Design of Information-Sharing Media Based on Observation of Reading and Writing Behavior on Message Boards within Large Organizations

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***Abstract*—To provide an unconventional means of information sharing within large organizations such as universities and companies, we set up a whiteboard information-sharing space within our university and observed and analyzed users' writing and reading behavior. As a result, we designed and implemented an electronic bulletin board that clearly segregates topics, provides space for replies, changes the posting display period according to the status of replies, and has a mechanism to make less important information as inconspicuous as possible. From an experiment with our electronic bulletin board, we confirmed that users were able to use the board to continuously post and reply to messages. Our notable achievement is that we have implemented the advantages of the analog world, which were revealed through the observation of reading and posting behavior on the whiteboard, into a system that is the digital world.**

Keywords; information sharing; electronic bulletin board; observational study; user study.

I. INTRODUCTION

There are people around us who have already solved their own problems. Casual conversations with those people often contain useful information. However, because we generally spend most of our time in a small community, such as a laboratory in a university or a department in a company, we do not have many opportunities to share information with people outside of our own community. In fact, a survey [1] on information sharing opportunities at universities shows that opportunities to ask questions and seek advice from friends and seniors are decreasing year by year. The reason for this could be that as students move up through the grades, they spend more time on research activities and spend more time in their laboratories. In other words, as mentioned above, they spend more time in the small community of the laboratory.

To solve this problem, there may be means of information sharing within each organization. For example, Slack can be used for each department [2] and group LINE for each laboratory [3]. However, the information-sharing forums provided by organizations are often used by bosses and supervisors as one-way places for sending out information. Therefore, community members have the impression that the information sharing space is a formal place. This makes it difficult to share information beyond the boundaries of departments and school grade. In addition, communities for information sharing prepared by individuals are often subdivided into close-knit groups over time and cease to function as a community.

To provide an unconventional means of information sharing in large organizations such as universities and companies, we set up an information sharing space using a whiteboard in our university, and we observed and analyzed users' writing and reading behavior. On the basis of the results, we designed and implemented an electronic bulletin board as an information sharing medium, and we discuss its effectiveness and usefulness.

This paper is organized as follows. Section 2 describes related works. Section 3 describes an observational study of the set-up of the whiteboard. Section 4 describes the design policy of the electronic bulletin board based on the results of the study in the previous section. Section 5 describes an observational experiment to verify the effectiveness of the designed electronic bulletin board. Section 6 summarizes this work and discusses future prospects.

II. RELATED WORKS

There have been many studies on information sharing. Nishimoto et al. [4] are known for their research on the promotion of information sharing in large-scale organizations. In their system, a person who has a transponder, a device that automatically sends a signal when it receives a different signal, approaches a large display in a shared space, and a question registered in advance by the person is displayed. This facilitates information sharing with users of the shared space who happen to see the question. The advantage of their system is that it is a system that does not require information providers to register their information with the system in advance, while general knowledge management software requires them to register their information with the system. However, their system has the disadvantage that users with transponders need to stay in the shared space for a long time to actively share information.

Snowdon et al. [5] performed another study on information sharing within a large organization. They propose a recommendation system that semi-automatically displays filtered information on the basis of user comments and feedback for each post. One of the features of their system is that it gives users a more organic impression by randomly arranging the posted information when it is displayed. When they actually operated their system, they found that the contents of the posts were often suited to the characteristics of the organization, but only some users posted, and not a wide range of users contributed.

On the other hand, The Notification Collage [6] is an information sharing system used within small communities.

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This system aims to share information not with individuals but with the community as a whole by allowing people in a small community to post their daily discoveries to the system. In this system, posted information is not displayed in a list as in a general chat tool but is arranged randomly as in an analog bulletin board. The Notification Collage can be used from both large displays and personal terminals. However, most of the users post and browse from their personal terminals, so there have been few opportunities to use the large display.

In this study, we propose a message board like that installed in many railroad stations in Japan as a means of sharing information that can be used by anyone without the need for users to stay at that location. We set up a whiteboard in our university that users can freely write on and read information from. On the basis of observing users' writing and browsing behavior on the whiteboard, we design an electronic bulletin board that encourages information sharing among people in the same organization.

III. Observation of Whiteboard Posting and Reading Behavior

As mentioned earlier, to realize information sharing that incorporates the advantages of message boards, we set up a whiteboard in our organization for approximately two months and observed posting and reading behavior. The purpose was to examine the characteristics of information sharing behavior on the whiteboard and the requirements for an electronic bulletin board.

