

iPlayer: Development and Evaluation of the Interactive Streaming Player for e-learning

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This research is aimed at developing and evaluating an interactive streaming player for e-learning: iPlayer. Unlike the conventional way of streaming academic content, the iPlayer is an interactive system that lets a learner give feedback on the lecture that he/she is watching and view the reactions of other learners. As a result of the evaluation, it was found that this streaming video distribution for e-learning enables a learner to feel more social presence of others and gain further satisfaction with e-learning. The result also suggests a possibility to facilitate collaborative study in e-learning. Further research is expected to advance a new and practical research field that combines both the study of CSCL (Computer Supported Collaborative Learning) and video streaming of academic content, which have been studied separately.

Keywords: e-learning, streaming, social presence, sense of community, satisfaction of learning, maintenance of motivation for learning

1. Research Background

1.1. Social Background

With the growing popularity of the Internet, the subjective use of e-learning built on IT communication networks (Advanced Learning Infrastructure Consortium 2003) is being popularized, particularly in the area of higher education. Along with WBT (Web-Based Training) and CSCL (Computer Supported Collaborative Learning), the video distribution of academic content is prevailing due to the spread of an ever-expanding broadband environment nationwide. Okawa et al. (1999) started distributing academic content via the Internet in the SOI (School of Internet) project at Keio University. There are other research groups focusing on this area including iii online in the University of Tokyo (Mochizuki et al 2003), ISTU (Internet School of Tohoku University) (Mitsuishi and Kumai 2003), and Kyoto University (Murakami et al. 2004).

Usui (2002) and Matsuoka (2001) point out that one of the challenges in this type of e-learning is how a learner can maintain motivation for learning. Some approaches have been made to solve this problem. Nishimori et al. (2003) developed a system utilizing CSCL to raise the motivation for learning by enabling learners to communicate with each other through electronic bulletin boards. Another example is to provide learners with support from mentors (Yoshida 2001). However, nobody has ever tackled this issue in light of video distribution itself. Despite the recent rise in the practical use of video distribution of academic content for e-learning, it has not

been recognized as a target for research, and no solutions have been presented to the above mentioned problem. Although the technology called SMIL (Synchronized Multimedia Integration Language) to integrate lecture streaming and its presentation materials has long captured attention in the field of video streaming, no research has been targeted for creating a video distribution system that helps viewers maintain motivation for learning (STROM 2001).

Therefore, our aim was to develop and evaluate a streaming player for e-learning that proposes a solution for the long-standing problem regarding the maintenance of motivation for learning.

1.2. Previous Research

E-learning tends to be one-way communication in a large classroom. How to maintain interactivity in such an environment has always been a problem. One of the solutions to this problem can be the use of response analyzers by which learners are able to give some feedback on the lecture and presentation materials they are viewing. There has been some research on the use of response analyzers where the instructor and learners are facing each other in the same classroom. Such examples include the Class Optimization Assistance Program that utilizes group response curves (Nagaoka 1986) and the distant learning program carried out through video conferencing (Ueno and Yoshida 2003).

The purpose of these programs is the smooth and efficient operation of classes in a synchronized type of

teaching, while there has been no research on non-synchronized streaming video distribution for e-learning with the aid of the technology that promotes interactivity in a classroom. In technology-assisted distant learning, it is hard for a learner to feel as if he/she is in a real classroom atmosphere and studying with other learners. Murakami et al. (2001) indicate that a learner has a tendency to appreciate a sense of unity with a lecturer in the distant learning program. CASAROTTI et al. (2002) also clarify that a student can raise his/her attention, interest, sense of participation, concentration, satisfaction, and feeling of efficiency through interaction with a lecturer and other students in the distant learning program. Both studies stress the importance of promoting interactivity in the case of distant learning.

Furthermore, Ikeda (1989) points out that a user is more likely to participate in a communication space aided by computer or media if he/she can feel the social presence of others. Social presence is an idea coined by SHORT et al. (1976). It is defined as a person's degree of sensing the other being "there," (Kawaura 1990) or a degree of being sensed as a real person. GUNAWARDENA and ZITTLE (1997) also suggest that enhancing the social presence of learners and lecturers increases a feeling of satisfaction with the distant learning. Based upon this result, they indicated the importance of considering the way to raise the social presence at the planning phase of distant learning.

