 2007. The means of the total scores based on viewpoints A and B are 11.5 (S.D.= 3.29) and 12.6 (S.D.= 4.42), respectively.

To determine where there are differences in the mean score based on viewpoints A and B in 2006 and 2007, the t-test is performed with the null hypothesis (H_0), which indicates that the "mean scores are the same", and the alternative hypothesis (H_1), which implies that the "mean score in 2007 is greater than that in 2006." The results of the t-test show that there is no significant statistical difference between the mean scores based on viewpoints A ($t(152.8) = 1.17$, n.s.). However, the mean score based on viewpoints B in 2007 is significantly greater than that in 2006 ($t(170) = 2.24, p < .05$). As a result, the mean of the total scores in 2007 is also greater than that in 2006 ($t(160.6) = 1.99, p < .05$).

This result shows that asynchronous discussions among students help improve raises their scores. In particular, these discussions improve the student's understanding, which is not possible by simply reading the learning materials.

3.2 Evaluation of Functionality

After the experiment, we carried out a questionnaire survey. The students were questioned about the usefulness and intended purpose of the features provided by the system, and 69 students answered these questions.

Figure 6 shows the results of the questions regarding the usefulness of the annotation features in the learning process. The first question is based on writing annotations directly on the web-based materials. The second question inquires about sharing annotations among users, and the third question is based on writing comments to others' memos. The last question is based on the usefulness of sharing annotations and writing comments to communicate with other users. From these results, we can observe that the features of writing and sharing annotations and writing comments are highly valued by the students. However, students opined that these features are not sufficient for supporting smooth communications.

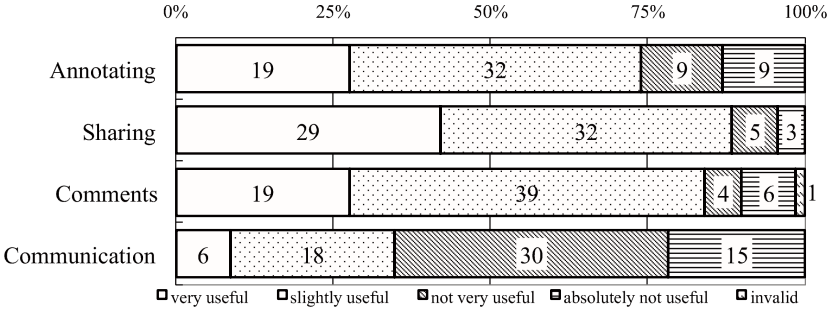

Fig. 6. Usefulness of annotations

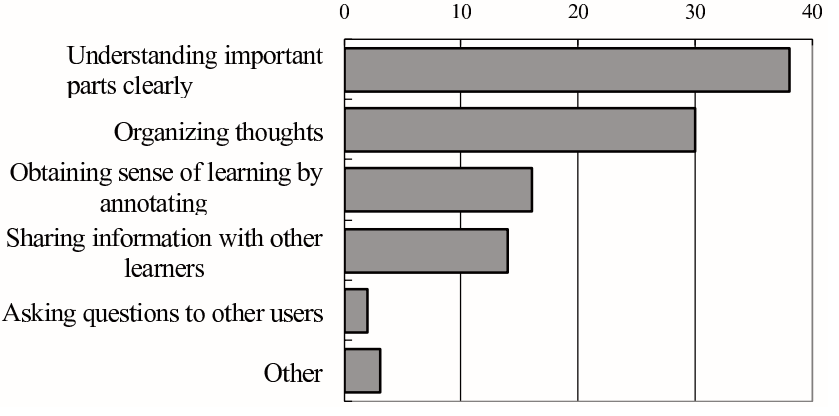

Fig. 7. Intended purposes of annotations

Figure 7 shows the intended purposes of the annotations. The annotations are mainly used to clarify important parts of the learning material and to organize the users' opinions. Therefore, the students mainly used the annotations to improve their understanding of the material, and approximately 20% of the students were of the opinion that one of the intended purposes of annotation is information sharing. However, when we asked the same question regarding the usefulness of annotations in improving their knowledge to 25 other students who had used the previous version of "Writable Web"[5], only 3 (12%) answered in the affirmative.

The results of the questions regarding the usefulness of the portal page features that support asynchronous discussions. According to these results, though the students evaluated the overall features of the portal page well, they felt that the ranking of the annotations and bookmarks is not particularly useful in asynchronous discussions.

On the basis of these results, we will improve and review the features of the system in order to foster asynchronous discussions and communications.

4 Conclusions

In this paper, we have discussed the evaluation of an asynchronous discussion system. We improved the main features and usability of this system on the basis of the results of the first experiment conducted on the previous version of the system. Thus, we implemented several new features in the system in order to foster asynchronous discussions by information sharing.

To evaluate the improved system, we conducted an experiment in the actual class with 88 students. The students used the system to organize their thoughts and highly evaluated the features of the system regarding annotating and annotation sharing. Moreover, the students could participate in asynchronous discussions on the web-based materials, thus obtaining a understanding of the subject than the students who did not participate in these asynchronous discussions.

Acknowledgement

This research was partially supported by the Ministry of Education, Science, Sports and Culture, Grant-in-Aid for Young Scientists (B), 18700642, 2006–2008.

References

1. Barolli, L., Koyama, A., Durresi, A., Marco, G.: A Web-based e-Learning System for Increasing Study Efficiency by Stimulating Learner's Motivation. Information Systems Frontiers 8(4), 297–306 (2006)
2. Cadis, J., Gupta, A., Gruding, J.: Using Web Annotations for Asynchronous Collaboration Around Documents. In: Proceedings of the 2000 ACM Conference on Computer Supported Cooperative Work, pp. 309–318 (2000)
3. Koivunen, M.: Annotea and Semantic Web Supported Collaboration. In: Proceedings of UserSWeb, 1st Workshop on End User Aspects of the Semantic Web, vol. 137(1), pp. 5–17 (2005)
4. Kunimune, H., Niimura, M., Wasaki, K., Fuwa, Y., Shidama, Y., Nakamura, Y.: The Current Activities and the Evaluations of Graduate School of Science and Technology on the Internet, Shinshu University. Transactions of Japanese Society for Information and Systems in Education. 22(4), 264–271 (2005)
5. Kunimune, H., Yokoyama, K., Niimura, M., Fuwa, Y.: An Annotation Sharing System for e-Learning Materials. In: Proceedings of ED-MEDIA 2007, pp. 3366–3371. Association for the Advancement of Computing in Education, Norfolk (2007)
6. O'Hara, K., Sellen, A.: A Comparison of Reading Paper and On-line Documents. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 335–342 (1997)