A. Overview of observations

We installed whiteboards in the corridors on the second and third floors of our faculty building in our university (see Figure 1) for about two months. The reason is that these locations are conspicuous to students who are on their way to the student hall building where the cafeteria and store are located and to the common lecture building where many lectures are held. We used the term "bulletin board" except when it was necessary to distinguish between a message board and a bulletin board. The reason is that our use of the term "message board" could have given the impression that it was a place for one-way transmission of information.

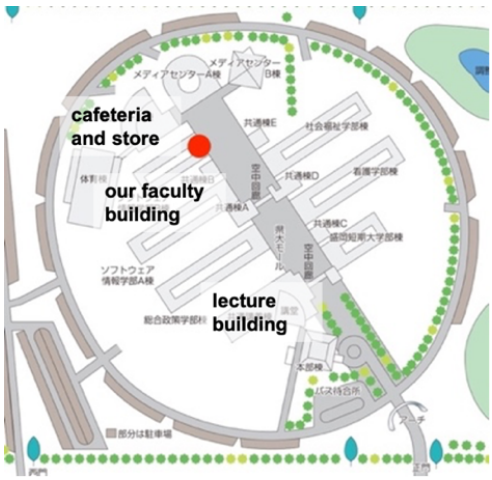

Figure 1. Campus plan of our university and locations of whiteboards [Red circles indicate locations (2nd and 3rd floor)].

We set up a whiteboard with a pen and an eraser (see Figure 2). We posted a sign next to the whiteboard explaining that "this whiteboard is a place for students to write questions and answers about student life" in order to create an environment where interaction among students is likely to occur. When two days had passed since students filled in the whiteboard, or when the board was 80% full, we removed the oldest entries from it.

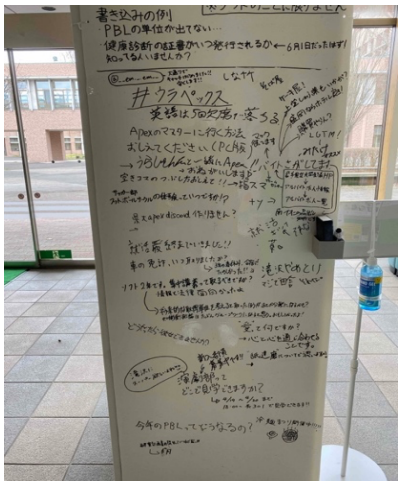

Figure 2. Installed white board.

To collect data to be used to analyze information sharing behavior, we took pictures of the entries on the board every weekday evening. From these pictures, we manually transcribed the contents written on the board, and organized the contents of the writings and their relationships with other writings (related topics, question-answer relationships, etc.). Furthermore, we conducted a questionnaire survey of all students at our university at the end of the observation period. We also posted a notice on the board warning students that their entries were to be used only for academic purposes, and that if they did not agree to the use of their entries, they were not to post on the board.

B. Observation results

In this part, we focus on 3 interesting aspects of posting and reading behavior on the board: the format of the board, the continuity of topics, and the reading and writing by multiple people.

1) Influence of display format

When the whiteboard was first set up, we expected that writing and replies would be more active if there was no fixed area to write on, such as one reserved with a dividing line. Therefore, when the whiteboards were first installed, there was nothing written on them except for an example at the top. To compare the influence of nothing being written on the board and of the board having a fixed writing area, we set up a 2×7 grid on the board about a month and a half after it was set up. To indicate that each grid was prepared for writing about a single topic, we put a "Q" mark in each grid, which means question. A few days later, the "Q"s in the right column were replaced with "A"s by students other than ourselves (see Figure 3).

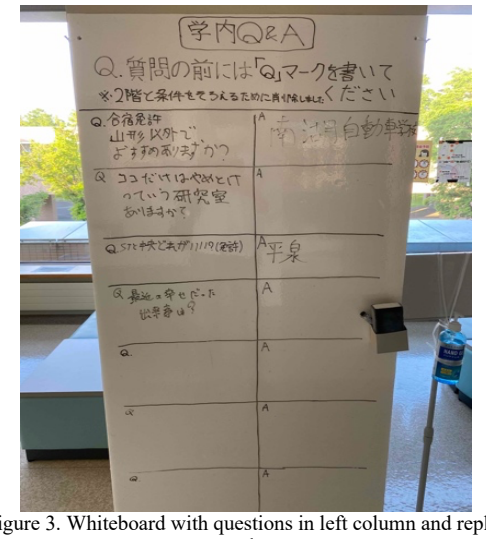

Figure 3. Whiteboard with questions in left column and replies in right column.

As a result, there were 16 entries. Of these, 11 were replies to the "Q" mark. The number of 16 posts on this day was the highest number of posts per day. We assume that the reason is that the topics were clearly delineated and that there was enough writing space for the replies. Therefore, we will design an electronic bulletin board that has a separate area for writing topics and a space for replies.