GUNAWARDENA (1995) notes that the social presence can be elevated by presenting social clues of other participants in a communication even in the field of CMC (Computer-Mediated Communication) including non-synchronized e-mail media. Therefore, these results could lead to an idea that the social presence can also be raised by providing some information concerning other learners in non-synchronized e-learning environment.

ROVAI and LUCKING (2003) conducted a comparative study as to a sense of community between a learner in a classroom and one in a distant-learning program. The result made it clear that a learner in the distant-learning situation has a lower sense of community. As PALLOFF and PRATT (1999) point out, it is considered very important to create a community for distant learners who tend to feel isolated geographically in technology-assisted distant learning. Such an effort will contribute to maintaining the motivation of learners in e-learning.

Nonetheless, no attempts have been made to enable a learner to feel a sense of community in non-synchronized streaming video distribution for e-learning.

GARRISON and ANDERSEN (2004) suggest that the social presence is indispensable in creating a community of inquiry, which is an important factor in higher education.

Therefore, it can be pointed out that it is also necessary to consider the way to raise the social presence of a learner in the phase of planning non-synchronized e-learning environments.

As mentioned above, it is considered effective to create a system that allows a learner to give feedback on the lecture, as well as to retrieve the information of other learners who watch the same lecture in order to solve the

challenging issue of motivating learners in such e-learning environments.

1.3. Purpose of the iPlayer

In this research, we developed an interactive streaming player for e-learning: iPlayer based on the previous research. As shown in Figure 1, the iPlayer is a Web-based client application that enables a user to view streaming academic content for non-synchronized e-learning.

We adopted the expertise of response analyzers by which learners are able to give some feedback on the lecture and that of Awareness Research that visualizes other learners' feedback as awareness information (GUTWIN et al. 1995). The Awareness Research has been performed separately in the field of CSCL based on the suggestions given by Murakami et al. (2001). The purpose of the iPlayer and its functions are summarized below:

1. The iPlayer can help a learner concentrate on the lecture by letting him/her give feedback. It provides a function called "My Reactions," that shows icons according to the number of a learner's reactions (see ① in Figure 1) by letting the learner click the mouse whenever he/she feels any part of the lecture is "interesting or important." (This act is called "Reaction" in the iPlayer) It gives not only streaming lecture videos but also a function called "My Supplies," that enables a lecturer to pre-register the important information including the keywords and points to make it visible for a learner during the lecture (see ③ in Figure 1).
2. The iPlayer can help a learner obtain the social presence of others by letting him/her view the awareness information of others. In order for a learner to improve his/her sense of community with others, it provides a function called "Total Reactions," that visualizes feedback made by others as awareness information. (see ② in Figure1) The learner can recognize when other learners who have already watched the same lecture feel any part of it is "interesting or important" by showing the sum of My Reactions.

The iPlayer, equipped with these features, also aims to help learners have an improved feeling of satisfaction with e-learning.

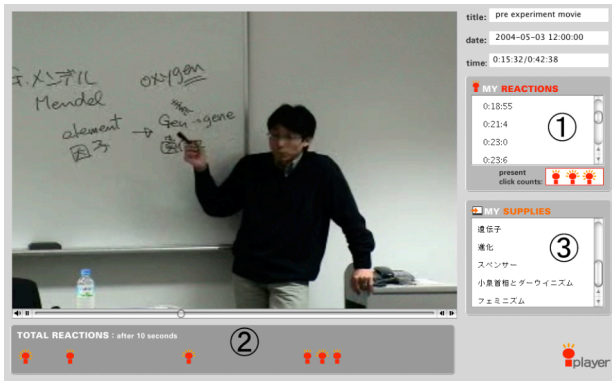


Figure 1: Image of the iPlayer Interface

2. iPlayer

2.1. Development of the System

The iPlayer is a video distribution system for academic content for non-synchronized e-learning that runs on a client Web browser. We designed the system that runs on the Web browser so that a user (as far as possible) is not required to install any additional software. The iPlayer consists of a server side that handles streaming of video data and the collection of the interaction data, and a client side that plays those videos, shows supplemental information and gives input fields for user data. (see Figure2)



Figure2: System Diagram of the iPlayer

For the server side, we used Apache1.3.27, php4.3.1 and Mysql3.23.58 that run on Linux (Kernel version 2.4.20). Based on a user request (Reaction level and timing) that the Web server receives, the php engine retrieves the results from the database and sends them back to the user client.

As the streaming server, we used Darwin Streaming Server. The server distributes streaming content through RTSP (Real Time Streaming Protocol) (Schulzrinne et al. 1998). Streaming video, My Reactions, Total Reactions, and My Supplies are all synchronized based upon the timeline of streaming video.

For the client side, we used Java applet (Java2- 1.4.2). We also used QuickTime for Java API to play videos.

Thus, the client side requires Java applet Runtime and QuickTime playing environment.

2.2. Functions

2.2.1. Video Streaming

The iPlayer application on the client side plays academic video content sent from the server. It supports QuickTime format with a resolution of 720×480 pixels. Just like QuickTime Player, the player is equipped with a volume control, a play/pause, a fast-rewind, and a fast-forward button at the bottom of the image screen. A user controls incoming video data through this user interface.

2.2.2. My Reactions

A past record of a user's Reactions is listed in My Reactions. (see ① in Figure 3)



Figure3: Image of My Reactions

When a learner takes the same streaming lecture at the second time and later, the past Reactions are listed in time sequence. Clicking each item takes the learner directly to the scenes when he/she recorded Reactions. By so doing, My Reactions can be used as a bookmark on the video streaming.

The list is updated as the video goes on and the closest Reactions to the present moment are always listed on top.

The frame located on the right side of "present click counts" (see ② in Figure 3) is usually blank. The number of icons at "present click counts" increases in accordance with how many times a learner right-clicks the mouse while viewing a lecture on the iPlayer. Light-shaped icons are turned on at three different levels according to how many times the learner clicked. One click corresponds to one level and also shows a degree of "interest" and "importance" the learner feels. If there is more than a second interval between clicks, the subsequent clicks are reset, and the number of icons at the time (hereafter Reaction Level) is recorded.

2.2.3. Total Reactions

Total Reactions show a learner where other learners who have already viewed the same lecture reacted in

time sequence, and how much they reacted with the level and number of icons.

As the arrow in Figure 4 indicates, the icon always moves from right to left in synchronization with the movie. In Figure 4, the far left side indicates the present time and the far right shows the time 10 seconds later from the present. This function gives the learner the opportunity to understand when the reactions of other learners come within 10 seconds.

The icons that appear in time sequence indicate three different reaction levels recorded through My Reactions in the past. As the sum of My Reactions of other learners who have already watched the lecture are shown on the screen, many learners can confirm when the scenes which received high reaction level come in advance.



Figure4: Image of Total Reactions

2.2.4. My Supplies

As shown in Figure 5, a links page for supplemental information for a lecture is shown on the screen. The listed keywords are associated with the appropriate timing of a movie and sorted as the movie proceeds. The list is synchronized with the movie and the keywords related to the present and the subsequent scenes are always listed on top.

When a learner clicks a link, the supplemental information page appears in another window. (see Figure 6)

A lecturer pre-registers the supplementary materials and links them to the opportune scenes on the lecture movie.

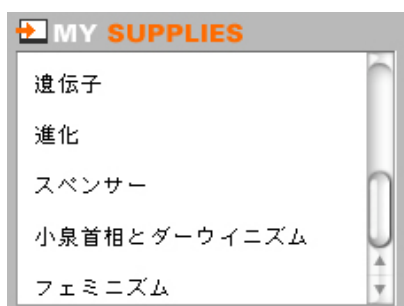


Figure 5: Image of My supplies

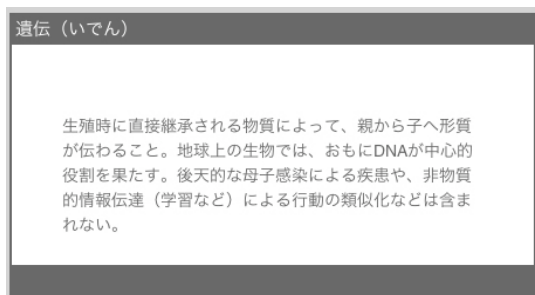


Figure 6: Image of sub-window for a supplementary material

In the next chapter, we verify the effect of the iPlayer, which embodies the purpose and functions stated above.