2) Continuation of topics

As mentioned earlier, we periodically deleted posts. However, when a post received a reply and the topic was continued, the deletion period was extended for two days from the new reply. Since we deleted only on weekdays, there were topics posted for longer than usual because they fell on a Saturday or a Sunday. They continued to receive replies after more than 10 days had passed. Therefore, we will change the deletion period on our electronic bulletin board according to the status of replies to each topic.

3) Writing and reading by two or more people

During the observation period, we frequently observed several people reading the whiteboard, as shown in Figure 4.

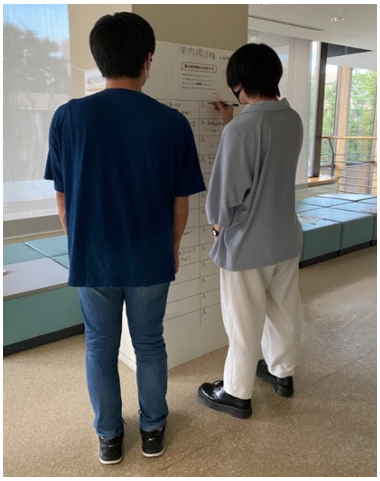
Figure 4. Multiple people writing on whiteboard.

In some cases, we observed multiple people filling in the whiteboard (that is, only one person was actually filling in the whiteboard, while the topic was being discussed by multiple people). This is a situation not seen in online communication such as chat rooms or electronic bulletin boards. We believe that it is important to take advantage of the benefits of analog communication, as in this case, to activate information sharing. Therefore, we envision an electronic bulletin board that can be set up in a shared space and be written on and read by multiple people, instead of from individual PCs.

C. Results of questionnaire responses

After the observation period, we conducted a questionnaire survey of all students at our university. The purpose was to gather information that could not be obtained from the observation, such as the attributes of the whiteboard users and their motives for writing on the whiteboards, as well as to gather information on features that should be incorporated into our electronic bulletin board. There were 208 responses. In this paper, we discuss the handling of unimportant information and the presentation of the posting period.

1) Dealing with less important information

In response to the questionnaire question "Have you obtained necessary information or new findings from this whiteboard?", 58.2% of the respondents answered "No." The reasons were "I found it difficult to understand which information was important because there was too much unimportant information (44.8%)," "I felt the quality of the answers was low (22.9%)," and "I found it difficult to understand which information was important because there were many invitations to join club activities (9.5%)." There were also several responses that said, "There was a lot of unimportant information, so I thought I could post any topic I wanted." During the observation of the whiteboard, we left unimportant information and invitations to club activities as they were to facilitate posting. From the results of this survey, we will proactively address less important information on our electronic bulletin board. One approach is to limit the number of replies to only one so that the less important information is less noticeable to the user. Another approach is to demonstrate on the board how long a post will remain to avoid less important information being displayed for a long time.

2) Duration of display of posts

As already explained, during the observation period, we periodically deleted posts. Since we did not indicate the posting period on the board, we received a request in the survey to clarify when posts would be deleted. However, users may be confused if they are directly informed of the time remaining until deletion. Therefore, we would like to add the following new feature to our bulletin board that informs users of how much time has elapsed for their posts by the shade of color of the text.

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IV. Design of Electronic Bulletin Board System for Information Sharing

We designed an electronic bulletin board system using a large display based on the results of observations of writing and reading behavior on the whiteboard described above. In this section, we provide an overview of the electronic bulletin board system we designed and explain the features of our system.

A. Outline of electronic bulletin board system

As mentioned above, we assume that our electronic bulletin board system will use a large display to allow multiple users to post and view information. We also assume that users can only post to our system from a keyboard connected to the display terminal (Raspberry Pi 4). From our observation that replies are more active when topics are clearly segmented, we will arrange posts and replies so that they are in pairs.

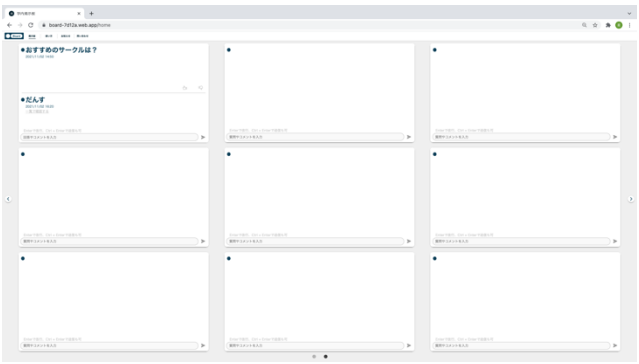

Figure 5. UI of electronic bulletin board (whole).