3. Evaluation of the iPlayer

3.1. Monitors and Subjects for the Evaluation Experiment

First and second year graduate students who are non-science majors at the University of Tokyo were chosen as monitors and subjects for the evaluation of the iPlayer. Of all the volunteering students, 39 students (27 males and 12 females) who said that they had never heard of e-learning were selected. Then, they were randomly allocated either to a group using an player (Total: 19, 15 males and 4 females) or to a control group not using an iPlayer (Total: 20, 12 males and 8 females).

3.2. Procedure for the Evaluation

3.2.1. Flow of the Experiment

Students were put in a partitioned space and experimented separately. After entering the space alone, they were required to fill in their answers to preliminary questions regarding how to use a computer and a lecture. After answering these questions, they put on headphones and took the streaming lecture of “Evolutional Ecology Informatics” for 35 minutes. The lecture had been given during the winter semester of 2003 at the Graduate School of Interdisciplinary Information Studies at the University of Tokyo. The subjects in the group using an iPlayer (hereafter the iPlayer group) used the iPlayer, on the other hand, the ones in the control group not using an iPlayer (hereafter the control group) used a usual Quick Time Player.

The subjects in the iPlayer group were given some instructions for each function of the iPlayer in advance. After going through the 35-minute lecture for e-learning, all the subjects were asked to answer some follow-up questions. The details for the questions will be mentioned in section 3.2.2. After filling out the questionnaire, each subject took the assurance test regarding the lecture. Each was given 10 minutes to answer a cloze test containing 16 questions.

Data for 10 people, obtained before the evaluation, were shown in Total Reactions. The data gained during the evaluation were not reflected in Total Reactions. The subjects belonging both to the iPlayer and control groups were instructed not to fast-forward, fast-rewind, and pause while watching the lecture.

3.2.2. Criteria and Method of the Evaluation

There were four criteria for evaluation regarding the iPlayer users.

- 1) Was the learner more focused on the lecture he/she was viewing?
- 2) Did the learner feel the social presence of other learners?
- 3) Did the learner have a sense of community with other learners?
- 4) Was the learner satisfied with e-learning study?

To clarify the four points above, the follow-up questionnaire included the following questions.

- 1) Five questions were given to the subjects to evaluate the extent to which they could concentrate on the lecture. The details are as follows;
 1. I often took my eyes off the screen. (Inverted question)
 2. I often thought about things other than the lecture for e-learning. (Inverted question)
 3. I listened attentively to the lecturer.
 4. I paid most of my attention to the screen.
 5. I only thought about the things related to the lecture.

The subjects were asked to indicate their degree of agreement with each statement on a seven-point scale (Likert Scale) ranging from “strongly agree” to “strongly disagree.”

- 2) As for the social presence, we made three questions based on the method developed by SHORT et al. (1976). We draw upon the translated questions by Kawaura (1990) and Aida (1990);
 1. sociable---unsociable
 2. cold---warm (Inverted question)
 3. personal---impersonal (Inverted question)

The subjects were asked to rate the impression or image of other learners who took the same lecture on a seven-point scale adopted from “SD (Semantic Differential)” method.

- 3) Regarding a sense of community, we made six questions based on “Sense of Classroom Community Index” created by ROVAI (2002). We also took the

difference of classroom culture between Japan and the United States or Europe into consideration. There are six questions as follows;

1. I felt familiar with other learners who were taking the same lecture for e-learning.
2. I thought other learners taking the same lecture helped me understand the lecture.
3. I felt a sense of fellowship with other learners taking the same lecture.
4. I did not think I could depend on other learners taking the same lecture. (Inverted question)
5. I did not know anything about other learners taking the same lecture. (Inverted question)
6. I did not feel familiarity with other learners taking the same lecture. (Inverted question)

The subjects were asked to indicate their degree of agreement with each statement on a seven-point scale (Likert Scale) ranging from “strongly agree” to “strongly disagree.”

- 4) Concerning the degree of satisfaction, we made seven questions to evaluate the degree of satisfaction with e-learning, based on the research by Shimizu et al. (1997). The seven questions are as follows;
 1. It is better for me not to take the lecture for e-learning. (Inverted question)
 2. I want to take the lecture for e-learning again.
 3. The lecture for e-learning is difficult to understand. (Inverted question)
 4. I feel motivated even on the lecture for e-learning.
 5. I feel less enjoyment in taking the lecture for e-learning. (Inverted question)
 6. I feel satisfied even with the lecture for e-learning.
 7. Overall, I have a good impression of the lecture for e-learning.

The subjects were asked to indicate their degree of agreement with each statement on a scale of one to seven (Likert Scale) ranging from “strongly agree” to “strongly disagree.”

4. Results of the Evaluation

4.1. The analysis of self-evaluation to the degree of concentration

Table 1 shows the results for mean value and standard deviation for each item regarding the self-evaluation to

the degree of concentration during the lecture for e-learning. The results are listed in the iPlayer group and the control group respectively. (The inverted questions are reversely modified.)

Table 1: The analysis of self-Evaluation to the degree of concentration

	iplayer group(n=19)		control group(n=20)		t	df
	AVG	SD	AVG	SD		
I often took my eyes off the screen. (Inverted)	4.89	1.56	4.40	1.85	0.90	37
I often thought about things other than the lecture for e-learning. (Inverted)	4.89	1.33	3.90	1.29	2.37 [*]	37
I listened attentively to the lecturer.	5.84	0.90	5.25	1.16	1.77 [†]	37
I paid most of my attention to the screen.	5.00	1.83	4.60	1.73	0.70	37
I only thought about the things related to the lecture.	4.26	1.66	3.30	1.34	2.00 [†]	37
Concentration Score	4.98	1.22	4.29	1.23	1.75 [†]	37

Notes) [†]“t” value is a result of t test, and “df” is a degree of freedom. ^{*}p<.10; [†]p<.05

Table2: The analysis regarding the social presence of other learners

	iplayer group(n=19)		control group(n=20)		t	df
	AVG	SD	AVG	SD		
Social presence score (=76)	4.28	0.98	3.67	0.65	2.29 [*]	30.96

Notes) ^{*}“t” value is a result of t test, and “df” is a degree of freedom. ^{*}p<.05

Table3: The analysis of a sense of community with other learners

	iplayer group(n=19)		control group(n=20)		t	df
	AVG	SD	AVG	SD		
I felt familiar with other learners who were taking the same lecture for e-learning.	3.84	1.80	2.75	1.29	2.18 [*]	37
I thought other learners taking the same lecture helped me understand the lecture.	4.26	1.48	2.20	1.06	5.02 ^{**}	37
I felt a sense of fellowship with other learners taking the same lecture.	3.32	1.67	2.40	0.94	2.10 [*]	28.08
I did not think I could depend on other learners taking the same lecture. (Inverted)	3.63	1.54	2.55	1.47	2.25 [*]	37
I did not know anything about other learners taking the same lecture. (Inverted)	2.42	1.39	1.81	0.77	1.69	27.86
I did not feel familiarity with other learners taking the same lecture. (Inverted)	3.47	1.58	2.30	1.26	2.57 [*]	37
Sense of community score (=88)	3.49	1.14	2.34	0.94	3.45 ^{**}	37

Notes) ^{*}“t” value is a result of t test, and “df” is a degree of freedom. ^{*}p<.05; ^{**}p<.01

According to the test for equality of variances performed in each item, the hypothesis of equality of variances for all the items was not dropped on the level of 10%. Therefore, we employed Student’s *t* test for all the items. The results revealed that statistical significance was observed in the item, “I often thought about things other than the lecture for e-learning” ($p<.05$), while difference of tendency was found in the items, “I listened attentively to the lecturer” and “I only thought about the things related to the lecture” ($p<.10$).

In order to analyze the self-evaluation to the degree of concentration comprehensively, we made a comparison between the iPlayer and the control groups by using a concentration score ($\alpha = .89$), which is the average of the

five items. As a result, the hypothesis of equality of variances was not dropped, and difference of tendency was observed in the mean value.

In summary, it was found that the students in the iPlayer group had a tendency to score highly with regard to the points that “I listened attentively to the lecturer” and “I did not think about things other than the lecture for e-learning.”

4.2. The analysis regarding the social presence of other learners

We employed Cronbac’s α coefficient in order to evaluate the reliability of three items as to the social

presence of other learners. After obtaining the value, $\alpha = .76$, we used the average of three items as a social presence score. Table 2 shows the results of mean value and standard deviation regarding the social presence score. The results are listed in the iPlayer group and the control group respectively.

According to the test for equality of variances, the hypothesis of equality of variances was dropped on the level of 10%. Therefore, we employed Welch's *t* test. Consequently, statistical significance was observed.