In addition, to display as many topics as possible on the display, the posts are arranged in a grid (see Figure 5). Also, an area is reserved for writing where no posts exist. The initial design envisioned a 4×4 grid of posting areas, but we decided to increase the font size in a 3×3 grid so that posts can be viewed from a distance. As shown in Figure 5, the UI screen is a single slide, and the screen changes to a slide show every minute. Moreover, if there is no space to post, users can move to another screen using the toggle buttons on the left and right sides of the screen to find a space where no posts have been made and post a message.

Figure 6. Posting area (Upper row: Post, Lower row: Reply to post).

The grid-like posting area is divided into upper and lower rows, with posts displayed in the upper row and replies in the lower row (see Figure 6). If there are multiple replies, replies that have been displayed for less than 12 hours or that have been labeled as "good" by other users are displayed first.

B. Feature function: Reaction to posts and display time

Users can react to posts and replies (one per post) by clicking the "good" and "bad" reaction buttons. When a user reacts to a post, he/she can do so from both the post area and the reply area. In the case of replies, the user can react only from the reply area.

We also set a display period of 5 days for each post. If a post receives a "good" reaction, the display time is extended for 12 hours. If there is a reply to a post, the time is extended for 24 hours. If there is a "bad" reaction to a post, the time is reduced to 24 hours. Furthermore, if the number of "bad" reactions to each reply exceeds a threshold value, the reply is not displayed.

Table I. Text color shading change

Days	Intensity
More than 3 days	1.0
Less than 3 days	0.9
Less than 2 days	0.8
Below 1 day	0.6
Less than 12 hours	0.5
Less than 6 hours	0.4

In addition, to address the opinion in the survey that "it is difficult to know when a post will be deleted," we have incorporated a function to gradually lighten the color of the text as the end of the display period approaches (see Table 1).

V. Experiment

An experiment was conducted for about four months (two months were during the summer vacation) to check the usage of our electronic bulletin board.

Figure 7. Installed electronic bulletin board and its surroundings.

We set up our bulletin board (see Figure 7, the large display is our bulletin board) in front of our university store. We received 70 posts and 134 replies in about 4 months.

A. Number of posts

Since summer vacation at our university started soon after the board was installed, the number of posts per day was small. However, after vacation, we found that there were up

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to 14 posts per day and almost no days without posts. The reason for this is that the electronic bulletin board is located in front of the cafeteria and the store of our university, and the number of students staying in this area has increased since the summer vacation ended and classes started.

B. Number of posts per time of day

In terms of the number of posts and replies by time of day, we found that most posts were made at around 12:00 and 16:00. The reason for this may be that there is a lunch break at 12:00, and many students stop by the store after 16:00 during after-school hours. However, more people stopping by means more people watching. We consider the increase in posts in this situation to be unexpected in light of what is called social embarrassment [7], in which people become less likely to act because they are being watched by others. To investigate why this happened, we conducted field observations and observed that several people were using the board together as mentioned above. This is a situation that does not exist in online interactions.

C. Reply to posts

In the whiteboard observation, replies to posts were concentrated in the first week after posting. However, in this experiment, replies continued for about two weeks to one month. We think that the reason for this is that the duration of the display period was extended due to there being continuous replies.

D. Use of reaction buttons

The number of reactions was 60 good ones and 8 bad ones. At first glance, the reaction button seemed to be utilized, but in reality, it was used only for specific topics and thus not widely used. Therefore, the bad button was often used for meaningless posts, and there were no cases where the posting period was shortened.

VI. Conclusion and Future work

In this paper, we designed and implemented an electronic bulletin board for information sharing in a large organization, based on the results of whiteboard observations, and confirmed its usage. From the results of the observations, we used a display format that clearly segregates topics, provides space for replies, changes the posting display period according to the status of replies, and has a feature that makes unimportant information as inconspicuous as possible. In addition, we considered it important for our system design to incorporate the advantages of the analog world, which allows users to post and read together with others in the same space. For this reason, our system is not closed to the Internet, but can be accessed from both the Internet and the analog space through a large display. From an experiment, we confirmed that users are able to continuously post and reply to messages using the electronic bulletin board. Our notable achievement is that we have implemented the analog advantages revealed by our observations into an IT system in the digital world.

On the other hand, it is difficult to say from the results of this experiment that all users were actively using our system. While many users read our electronic bulletin board, we recognize that there are users who cannot post even if they want to because they are afraid of being seen by others.

We plan to further analyze the results of the experiment and add more user-friendly functions in the future. We also intend to improve our system so that users can easily post from their personal mobile devices.

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