To summarize, it was identified that although there exists some dispersion of the values compared with the control group, the iPlayer has the effect of making the students have a greater feeling of the social presence of others.

4.3. The analysis of a sense of community with other learners

Table 3 shows the results of mean value and standard deviation for each item regarding a sense of community with others. The results are listed in the iPlayer group

and the control group respectively. (The inverted questions are reversely modified.)

According to the test for equality of variances conducted in each item, the hypothesis of equality of variances dropped by 10% in the two items, "I felt a sense of fellowship with other learners taking the same lecture" and "I did not know anything about other learners taking the same lecture." Therefore, we adopted Welch's *t* test for the two items above, while we used Student's *t* test for the rest. The results showed that statistical significance was observed in all the items ($p < .05$) except "I did not know anything about other learners taking the same lecture."

We also made a comparison between the iPlayer and the control groups by using a sense of community score ($\alpha = .88$), which is the average of six items. As a result, statistical significance was observed in the mean value ($p < .01$).

As mentioned above, it was shown that the students using the iPlayer felt a greater sense of community with others.

Table4: The analysis of the degree of satisfaction with e-learning

	iplayer group(n=19)		control group(n=20)		t	df
	AVG	SD	AVG	SD		
It is better for me not to take the lecture for e-learning. (Inverted)	5.84	1.12	5.30	1.49	1.28	37
I want to take the lecture for e-learning again.	5.84	0.83	4.75	1.37	3.02 **	31.62
The lecture for e-learning is difficult to understand. (Inverted)	5.53	1.17	4.75	1.21	2.03 †	37
I feel motivated even on the lecture for e-learning.	5.68	0.95	4.95	1.19	2.12 †	37
I feel less enjoyment in taking the lecture for e-learning. (Inverted)	5.84	0.76	4.60	1.60	3.11 **	27.53
I feel satisfied even with the lecture for e-learning.	5.95	0.97	4.50	1.50	3.59 **	32.67
Overall, I have a good impression of the lecture for e-learning.	5.53	1.12	4.55	1.43	2.36 †	37
Satisfaction score ($\alpha = .90$)	5.74	0.73	4.77	1.08	3.28 **	37

Notes) † "t" value is a result of t test, and "df" is a degree of freedom. † $p < .05$; ** $p < .01$

Table5: The analysis of correlation between four criteria

n=39	concentration	presence	community
Concentration score	-		
Social presence score	0.08	-	
Sense of community score	0.16	0.44 **	-
Satisfaction score	0.29 †	0.38 †	0.15

Notes) † $p < .10$; † $p < .05$; ** $p < .01$

4.4. The analysis of the degree of satisfaction with e-learning

Table 4 shows the results of mean value and standard deviation for each item regarding the degree of satisfaction with e-learning. The results are listed in the iPlayer group and the control group respectively. (The inverted questions are reversely modified.)

According to the test for equality of variances conducted in each item, the hypothesis of equality of

variances was dropped by 10% in the three items, "I want to take the lecture for e-learning again," "I feel less enjoyment in taking the lecture for e-learning," and "I feel satisfied even with the lecture for e-learning."

Therefore, we adopted Welch's *t* test for the three items above, while we used Student's *t* test for the rest. The results revealed that statistical significance was observed in all the items ($p < .05$) except "It is better for me not to take the lecture for e-learning."

We also drew a comparison between the iPlayer and the control groups by using a satisfaction score ($\alpha = .90$), which is the average of seven items. Consequently,

statistical significance was observed in the mean value ($p < .01$).

In conclusion, it was shown that the iPlayer has the effect of making the students feel more satisfied with e-learning.

4.5. The analysis of correlation between four criteria

In order to analyze the correlation between concentration, social presence, sense of community, and satisfaction scores, we performed partial correlation analysis with a dummy, using the difference of conditions in experiment as a control variable.

As a result, we found a positive correlation that was statistically significant between the social presence and sense of community scores ($r = .44$, $p < .01$), as well as between the social presence and satisfaction scores ($r = .38$, $p < .05$).

Therefore, it was confirmed that the social presence of other learners that the iPlayer provides is linked to a sense of community with others and a feeling of satisfaction with e-learning.

4.6. The analysis of learning effectiveness

The average score for the iPlayer group stood at 12.84 ($SD = 1.71$), on the other hand, the students in the control group marked the average score of 12.10 ($SD = 1.94$) in the follow-up test in which a student was graded from 0 to 16. We compared the average scores for the follow-up test between the iPlayer and control groups so that we could analyze the learning effectiveness the iPlayer provided. However, the results showed no statistical significance ($t(37) = 1.26$, n.s.).

Accordingly, these results indicated no learning effectiveness of the iPlayer. However, this experiment was a mere 35-minute evaluation. This research placed its primary focus on the maintenance of motivation for learning. Therefore, it is clear that we need to carry out a different form of experiment to analyze more specifically the learning effectiveness that the iPlayer offers.

5. Conclusion and Future work

5.1. Conclusion

In this research, we developed an interactive streaming player for e-learning, the iPlayer, with the aim of achieving the following objectives:

1. Enabling a learner to concentrate on a lecture by giving feedback while viewing it
2. Enabling a learner to feel more social presence and a sense of community of other learners, as well as improve a feeling of

satisfaction with e-learning through obtaining the awareness information of others.

The following results were obtained for the use of the iPlayer in e-learning.

The player provides learners with:

1. The possibility of being more focused on learning
2. The effect of feeling more social presence of other learners
3. The increase in a sense of community with other learners
4. The increase in a feeling of satisfaction with e-learning

It was also found that the social presence of other learners has a positive correlation with a sense of community and a feeling of satisfaction.

The results suggest that streaming video distribution with the use of the iPlayer enables a viewer to feel more social presence of others and obtain further satisfaction with e-learning. Furthermore, the increase in a sense of community specifies that learners will feel more connected with others through the use of an iPlayer in the e-learning process. These results will offer an excellent clue to solving the current problem regarding how to raise the motivation of learners in e-learning.

5.2. Future work

In this research, we took an experimental approach for the evaluation of the iPlayer. The result clarified that the iPlayer has the effect of increasing the learner's feeling of satisfaction with e-learning. Nonetheless, this evaluation experiment was carried out only once in this research. In this sense, it still remains uncertain how continuous use of the iPlayer will influence learners. Therefore, as a challenge for future research, more practical research is required to examine what sort of benefits or effects the iPlayer offers by implementing this application on an e-learning system in actual operation.

In addition, this research did not show any significant learning effectiveness with the use of the iPlayer. What we expect from the results in this research is that the iPlayer helps a learner maintain motivation for study and continuous use of e-learning. Therefore, although this short-term research failed to show the learning effectiveness of the iPlayer, it is expected that it will be proved in the long-term operation of e-learning system. We need to analyze the aspect of effectiveness further in the long-term operation of e-learning system equipped with the iPlayer. We should also examine and analyze the correlation between the iPlayer and CSCL in this practical research.

A Web-based e-learning system is generally equipped with interactive communication tools such as an electronic bulletin board. With the aid of these tools,

learners usually study collaboratively through exchanging information or debating with each other. The research conducted by GARRAMONTE et al. (1986) showed that a user who had posted a message on an electronic bulletin board was the one who felt the social presence of others. Based on this research, it could be considered that letting a learner feel more social presence of others is an effective way to stimulate his/her study in CSCL.

This research showed the effects that iPlayer users begin to feel the social presence and a sense of community with others. The iPlayer is expected to provide a user with not only the increase in a feeling of satisfaction with e-learning through sensing the social presence of others but also smooth collaborative study with others by utilizing tools such as an electronic bulletin board.

5.3 Summary

Unlike the conventional way of streaming academic content, we developed an interactive system, the iPlayer, that lets a learner give feedback on the lecture and view the reactions of other learners. The result suggested a possibility that a user begins to view the lecture attentively. In addition, it was found that the iPlayer provides a user with the effect of feeling more social presence of others, the increase in a sense of community with others, and the rise in a feeling of satisfaction with e-learning. Furthermore, it was confirmed that the social presence of other learners has a positive correlation with a sense of community and a feeling of satisfaction with e-learning. These results will offer an excellent clue to solving the current problem regarding how to raise the motivation of learners in e-learning. In addition, this research also suggests that the iPlayer has the possible added benefit of stimulating the user's collaborative study with others in on-line video streaming.

Further research is expected to advance a new field of research and practice that combines both the study of CSCL (Computer Supported Collaborative Learning) and video streaming of academic content, which heretofore have been studied separately. With the development of this new field, it is expected that we can provide learners employing e-learning with more satisfaction and a better learning environment.

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